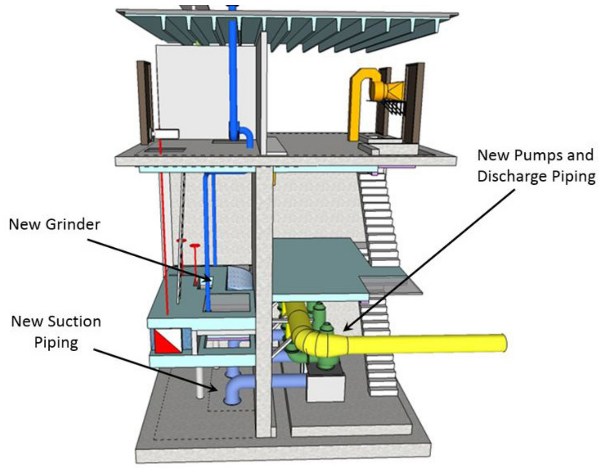
Prepared for
Silicon Valley Clean Water

April 3, 2017

FINAL



Belmont Conveyance System - Project Planning Report

FINAL

SVCW Conveyance System Program
Belmont Conveyance
Project Planning Report

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List of Abbreviations

ADWF	average dry weather flow
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
ATS	Automatic Transfer Switch
BC	Brown and Caldwell
BCDC	Bay Conservation and Development Commission
BPS	Belmont Pump Station
Caltrans	California Department of Transportation
CCI	Construction Cost Index
CEQA	California Environmental Quality Act
CIP	Capital Improvement Project
CIPP	cured-in-place pipe
CPT	Cone Penetrometer Tests
CSMP	Conveyance System Master Plan
dBA	A-weighted decibels
e.g.,	example
EDR	Environmental Data Resources, Inc.
ENR	Engineering News Record
etc.	etcetera
FA	foul air
FAA	Federal Aviation Administration
FEF	Flow Equalization Facility
FEMA	Federal Emergency Management Agency
FM	force main
FRP	fiberglass reinforced plastic
ft	feet
GDR	Geotechnical Data Report
GIR	Geotechnical Interpretive Report
H_2S	hydrogen sulfide
HDPE	High Density Polyethylene
HI	Hydraulic Institute
HMI	human-machine interface
HP	horsepower
HVAC	heating, ventilation, and air conditioning
I/O	input/output
ILS	Influent Lift Station
JPA	Joint Powers Authority
Kw	kilowatt
LCC	life cycle cost
LEL	lower explosive limit
L_{eq}	Equivalent Noise Level
lf	linear feet
MCBS	mechanically cleaned bar screens
MCC	motor control center
MG	million gallons
mgd	million gallons per day
MPPS	Menlo Park Pump Station
NFPA	National Fire Protection Association
Nikon	Nikon Precision, Inc.
O&M	operations and maintenance
P&IDs	process and instrumentation diagrams
PCB	polychlorinated biphenyl
pcf	per cubic ft
PDWF	peak dry weather flow
PG&E	Pacific Gas and Electric Company
PLC	Programmable Logic Controller
POR	preferred operating range
ppmv	parts per million by volume
PS	pump station
psf	pounds per square foot
psi	pounds per square inch
psig	pounds per square inch gauge
PVC	polyvinyl chloride
PWWF	peak wet weather flow
RCPS	Redwood City Pump Station
RLS	Receiving Lift Station
RPZ	Runway Protection Zone
RSPS	Redwood Shores Pump Station
RTP	Reinforced Thermoset Polyester
SBSA	South Bayside System Authority
SCADA	Supervisory Control and Data Acquisition
SCBS	San Carlos Booster Station
SCPS	San Carlos Pump Station
SCS	SCPS site
SCSP	Strategic Consolidation Sewerage Plan
SRF	State Revolving Fund

SS	sanitary sewer
SSFM	sanitary sewer force main
SVCW	Silicon Valley Clean Water
TMs	Technical Memoranda
TPH	total petroleum hydrocarbons
US-101	U.S. Highway 101
UST	underground storage tank
VFD	variable frequency drive
WBSD	West Bay Sanitary District
WWTP	wastewater treatment plant
YBM	Young Bay Mud

Executive Summary

The Belmont Conveyance Project consists of three project components: Belmont Force Main (FM) Rehabilitation, Belmont Pump Station (BPS) Rehabilitation and the San Carlos Pump Station (SCPS) Improvements. The Belmont FM Rehabilitation includes lining the existing FM sections that will convey wastewater from the BPS to the SCPS for conveyance into a gravity pipeline. The BPS Rehabilitation consists of rehabilitation of the existing BPS with seismic upgrades, pump replacements to convey future flows and upgrades to piping and the electrical system. Lastly, the SCPS Improvements will include the installation of piping and improvements to decommission the pump station, provide flow metering and sampling of San Carlos and Belmont flows and combining the flows for conveyance into the gravity pipeline.

This Belmont Conveyance Project Planning Report is intended to be used for several purposes including: documenting the status of project development for use when the project design is funded, fulfilling State Revolving Funding (SRF) planning loan compliance and construction loan application requirements, and as background information should the project be completed using a design-build method of project delivery. The Belmont Conveyance Project Planning Report discusses the project's background and purpose, setting, compiled data and assumptions, project specific analyses completed to date, the selected project description, cost estimate, schedule and next steps for progressing the design.

Background

The SVCW conveyance system transports raw wastewater from its "Member Agencies" (City of Belmont, City of San Carlos, City of Redwood City and West Bay Sanitary District[WBSD]) to the SVCW wastewater treatment plant (WWTP). Four pump stations convey flow to the SVCW WWTP through the conveyance system force main: BPS, SCPS, Redwood City Pump Station (RCPS), and Menlo Park Pump Station (MPPS). These pump stations and force mains will require upgrades since the pump stations are at the end of their useful lives and cannot meet the 2030 projected flows. An analysis was conducted to identify alternatives to improve the conveyance system that may reduce impacts to residents, businesses and other facilities. The alternatives analysis identified over 140 combinations of pipeline alignments and pump station locations that included different construction methods and modes of operation (e.g., gravity and pressure conveyance and configuration and location of conveyance storage).

The proposed overall Wastewater Conveyance System and Treatment Reliability Improvement Project, hereinafter referred to as the proposed Conveyance System Project, consists of the replacement/rehabilitation or repurposing of existing pump stations, improvements to the existing WWTP, and replacing portions of the existing force main pipeline with a deep gravity pipeline and new force mains. The proposed Conveyance System Project is characterized by major conveyance components including installing a new gravity pipeline, Receiving Lift Station (RLS), flow diversion facilities, influent connector pipes, and the replacement, rehabilitation or repurposing of the four pump stations. Figure ES-1 shows a schematic of the proposed Conveyance System Project.

Figure ES-1. Schematic diagram of the proposed Conveyance System Project

(Source: Kennedy/Jenks Consultants)

Recommended Belmont Conveyance Project

The proposed Conveyance System Project includes upgrades and improvements at many of SVCW's existing conveyance facilities, and involves construction of new facilities. This project planning report is focused on the improvements at the BPS, Belmont FM and SCPS, which are three components of the Conveyance System Project, and are referred to herein as the Belmont Conveyance Project. The proposed Belmont Conveyance Project includes the following major upgrades and improvements:

- **Belmont FM Rehabilitation.** The Belmont FM Rehabilitation would change how Belmont flow enters the SVCW conveyance system and would include the following components: rehabilitate an existing 1,150 foot 24-inch segment of the force main; and slipline 3,550 ft of the 54-inch diameter force main to transport the Belmont flow to the new gravity pipeline near the SCPS. These operational changes are needed for the Belmont system to function with the proposed gravity pipeline. This requires the force mains to be rehabilitated to function correctly from a hydraulic and water quality standpoint.
- **BPS Rehabilitation.** The 0.06-acre BPS property is owned by the City of Belmont and is located on Shoreway Road. The existing BPS includes the pump station building and three pumps. The three existing pumps within the BPS would be replaced with three new 5.5 mgd, 75 horsepower (HP) pumps. In addition, all electrical components, and all site security within the BPS would be upgraded to current SVCW standards at the time of construction. Most of the rehabilitation and replacement at the pump station is expected to occur within the existing building. Additionally, some site improvements may be necessary to accommodate new electrical components (e.g., generator) and containment walls for accommodating future sea level rise.
- **SCPS Improvements.** The improvements at SCPS include: extending the San Carlos sanitary sewer to the proposed gravity pipeline; extending the Belmont FM to allow Belmont wastewater flows to connect to the proposed gravity pipeline; relocating the 10-inch San Carlos Force Main; installing flow metering and sampling structures; and installing a Flow Combination Structure and installing 48-inch diameter pipe at the San Carlos Inlet Structure stub-out to connect to the proposed gravity pipeline. The San Carlos wastewater pipeline and Belmont FM would be extended and combined in an irregular-pentagon shaped structure to combine the flows and provide one connection point to discharge into the proposed gravity pipeline.

Project Schedule and Budget

The schedule of work for the Belmont Conveyance Project was developed as part of the proposed Conveyance System Project schedule. Currently, design development for the Belmont Conveyance Project is scheduled to begin in April 2017. Bid and award of the SCPS Improvements will occur in November 2018, the Belmont FM Rehabilitation in April 2022, and the BPS in September 2023. Construction of the SCPS Improvements will begin in March 2019, the Belmont FM in April 2022, and the BPS in September 2023. Construction of all three projects included in the Belmont Conveyance Project will be complete in August 2024.

Brown and Caldwell (BC) developed a Class 3 cost estimate, as defined by the American Association of Cost Engineers (AACE), for the Belmont Conveyance Project in April 2016. The capital costs were originally developed in 2016 dollars, but escalated to 2023, 2022 and 2019 for the BPS, Belmont FM Rehabilitation and SCPS Improvements, respectively, which are the midpoint years of construction. The capital costs occurring after the Year of Beneficial Use (2022), when the RLS and tunnel are in operation, were discounted back to the Year of Beneficial Use as described in Section 6. Table ES-1 summarizes the construction costs, soft costs, 2016 capital costs, and escalated capital costs for the Belmont Conveyance Project.

Table ES-1. Belmont Conveyance Project capital cost

	BPS Rehabilitation	Belmont FM Rehabilitation	SCPS Improvements
Total Construction Cost	$4.1 M	$5.2 M	$1.1 M
Contingency and Soft Cost Subtotal (25% Contingency and 40% of Construction Cost for Belmont FM and 43% of Construction Cost for BPS and SCPS)	$1.0 M $1.8 M	$1.3 M $2.1 M	$0.3 M $0.5 M
2016 Capital Cost	$6.9 M	$8.6 M	$1.9 M
2019 Capital Cost[2]	--	--	$2.1 M
Market Fluctuation Ranges[1]	--	--	$2.1 M – $2.3 M
2022 Capital Cost[2]	--	$10.9M	--
Market Fluctuation Ranges[1]	--	$10.5 M - $11.9 M	--
2023 Capital Cost[2]	$9.0 M	--	--
Market Fluctuation Ranges[1]	$8.7 M – $9.8 M	--	--
Year of Beneficial Use Capital Cost[3]	$8.4 M	$10.9M	$2.1 M
Market Fluctuation Ranges [1]	$8.1 M - $9.2 M	$10.5 M - $11.9 M	$2.1 M – $2.3 M

1. *Market fluctuation range of -5 percent (low) to 15 percent (high) developed by SVCW. Source: SVCW Conveyance System Construction Cost Analysis, Front of Plant, Revision Date: April 22, 2015, Revision 28b.*
2. *Capital costs are escalated to mid-point of construction years. These differ for each component of the Belmont Conveyance Project.*
3. *The Year of Beneficial Use is 2022. Where the mid-point of construction year occurs after the Year of Beneficial Use, the capital cost was discounted to the Year 2022. If the mid-point of construction year is less than or equal to the Year of Beneficial Use, the escalated capital cost to the mid-point of construction year was used. See Section 6 for further details regarding explanation of Year of Beneficial Use, escalation and discounting.*

Outstanding Issues to Carry into Subsequent Design

Several items will need further refinement and coordination with SVCW. These items include, but are not limited to hydraulic modeling, pump selection, odor control sizing and hydraulic transient analysis. Additional design aspects to consider include equipment removal and maintenance access, flood protection, construction sequencing and impacts on other conveyance system projects, and storm water management. In addition, further geotechnical, overall pump station condition and seismic retrofit evaluations are recommended to progress the design.

Section 1

Introduction

This Belmont Project Planning Report discusses the Belmont Conveyance Project. The Belmont Conveyance Project includes rehabilitation of the BPS that will pump flow from the City of Belmont to the gravity pipeline that will then transport wastewater from the Member Agencies to the RLS to feed the new Headworks Facility at the WWTP. Additionally, the Belmont Conveyance Project will include rehabilitation of the existing Belmont FM that conveys wastewater from the BPS to the SVCW conveyance system. The Belmont Conveyance Project will also include repurposing of the SCPS. Wastewater generated by the City of San Carlos will flow by gravity to the RLS, so the pump station will no longer be needed after the new gravity pipeline is in operation. The new San Carlos Odor Control Facility, designed by others and discussed in a separate project planning report, will be constructed at the existing SCPS site. The Belmont Conveyance Project is one component of the proposed Conveyance System Project; other related projects are discussed in separate project planning reports.

The Belmont Conveyance Project Planning Report is intended to be used for several purposes including: documenting the status of project development for use when the project design is funded, fulfilling SRF planning loan compliance and construction loan application requirements, and as background information should the project be completed through the use of a design-build method of project delivery. Project planning reports for the other elements of the conveyance system have been prepared as separate documents. The project planning report discusses the following topics:

- **Section 1 – Introduction:** The Overall Conveyance System and Belmont Conveyance Project's background and purpose.
- **Section 2 – Setting:** The Belmont Conveyance Project's setting including physical, institutional and interproject setting.
- **Section 3 – Compiled Data and Assumptions:** Compiled data and assumptions including planning and design parameters and assumptions and a summary of field investigations.
- **Section 4 – Project Specific Analyses:** Belmont Conveyance Project specific analyses including alternatives analysis, siting evaluation and hydraulic analysis.
- **Section 5 – Selected Project Description:** Selected Belmont Conveyance Project description including a written description of the recommended Belmont Conveyance Project alternative, major components, conceptual drawings, process and instrumentation drawings, design criteria, major equipment, useful life of the project, equipment replacement frequency, site layout, energy, constructability, construction sequencing and additional design considerations.
- **Section 6 – Cost Estimate and Schedule:** Cost estimate and schedule including life cycle costs and a planning level schedule for design and construction.
- **Section 7 – Outstanding Project Issues:** Next steps for subsequent design including a description of unresolved issues, further field investigation, description of additional analyses, decisions required from SVCW staff or management and items critical to interproject coordination.

1.1 Background

1.1.1 SVCW is a wastewater utility in San Mateo County

SVCW is a Joint Powers Authority (JPA) that owns and operates a regional WWTP at the eastern end of Redwood Shores, within Redwood City, and related wastewater pumping and transmission facilities. SVCW treats the majority of the wastewater generated from the mid-peninsula of San Mateo County south of the San Mateo Bridge. The JPA members include the cities of Belmont, Redwood City, and San Carlos, and the West Bay Sanitary District (WBSD; which provides sanitary sewer collection services to the cities of Menlo Park, Portola Valley, and portions of Atherton, Woodside, East Palo Alto, and unincorporated areas of San Mateo County.

The individual members of the JPA own and operate the sanitary sewer collection systems within their respective jurisdictions. WBSD also owns the existing flow equalization facility (FEF) that is leased to SVCW and used to store wastewater during wet weather conditions. SVCW owns and operates the WWTP and the sanitary sewer FM and pump stations that convey the wastewater from the member agency connections to the treatment plant.

1.1.2 Existing conveyance system

SVCW's existing conveyance system assets include four pump stations, one for each of the four Member Agencies, a wet weather booster station located in the SCPS, an influent lift station located at the WWTP, and an approximately nine-mile-long FM. SVCW leases from the WBSD a FEF, which is an integral part of SVCW's existing conveyance system.

1.1.3 History of SVCW and the conveyance system

To understand the need for the proposed Wastewater Conveyance System and Treatment Reliability Improvement Project (the proposed Conveyance System Project) it is useful to know the history of SVCW, the assumptions used during the original design of the conveyance system, why the various components were built, and why at different times. This description of the history of SVCW will illustrate that the conveyance system is being operated in a manner different than its original design intent and, now, beyond its useful life.

Until the mid-1960's the mid-peninsula cities had their own wastewater treatment plants. Redwood City Sanitary District owned and operated the Redwood City Sewage Treatment Facility. Belmont and San Carlos owned and operated the Belmont/San Carlos Joint Sewage Treatment Facility. The developer of Redwood Shores (Mobil Land) owned the Redwood Shores Treatment Plant and it was operated by Redwood City Sanitary District. The Redwood City and Belmont/San Carlos plants separately discharged effluent to San Francisco Bay. The Redwood Shores Plant consisted of oxidation ponds and had no discharge as all the wastewater was evaporated. The level of treatment provided by these three plants and the locations of their outfalls could not meet the new stricter wastewater treatment and disposal regulations being imposed and developed at the state (Porter-Cologne Act, 1969) and federal (Clean Water Act, 1972) levels.

The Regional Water Quality Control Board (Regional Board) ordered a 10-to-1 dilution requirement for San Francisco Bay discharges. With encouragement from the Regional Board, in June 1969, the three cities formed the Strategic Consolidation Sewerage Plan Joint Powers Authority (SCSP JPA) for the purpose of addressing the new water quality regulations on a regional basis. To meet the 10-to-1 dilution requirement as soon as possible, the SCSP JPA would build connecting pipelines and a deep-water outfall for discharging the effluent from the existing three small treatment plants in advance of constructing the regional treatment plant. The site of the regional treatment plant needed to be decided so design of the new outfall could begin. After considering several sites, the

SCSP JPA selected the Redwood Shores Plant site at the mouth of Steinberger Slough for the regional plant.

The pipeline consisted of six miles of reinforced concrete pipe that connected the treatment plants to the deep-water outfall located at the mouth of Steinberger Slough[1]. This new conveyance system was designed as a low pressure FM. In 1969 designs were completed for the pipeline as well as for the Redwood City Pumping Plant and the San Carlos Pumping Plant. These pumping plants were built adjacent to the respective individual treatment plants. The pump stations, pipeline, and deep water outfall were put into service in 1971. The outfall, pipeline, and the Redwood City Pumping Plant (renamed RCPS) are still in use today.

Concurrent with the SCSP JPA improvement plans, Belmont's capital plans anticipated needing a new pump station and a pipeline that would connect it to the Belmont/San Carlos Joint Plant until the regional plant was operational. By the time the regional plant was operational and the Belmont/San Carlos Joint Plant closed, Belmont would also need a direct connection to the new SCSP FM. Design for a new pump station and direct connection FM on the west side of US-101 finished in 1973. The FM consisted of two segments. The first was from the new BPS to the point of the future connection to the 54-inch FM. This section was 1,200 ft of 24-inch welded steel pipe, lined and coated with cement mortar. The second segment was downstream of the future connection point and terminated at the San Carlos/Belmont Joint Plant. In this segment the pipe size was reduced to 20-inches and the material changed to asbestos cement pipe. This change in size and material was likely due to the City wanting to reduce costs for this segment that would be used for less than 10 years.

In the mid-1970's, in response to Regional Board direction, the service area for the regional plant originally envisioned by the SCSP JPA expanded to include the WBSD service area. In November 1975 the members of the SCSP JPA and WBSD (previous named Menlo Park Sanitary District) founded South Bayside System Authority (SBSA, renamed in 2014 to Silicon Valley Clean Water) JPA as the successor to the Strategic Consolidation Sewerage Plan JPA.

The addition of the WBSD area necessitated expanding the conveyance system to connect WBSD. Design of a 2.7-mile-long 33-inch diameter reinforced concrete pipe FM between the RCPS and the future MPPS site was completed in 1976. The pipe was put into service when the regional plant became operational in 1982. The addition of WBSD to the system required that a booster pump station be added to the FM system, as the additional WBSD flows were not anticipated in the original FM head loss and pressure calculations.

The five segments of the existing FM, with year built, are described in Table 1-1.

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[1] It should be noted that reinforced concrete pipe was the pipe of choice when the pipeline was designed in the early 1970's. High density polyethylene (HDPE) pipe was not available in large diameters at that time. The highly corrosive nature of the Redwood Shores saline soils made steel a poor candidate for this alignment.

Table 1-1. Existing FM location, size and length

Segment	Location	Pipe Inside Diameter (ID) (in)	Year Built and Material	Age of Pipeline (years)	Length[1]	
					Lineal Feet	Miles
1	Between MPPS and RCPS	33	1977 RCP	40	14,450	2.74
2	Between RCPS and SCPS	48	1971 RCP	46	12,950	2.45
3	Between the SCPS and Belmont "T"	54	1971 RCP	46	3,550	0.67
4	Between the BPS and Belmont "T"	24	1974 WSCL/C[2]	43	1,150	0.22
5	Between Belmont "T" and SVCW WWTP	54	1971 RCP	46	15,500	2.94
				Total Force Main	47,600	9.0

Source: *Based on Table 6.1 of the SVCW Conveyance System Master Plan (Winzler & Kelly, 2011)*

1. *Lengths are rounded to the nearest 50 ft and tenth of a mile.*
2. *WSCL/C = welded steel, cement mortar lined and coated. Construction date estimated based on design drawings being completed in February 1973.*

In anticipation of higher flows and the higher water surface elevation of the regional WWTP, SBSA modified existing pump stations or built new one(s). The (1971) Redwood City and the (1974) BPSs were enlarged. A new SCPS replaced the 1971 SCPS. The MPPS was a new pump station that was subsequently modified in 1990 as part of WBSD's flow equalization project. Table 1-2 provides a summary of dates related to the pump stations.

Table 1-2. Age of existing pump stations

Pump Station	Existing PS Operational	Enlarged, New or Modified	Years in Service
MPPS	1982	1990	35
RCPS	1971	1982	46
SCPS	--	1982 (new)	35
BPS	1974[1]	1982	43

1. *1974 is based on the date of the FM design drawings.*

Design of SBSA's regional WWTP was completed in December 1977 and the new plant became operational in 1982. When the regional WWTP plant was put into service, the four smaller plants were decommissioned and the new and upgraded pump stations began to pump wastewater to the regional plant.

1.2 Reasons the Project is Needed

The proposed Conveyance System Project is necessary to eliminate ongoing reliability concerns and accommodate changes in wastewater flowrates. Replacement of the conveyance system is SVCW's highest priority due to its age and continual state of failure. The existing SVCW conveyance system components are beyond their useful life. The American Society of Civil Engineers (ASCE) published a report entitled "Failure to Act" (ASCE, 2011) with the purpose "to provide an objective analysis of the economic implications for the United States of its continued underinvestment in infrastructure." Table 1-3 lists the useful life for FMs and pump stations used in the ASCE report.

Table 1-3. Useful lives of wastewater pump stations and force mains

Component	Useful Life (years)
FMs	25
Pumping Stations – Concrete Structures	50
Pumping Stations – Mechanical or Electrical	15

Source: *Table 5 of Failure to Act, the economic impact of current investment trends in water and wastewater treatment infrastructure (American Society of Civil Engineers, 2011)*

1.2.1 Force mains

SVCW's 46-year-old concrete force main is in poor condition and needs to be replaced. The pipeline suffers from several problems caused by the soils in which it is installed and the sewage characteristics. Problems have compounded, resulting in a history of numerous leaks. These leaks range from minor to the occasional catastrophic failure. Leaks require repairs along streets and in backyards and sometimes within biologically sensitive environments.

One section of the original force main that had the most leaks was replaced in 2015 with a fused-jointed high density polyethylene (HDPE) pipe. This was a 1.7-mile long portion of the 48-inch diameter force main from the RCPS to the north end of Inner Bair Island. The proposed Conveyance System Project will replace the remaining original force main that begins where the 48-inch replacement project ended (the north end of Inner Bair Island) and terminates at the WWTP.

Much of the existing force main is buried in young bay mud (YBM) soils that are poorly suited to the existing pipeline material and joint system. YBM has two main problems; it is expansive and corrosive. Expansive soils are weak, unstable, have high shrink-swell potential, and settle over time. The pipeline consists of 12-foot-long reinforced concrete pipe sections that are connected to each other with single non-restrained "O-ring" joints. The YBM soil does not provide sufficient support for the reinforced concrete pipe and its joints. This results in pipe movement and separation at the joints and is the cause of most leak events.

The bay mud soil is highly corrosive to buried steel and concrete that comes into direct contact with the soil. The pipe is also subjected to microbiologically influenced corrosion (MIC) from sewer gases inside the pipe. Internal and external corrosion of the concrete and reinforcing steel leads to more significant leaks. When surges in flow occur (such as during a power outage) the resulting pressure and vacuum surge conditions have broken the weakened pipeline resulting in major sewage spills. These types of leaks tend to be catastrophic with the potential of uncontrollable discharge of untreated wastewater to the environment.

The frequency of pipeline leaks is expected to increase as the pipe ages, given the current poor condition of the pipelines, continued movement of weak soils, and acceleration of the internal and external corrosion.

In addition to the problems related to the soil, the existing pipeline was designed as a low-pressure force main pipeline and not for typical force main pressures. When WBSD was added to the conveyance system and as wet weather flows have risen, flows in the force main have grown higher than the original design anticipated. When the WBSD flows were added, a booster pump station, and later a FEF, were added to the system.

With Herculean efforts, SVCW maintains pressures and surges in the conveyance system to within the force main's pressure limits, though this approach comes with significant risk. SVCW must carefully manage the flow in the pipeline to minimize leaks by opening and closing valves, turning on and off pumps (including the booster and influent lift pumps), diverting flow to storage, and backing up sewage in member agency collection systems. During wet weather events, wastewater flows from the WBSD collection system are diverted to the WBSD flow equalization facilities. When flows subside, the WBSD wastewater is pumped from the flow equalization facilities through the MPPS and to the treatment plant. Sometimes these pressure management efforts require using all available pumps and valves leaving limited or no backup equipment.

The reasons provided for replacing the pipelines are corroborated by industry accepted guidelines of useful life. The 46-years is well beyond a typical force main's lifespan of 25 years.

1.2.2 Pump stations

All five pump stations, the four Member Agency pump stations and the Influent Lift Station (ILS) are in varying states of condition, ranging from poor to very poor. Despite system-wide repairs and regular maintenance, the pump stations need replacement to provide safe and reliable operation and to accommodate the future projected flows through the system. Each pump station is at least 35 to 46 years old, well beyond the 15-year useful life for the mechanical and electrical components, and approaching the life of the concrete structure. In most instances the condition of the equipment has degraded to the extent that the systems require extensive maintenance to ensure functionality and reliability. To keep the pump stations operational, SVCW is spending millions of dollars to replace various pump station components, such as control systems, pumps, and valves. These components will not be used after the proposed Conveyance System Project is completed.

The solution to the current conveyance system problems SVCW is facing is to replace the original pipeline with a new pipeline that is designed for local soils conditions and system flows, and to replace or rehabilitate the pump stations. The conveyance pipeline and the pumping system improvements are interconnected and need to be planned, designed, and constructed in tandem.

1.2.3 Headworks

The proposed Conveyance System Project also includes construction of a Headworks to house screening and grit removal facilities. This process will be the first step in treatment. It removes rags, sand, grit, and debris that damage pumps and other process equipment.

The original SVCW WWTP facility was built with no Headworks. The plant's current partial screening and grit removal processes continue to allow excessive downstream grit and unscreened material that cause premature wear on equipment and result in high maintenance and repair costs. Large debris and inorganic solids such as rags that are not removed by the existing screening equipment are removed manually. Manual removal of rags is labor intensive and places plant personnel in challenging work environments. SVCW recently installed new digester mix pumps, rotary screen presses, and gravity belt thickeners. This new equipment is very susceptible to damage caused by rags and debris. Without the Headworks, this new equipment will experience the same premature wear as the older equipment.

SVCW's decision to install screening and grit removal facilities was made for purposes of protecting its employees, addressing the continued high costs for labor and equipment damage, and increase the reliability of the overall treatment process. Effective screening of incoming wastewater will save both operation and maintenance costs and improve SVCW's operational capabilities.

1.3 Proposed Conveyance System Project Overview

The proposed Conveyance System Project proposes a combination of rehabilitating, repurposing, and decommissioning existing SVCW conveyance system assets, and the construction of replacement assets. Brief summaries of the major components included in the proposed Conveyance System Project are provided in the following paragraphs.

1.3.1 Pipelines

A 15-foot outside diameter tunnel will be built using a tunnel boring machine to connect the recently constructed 48-inch replacement force main (located at the northern end of Inner Bair Island) to the WWTP. The distance between top of the tunnel and the ground surface will range from 20 to 52 ft. Inside this tunnel will be a new 11-foot inside diameter gravity pipeline. This new gravity pipeline will replace the remaining portion of the 48-inch and the entire existing 54-inch force main pipelines. The BPS would be connected to the new gravity pipeline by rehabilitating the existing 24-inch pipeline and a portion of the 54-inch pipeline. The 33-inch force main pipeline that connects the MPPS to the RCPS would remain as it exists.

1.3.2 Pump stations

The MPPS and the BPS will be rehabilitated and remain as part of the proposed Conveyance System Project. A new pump station will be built on the existing RCPS site and the existing pump station building will be repurposed to house auxiliary equipment that supports the new RCPS. The SCPS will no longer be needed and will be decommissioned. Portions of the SCPS building and yard will be repurposed to house odor control and ancillary equipment needed by other elements of the proposed Conveyance System Project. At the downstream end of the gravity pipeline, a new deep pump station (called the RLS) will be built to pump the wastewater from about 60 ft below grade to the new Headworks.

1.3.3 Headworks

A Headworks Facility will be constructed downstream of the RLS to provide coarse screening and grit removal from the raw wastewater. This is a new treatment process being added to the WWTP treatment train. Two new large-diameter pipes will be built to connect the Headworks to the existing primary treatment process. Odor control facilities for the RLS and Headworks will be installed adjacent to the Headworks Facility.

1.4 Planning and Design History of the Conveyance System Project

SBSA completed a Conveyance System Master Plan (CSMP) in August 2011 to plan and program the projects required for improving its conveyance system. The recommended approach at that time was to replace the existing force main with a new force main and to rehabilitate or replace the pump stations. Chapter 7 of the CSMP developed conceptual-level requirements for the replacement and rehabilitation of the SVCW pump stations that served as the baseline for the pump station predesign.

The CSMP also identified several items that required further refinement to be completed during the design phases of the project.

Following completion of the CSMP, BC started the preliminary design of the conveyance system pump stations in 2012. An Administrative Draft of the Conveyance System Predesign Report was completed in May 2014 (BC, 2014). The proposed project at that time consisted of the following key elements and is shown in Figure 1-1.

- Pipe Modifications:
  - Rehabilitation or replacement of the Segment 1 force main between MPPS and RCPS shown as PS1 and PS2 in Figure 1-1, respectively.
  - Replacement of the Segment 2 with a new 48-inch diameter force main
  - Installation of a 36-inch gravity line to convey flow from the Belmont Connection Point to SCPS, shown as PS3 in Figure 1-1.
  - Replacement of the Segment 3 force main with a 63-inch force main
- Pump Station Modifications:
  - New pump station at MPPS called PS1 in predesign
  - New pump station at RCPS called PS2 in predesign
  - New pump station at SCPS called PS3 in predesign
  - Elimination of BPS. BPS replaced with a connection from the Belmont Collection System to the 36-inch gravity line.

Figure 1-1. May 2014 predesign proposed SVCW conveyance system

Following submittal of the Administrative Draft of the Conveyance System Predesign Report in 2014 (Brown and Caldwell, 2014), SVCW decided to place the design of the conveyance system on hold in order to evaluate gravity pipeline alternatives, which could be used in lieu of a force main in the San Carlos and Redwood Shores areas. The alternatives that were evaluated consisted of varying combinations of pump stations, gravity pipeline, and force mains to convey wastewater from SVCW's Member Agencies to the WWTP. SVCW performed a success versus risk analysis of the alternatives and selected the proposed Conveyance System Project described in Section 1.3. On May 14, 2015, SVCW Board of Commissioners approved the proposed Conveyance System Project and granted permission to proceed with California Environmental Quality Act (CEQA) documentation and conceptual design.

BC began conceptual design of the pump stations in 2015 to support the development of the Draft Environmental Impact Report (EIR) that is required for CEQA documentation of the proposed Conveyance System Project. The Draft EIR was submitted in November 2016 (SVCW, 2016), and this project planning report summarizes the conceptual design as of that date. The proposed Conveyance System Project is displayed in Figure 1-2. The key elements of the proposed Conveyance System Project are described in Section 1.3.

Figure 1-2. Schematic diagram of the proposed project

(Source: Kennedy/Jenks Consultants)

Table 1-4 summarizes the major changes that occurred between 2014 preliminary design of the conveyance pump stations and the proposed Conveyance System Project as of November 2016.

Table 1-4. Pre-design vs. proposed Conveyance System Project comparison

Pre-design Project element	Pre-design (2014)	Proposed Conveyance System Project (2016)
Pipes		
Segment 1 Force Main	• Replacement or rehabilitation of Segment 1 force main	• No changes to Segment 1 force main under current project. Rehabilitation to occur in the future.
Segment 2 Force Main	• Replacement of Segment 2 force main with new 48-inch force main	• Part of Segment 2 replaced with 48-inch force main, segment labeled as "Airport Segment Alignment" in Figure 1-2 will be replaced with gravity pipeline.
Segment 3 Force Main	• Replacement of Segment 3 force main with new 63-inch force main	• Segment 3 will be completely replaced with gravity pipeline.
36-inch Gravity Line	• New 36-inch gravity line from BPS to SCPS. BPS flows to be pumped by SCPS.	• The 36-inch gravity line will no longer be installed. Existing 24-inch and 54-inch force mains will be rehabilitated and convey flow from BPS to the gravity tunnel.
Pump Stations		
MPPS (PS1)	• MPPS will be a new pump station called PS1.	• MPPS will be rehabilitated, but the name will not be changed.
RCPS (PS2)	• RCPS will be a new pump station called PS2.	• RCPS will be a new pump station, but the name will not be changed.
SCPS (PS3)	• SCPS will be a new pump station called PS3.	• SCPS will be repurposed to contain odor control facilities for the gravity pipeline.
BPS	• BPS will be eliminated. A connection will be made from the Belmont collection system for conveyance to SCPS.	• BPS will be rehabilitated and convey flow to the gravity pipeline at the old SCPS site.
RLS (Non-predesign item)	• Does not exist as part of pre-design.	• New RLS will be constructed to convey flow from the gravity tunnel into the new WWTP Headworks.

1.5 Project Purpose

This section discusses the Belmont Conveyance Project objectives and the expected benefits for the Belmont Conveyance Project.

1.5.1 Objectives

The objectives of the Belmont Conveyance Project are:

- Provide major upgrades and improvements to maintain long-term operation of the pump station and conveyance system. Currently, BPS requires frequent hands-on maintenance, and there are several ongoing operational challenges with the pump station in its current configuration. The existing equipment is at or near the end of its useful life.
- Improve access to BPS equipment. The existing pump station configuration has very little space for safe work access inside the facility.
- Allow the pump station to handle future projected Year 2030 flow. The existing pump station does not have the capacity to convey future flows.

- Improve the condition of the existing 24-inch and 54-inch force mains. A break occurred on the existing 54-inch force main in 2001; therefore, the condition of the force main is believed to be poor.
- Convey flows to the SCPS shaft so that SCPS can be decommissioned and repurposed.
- Maximizes SVCW's current assets by rehabilitating existing infrastructure such as BPS and Belmont FM and repurposing SCPS.

1.5.2 Benefits

The benefits of the Belmont Conveyance Project support the proposed Conveyance System Project objectives and include:

- Easier, more efficient and effective operation and maintenance of facilities.
- Improved safety with better access to operate and maintain facilities
- Lower operational impact on residences and businesses
- Ability of the new pump station to handle current and future projected flows
- Maintains gravity flow in the collection system without sanitary sewer overflows

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Section 2

Setting

The following section describes the area where the BPS, Belmont FM, and SCPS are located, adjacent facilities and other features (hydrologic, geologic, topographic, etc.) that impact the Belmont Conveyance Project.

2.1 Physical Setting

The existing SVCW conveyance system schematic is displayed in Figure 2-1. BPS, Belmont FM (Segment 4) and SCPS are located downstream of RCPS. BPS and SCPS flows combine at the intersection of Segment 3 (54-inch diameter force main) and Segment 4 (24-inch diameter force main) at the “Belmont Tee” for conveyance into the Segment 5 (54-inch diameter force main) ending at the WWTP. The following section describes the history and nearby facilities of the Belmont Conveyance Project components.

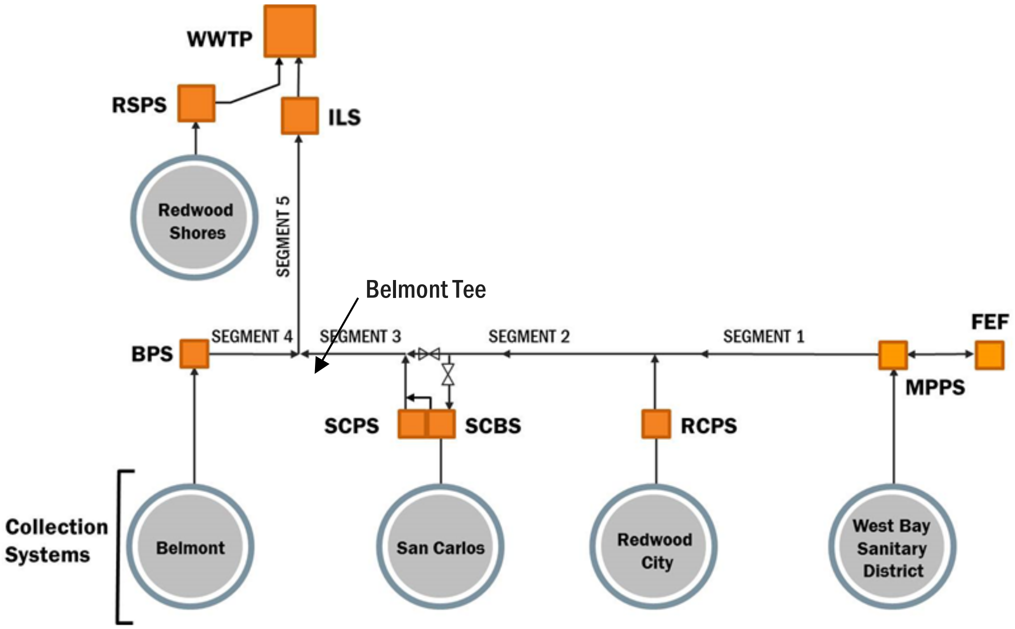

Figure 2-1. SVCW existing conveyance system schematic

BPS. The existing BPS is located on Shoreway Road in the City of Belmont. The BPS was built in 1971 and upgraded in 1982. The pump station pumps all the wastewater for the City of Belmont and the surrounding unincorporated areas of San Mateo County that are connected to the City’s sewer system into the existing SVCW force main system. Flow is transported from the City of Belmont collection system to the BPS by a 30-inch diameter gravity sewer.

Belmont FM and existing 54-inch force main. The Belmont FM is approximately 1,150 linear feet (lf) of 24-inch diameter pipe and located on Shoreway Road and Skyway Road, shown as Segment 4 in Figure 2-1. The existing 54-inch force main, Segment 3 in Figure 2-1, is located downstream of SCPS and connects SCPS into the existing conveyance system. The existing 54-inch force main is located within existing rights-of-way on Shoreway Road and Skyway Road, as well as within the California Department of Transportation's (Caltrans) rights-of-way at the Holly Street and US- 101 interchange.

The Belmont FM and existing 54-inch force main both flow toward and connect into the "Belmont Tee", located near the north end of 75 Shoreway Road, combining the flow for conveyance by a 54-inch force main (Segment 5 in Figure 2-1) to the WWTP. The physical location of these force mains are also shown in Figure 2-3.

SCPS. The SCPS is located on the northwest end of Monte Vista Drive in the City of San Carlos, adjacent to the San Carlos Airport, on a site that previously was occupied by the San Carlos-Belmont WWTP. The SCPS was built in its current location on the east side of the former San Carlos-Belmont WWTP in the early 1980s. The flow to the SCPS includes the sewage from the City of San Carlos and additional flow from surrounding unincorporated areas that are connected to the City's sewer system.

The following sections discuss the existing site features, utilities and surrounding areas of the BPS, Belmont FM and SCPS sites that will impact the design and construction of the new facilities and considerations as the design is progressed.

2.1.1 Existing site

The following section describes the existing site conditions.

BPS. The existing BPS is located on a 0.06-acre property is owned by the City of Belmont. The site is bordered by Jameco Electronics to the north and west, Shoreway Road and US-101 to the south, and Belmont Creek and the Bay Access Walking Trail to the south and east, as shown in Figure 2-2. The BPS is currently not secured with a chain link fence.

Figure 2-2. BPS site

Belmont FM. The Belmont FM and the 54-inch force main between BPS and SCPS will be rehabilitated; therefore, Segments 3 and 4 as mentioned above will combined into a single Belmont FM conveying flow from BPS to SCPS. The 24-inch force main that conveys flow from BPS to just southeast of Cormorant Drive to the Belmont Tee. The 54-inch force main conveys flow from SCPS to the Belmont Tee.

From the Belmont Tee, BPS and SCPS flows combine and are conveyed north through a 54-inch force main that connects the existing conveyance system to SVCW's WWTP. This section of force main (Segment 5 in Figure 2-1) will be abandoned as part of the Belmont FM Rehabilitation and with the installation of the gravity pipeline.

Figure 2-3 displays the existing 24-inch and 54-inch force main alignment from the BPS to the SCPS that is proposed to be rehabilitated and the 54-inch force main that is proposed to be abandoned. The portion of force main proposed to be rehabilitated crosses in front of a series of industrial businesses and business parks and will cross Holly Street within Caltrans right-of-way. Herein, the rehabilitation of the 24-inch force main and 54-inch force main and connection to the SCPS will be referred to as the Belmont FM Rehabilitation since they will be connected to provide a conveyance from BPS to SCPS.

SCPS. The SCPS is located on a 0.92-acre parcel owned by the City of San Carlos. The SCPS occupies 0.44 acres of the parcel, and the remaining 0.48 acres have been leased to the Fairfield Inn and Suites and two restaurants (Izzy's and Burger King). The San Carlos Airport is located to the north and east, the Hiller Aviation Museum to the south, and two restaurants to the north and east, as shown in Figure 2-3.

The SCPS site is secured with chain-link fence with two gates providing access to the site from Monte Vista Drive. It is graded to drain away from the SCPS building except for the small chemical delivery area, which has a berm around it and a drain near the building.

Figure 2-3. Belmont FM and 54-inch force main alignment

Figure 2-4. SCPS site

2.1.2 Site features and considerations

The following section discusses site features and considerations that will be pertinent to incorporate during predesign. Flood elevations and restrictions due to nearby facilities are also identified.

BPS. Maps produced by Federal Emergency Management Agency (FEMA) were reviewed during conceptual design. The BPS building is currently located outside of the 100-year flood zone at an elevation of 110 ft [National Geodetic Vertical Datum of 1929 (NGVD29) + 100 ft]. Facilities outside of the existing BPS building shall be set at an elevation of 110 ft to provide similar flood protection. Since the area surrounding BPS is within the 100-year flood zone, operations and maintenance (O&M) crews may not be able to reach BPS during the 100-year storm area flooding unless it's by a row boat or some other floating device.

Belmont FM. Most of the rehabilitation will be installed using trenchless methods. However, there will be open cut and slipline and cured-in-place pipe (CIPP) pits that require excavation in Shoreline Road. There will also be a slipline pull pit located at the Holly Street interchange within Caltrans right-of-way. Construction will need to minimize traffic impacts to nearby businesses along Shoreway Road. Close coordination with the City of Belmont, City of San Carlos and Caltrans will be required.

SCPS. The design and repurposing of SCPS will have limitations because of being located adjacent to the San Carlos Airport. In addition to the constraints provided in the City Code Chapter 18.09 regarding the use of property adjacent to the Airport, the design and construction must adhere to Federal Aviation Administration (FAA) requirements. Equipment heights at the SCPS site will be limited to stay outside of the Runway Protection Zone (RPZ) established by the FAA. The RPZ includes a horizontal setback but also a vertically inclined plane; therefore, building height limits are a function of the horizontal location of the building. Encroachment into the RPZ is possible for construction purposes; however, limitations will be imposed and include such items as safety measures and work hour restrictions. The RPZ limits shall be reviewed during final design to ensure the SCPS site is consistent with the FAA requirements and that construction limitations are clearly documented in the specifications for the SCPS Improvements Project. Additionally, Monte Vista Drive has been identified as a construction staging and storage area, but maintaining a 12-foot wide lane to the Airport's emergency access gate located at the end of the roadway will be required for its use. It is not anticipated the driveway entrance to the staff parking lot for the Hiller Aviation Museum will be obstructed.

The extent of additional permanent property needed for the SCPS Improvements and construction shall be determined and coordinated with the City of San Carlos during final design.

2.1.3 Existing utilities

Existing utilities at each location is discussed below.

BPS and Belmont FM. Along Shoreway Drive adjacent to the BPS site and the Belmont FM, communication lines, a 10-inch sewer and a 12-inch water line are located parallel to the force main along its entire alignment. Along Shoreway Drive and southeast of Cormorant Drive, additional utilities parallel the Belmont FM These utilities include gas lines ranging from four inches to 12 inches in diameter and a 12 inch to 18-inch storm drain. Excavation for lining pits during construction will need to consider bracing and/or possible interruption in service during the lining construction. Existing utilities are shown in the Pump Station Pre-Design drawings (Freyer & Laureta, 2013; Appendix A) that includes preliminary survey information along Shoreway Road.

In addition, a new Clear Channel billboard has been constructed within the BPS construction site (see drawings in Appendix A). Any impacts of the siting of the billboard will need to be assessed further during subsequent detailed design.

SCPS. Typical local urban utilities, such as water, sewer, gas, electrical and communications, are located in Monte Vista Drive along the southeast side of the SCPS. The pump station's influent and discharge piping is located along the south and eastern sides of the site. The design and construction of the SCPS Improvements is not anticipated to impact the local utilities; however, maintaining service of the existing influent and force main piping as well as accommodating future planned piping will be necessary. The following discussion summarizes the utilities that will have direct impact on the design and construction at the SCPS site. The wastewater utilities are shown on Figure 2-5.

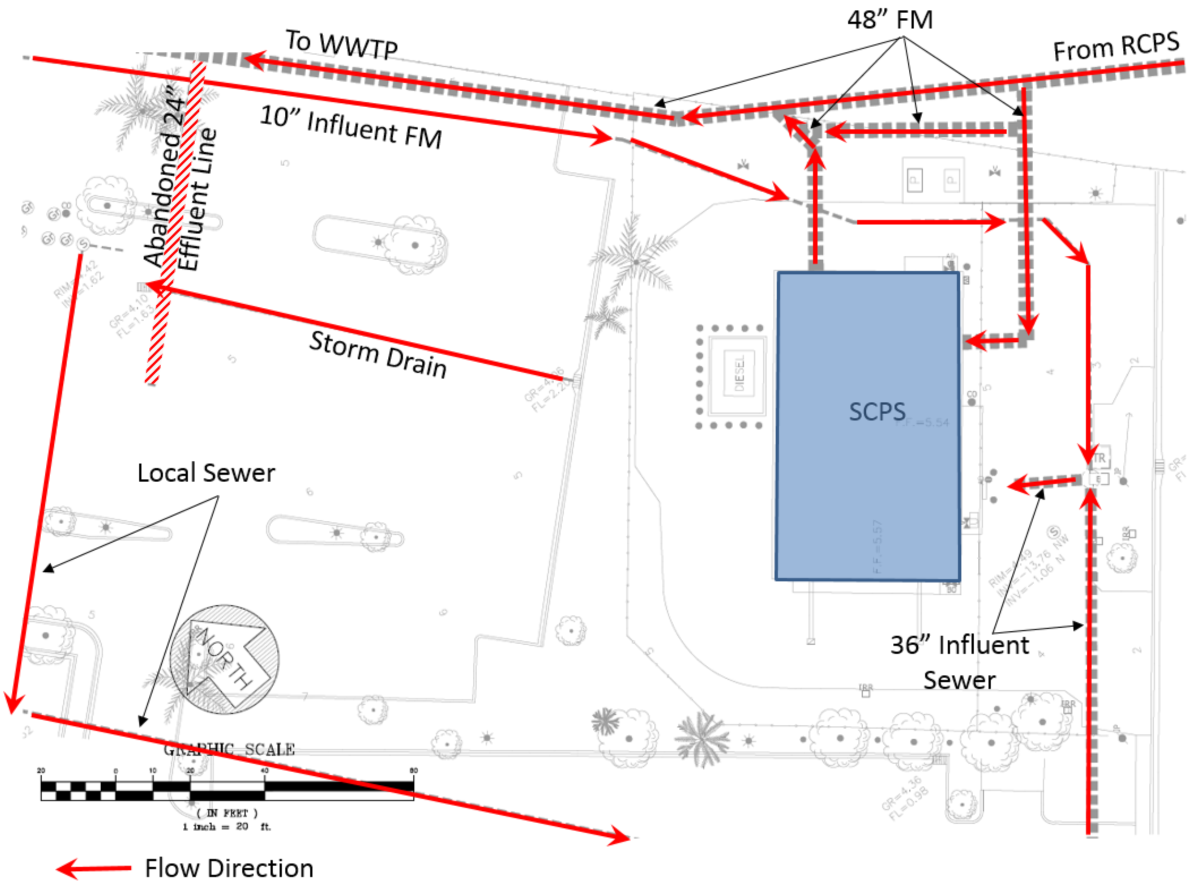

Figure 2-5. SCPS surrounding utilities

The majority of local utilities in Monte Vista Drive are located along the eastbound lane with the occasional service line crossing to the north side of the road. The SCPS Improvements are not anticipated to impact these utilities and their service connection (i.e. meter, transformer, etc.) to the pump station. Onsite yard piping for these utilities will likely require some modifications to accommodate the new facilities but it not anticipated these modifications will impact the overall area and utility systems.

In addition to the existing utilities serving the site, a new recycled water line may be extended to the SCPS site if needed. If it is, the recycled water line could be used at the site for such operational and maintenance tasks as wash down of equipment and structures. Redwood City owns and operates an existing 24-inch diameter recycled water pipe located in Skyway Road. A new service connection on the 24-inch diameter pipe could be made at the intersection of Monte Vista Drive and Skyway Road and the new service line installed in Monte Vista Drive to the SCPS site. The connection will require coordination with Redwood City for the new service line, anticipated to be a 6-inch diameter polyvinyl chloride (PVC) pipe, and shall maintain minimum separation criteria from other existing utilities in Monte Vista Drive. If minimum separation cannot be achieved, other methods of cross-contamination protection and/or identification of alternative alignments will need to be identified since Monte Vista Drive is crowded with utilities. The need for recycled water service will need to be confirmed during final design.

2.2 Institutional Setting

The following section discusses land use near the Belmont Conveyance Project sites and their impact on each site design.

BPS and Belmont FM. Land uses surrounding the BPS include commercial/office buildings to the north, a paved trail along the Belmont Creek channel to the east, and mobile homes over 500 ft to the northwest. There is also another trail on the southeast side of the creek channel and industrial buildings located along Shoreway Road. Shoreway Road and US-101 are located to the west and south of the site.

SCPS. The SCPS includes the existing 0.48-acre pump station site that fronts on Monte Vista Drive. Land uses along Monte Vista Drive include commercial buildings that house a hotel (Fairfield Inn and Suites) and the Hiller Aviation Museum. The new San Carlos Odor Control Facility will be constructed as a separate project and is discussed in a separate project planning report. The San Carlos Odor Control Facility falls within Zone 2 (Inner Approach/Departure) of the San Carlos Airport Land Use Plan.

2.2.1 Current and future nearby development plans

Current and future nearby developments are discussed below.

BPS and Belmont FM. The BPS is in an area zoned for industrial use. The parcel of land located to the southeast side of the BPS across the creek is owned by Nikon Precision, Inc. (Nikon) and is the site of a new Springhill Suites Hotel. Construction on the new hotel has begun as of March 2017. Currently, there are no development plans for the other areas in the vicinity of the BPS according to the Belmont General Plan 2035. A digital billboard has been constructed on the BPS site and will impact the type of construction equipment and lay down area available at BPS.

SCPS. The SCPS site is located in the area known as the East Side within the City of San Carlos and is generally zoned for commercial/industrial and airport use. There are no development projects planned for the area surrounding the SCPS site that would impact design and construction according to the San Carlos General Plan 2030 (City of San Carlos, 2009).

2.3 Interproject Setting

As shown in Figure 2-6, the BPS is located on the western side of the conveyance system and will be connected to the new gravity pipeline at the SCPS by rehabilitating an existing 1,150 foot 24-inch segment of the force main and sliplining 3,550 ft of the existing 54-inch diameter force main.

An overview of the proposed Conveyance System Project is displayed in Figure 2-7. The SCPS is located in the middle of the conveyance system. Because of the change in operations to improve the conveyance system, the existing SCPS will no longer be an active pumping station. The building will be repurposed to house odor control facilities to contain and treat odors venting from the San Carlos Inlet Structure, and the location where Belmont and San Carlos flows enter the gravity pipeline. The improvements at SCPS include: extending the San Carlos sanitary sewer to the proposed San Carlos Inlet Structure; extending the Belmont FM to allow Belmont wastewater flows to connect to the proposed gravity pipeline; relocating the 10-inch San Carlos force main into the 36-inch diameter San Carlos sewer; installing flow metering and sampling structures to collect data independently from each City's collection system; and installing separate trash rack and Flow Combination Structures upstream of the San Carlos Inlet Structure stub-out to connect to the proposed gravity pipeline.

Figure 2-6. SVCW existing conveyance system

Figure 2-7. Schematic diagram of the proposed Conveyance System Project

(Source: Kennedy/Jenks Consultants)

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Section 3

Compiled Data and Assumptions

This section summarizes the data compiled as of January 2017, and assumptions for the Belmont Conveyance Project design including flow data, planning parameters and previous studies such as the contaminated and hazardous materials survey, geotechnical investigations, corrosivity investigations and noise regulations investigation. Some of the studies discussed below were completed during the original 2014 predesign, prior to selection of the proposed Conveyance System Project, but are still applicable to the Belmont Conveyance Project.

3.1 Flow Data

The existing and future design flows as of January 25, 2017, which are based on recent flow data from SVCW, the latest Member Agency master plans and the Conveyance System Master Plan (CSMP) completed in 2011, are summarized in Table 3-1 in million gallons per day (mgd). The peak wet weather flow (PWWF) rates for each Member Agency are based on a single ten-year, 24-hour storm event occurring over the entire service area with a coincident time of concentration for each Member Agency pump station and connection to the conveyance system.

Table 3-1. Belmont Conveyance System design flow rates

	Existing			Future (2040)		
Pump Station	Minimum Flow (mgd)[1]	ADWF (mgd)[2]	PDWF (mgd)	ADWF (mgd)[3]	PDWF (mgd)[4]	PWWF (mgd)[5]
SCPS	0.6	1.3	3.7	2.9	5.8	26.6
BPS	0.3	1.4	3.2	1.8	3.6	16.3

1. *Minimum dry weather diurnal flow is based on flow data provided by SVCW's Supervisory Control and Data Acquisition (SCADA) output from each pump station provided from October 2015.*
2. *Average Dry Weather Flow (ADWF) for October 2015 is based on flow data provided by SVCW's Supervisory Control and Data Acquisition (SCADA) output from each pump station.*
3. *ADWF 2040 flow rates are from Table 5-9 of TM 1 for the Final Plant Capacity Study completed by BC in May 2013.*
4. *Peak Dry Weather Flow (PDWF) 2040 are hourly flow rates and are from the Member Agency Master Plans and CSMP.*
5. *Peak Wet Weather Flow (PWWF) is the worst case timing where the storm event peak flow reaches the entry point into the conveyance system at the same time. The Master Plans and CSMP show approximately a one-hour difference in the time of concentration within each Member Agency.*

The BPS flows range from 0.3 mgd at a minimum flow to 16.3 mgd at the Year 2040 PWWF. The Year 2040 ADWF for the BPS is approximately 1.8 mgd.

The SCPS flows range from 0.6 mgd at minimum flow to 26.6 mgd at the Year 2040 PWWF. The Year 2040 ADWF for the SCPS is approximately 2.9 mgd.

3.2 Project Planning Period

The planning period for the BPS Rehabilitation, Belmont FM Rehabilitation, and SCPS Improvements is 50 years, which is typical for a municipal facility. The useful life planning period extends from now to the Year 2040. For further information on the life cycle analysis completed for the Belmont Conveyance Project, see Section 6.

3.3 Summary of Field Investigations

The following section summarizes field investigations and surveys completed to support the Belmont Conveyance Project design.

3.3.1 Contaminated and hazardous materials survey

Field investigations at BPS and SCPS were conducted to collect samples to determine the presence of contaminated materials, specifically asbestos, lead, polychlorinated biphenyls (PCBs), and mercury. Additionally, a hazardous materials study was previously conducted to identify potential environmental conditions (e.g., hazardous condition during construction, contaminated soils) based on historical and current land uses. A summary of the findings is presented in this section.

3.3.1.1 Contaminated materials survey

The contaminated materials survey included asbestos and lead testing and a hazardous waste visual inspection. A pre-demolition asbestos survey and lead testing for SCPS and BPS was conducted on July 26, 2012 by Forensic Analytical as summarized by BC in TM 3.1 – Field Investigations Summary (BC, 2013a; Appendix B). The description and locations of asbestos and lead found at the pump stations are summarized in Table 3-2.

Table 3-2. Contaminated materials found at BPS and SCPS

Pump Station	Asbestos	Asbestos Location Description	Lead
San Carlos	12-inch beige vinyl tile floor and mastic	Surface level, west utility area, office, and bathroom	6 out of 8 paints tested
Belmont	None detected	N/A	5 out of 7 paints tested

A visual inspection of BPS and SCPS for suspect PCB-containing waste, universal waste and other hazardous waste was conducted on October 29, 2012 by Forensic Analytical (BC, 2013a). The purpose of the inspection was to identify hazardous materials that may be encountered in the pump station demolition. The items found at each of the pump stations fall within one of three categories: suspect PCB-containing waste, universal waste, and other hazardous waste materials. These items are summarized in Table 3-3.

Table 3-3. Hazardous waste inspection summary for BPS and SCPS

Category	Type	Waste Found at Pump Station	
		SCPS	BPS
Suspect PCB-containing waste	Electrical switch gear/transformers (wet type)	Yes	Yes
	Fluorescent light fixture ballasts	Yes	Yes
Universal waste	Lead acid batteries	Yes	Yes
	Light bulbs/tubes	Yes	Yes
	Miscellaneous chemicals and cleaning supplies	Yes	Yes
Other hazardous waste	Various oils	Yes	Yes
	Oily rags	Yes	Yes
	Diesel fuel	Yes	Yes
	Generator (oil, fuel, coolant)	Yes	Yes
	Sodium hypochlorite	Yes	No
	Bio hazard waste	No	Yes

Based on the materials found and their locations, the following are recommendations for handling the asbestos, lead, and PCBs at the BPS and SCPS:

- **Asbestos materials.** Remove prior to demolition by licensed asbestos abatement contractor. Consult Certified Asbestos Consultant to assist with project design and monitoring, including clearance inspection and air sampling after asbestos removal. If any additional suspect asbestos-containing material is discovered during the renovation, the work should stop, and the material should be tested.
- **Lead materials.** Work performed on surfaces containing any amount of lead must comply with the California Office of Safety and Health Administration (Cal/OSHA) Lead in Construction Safety Standard (8 CCR 1532.1). Remove lead paint at spots scheduled for disturbance by the construction to eliminate the Cal/OSHA trigger task and worker protection and monitoring requirements. Otherwise, use Cal/OSHA standards for working around lead. Remove areas of lead containing paint where the paint is peeling or deteriorated prior to sending components for recycling or disposal and prior to demolition. The paint chips are likely classified as hazardous waste and will contaminate any waste at the site with which they are combined. Paint chips and other waste generated from paint removal as well as painted components destined for disposal, should be tested for lead. If the lead content is determined to be hazardous according to the applicable federal and state regulations, the paint should be removed accordingly.
- **PCBs.** Sample the materials after energy isolation or otherwise assume that they contain PCBs. Remove suspect PCB-containing waste and dispose of according to state, federal and local requirements.

All regulated and hazardous waste items encountered should be properly packaged, labeled, transported and disposed of or recycled in accordance with all applicable federal, state and local regulations.

3.3.1.2 Hazardous materials study

A hazardous materials study was conducted for the BPS and SCPS site as part of the Phase I Environmental Site Assessment report, completed by Cornerstone Earth Group in May 2016, as included in the Draft EIR. The purpose of the study was to identify potential environmental conditions at the BPS and SCPS site that could include the presence or likely presence of hazardous substances or petroleum products on a property under conditions that indicate an existing release, past release, or a material threat of a release of these substances or products into structures on the property or into the ground, ground water, or surface water on the property. The study results provide information that can be used in final design to account for removal and disposal of hazardous substances or petroleum products in the Bid documents and cost estimates. The following conditions were identified.

BPS. A 2,000-gallon diesel underground storage tank (UST) was removed from the northwest side of the BPS building in 1996. During the UST removal, ground water reportedly was encountered at a depth of approximately eight ft. Analysis of a soil sample collected from the UST excavation (at the soil-groundwater interface) did not detect total petroleum hydrocarbons (TPH) or benzene, toluene, ethylbenzene and xylene (BTEX) compounds. Analysis of a ground water sample collected from the UST excavation detected BTEX compounds; TPH was not detected.

SCPS. Based on the study, a 12,000-gallon diesel UST was located on the SCPS property; however, the tank was removed from the side of the building in 1994. Soil and ground water sampling performed during the UST removal did not identify petroleum hydrocarbon concentrations exceeding residential screening levels.

According to the Phase I Environmental Site Assessment Report (Cornerstone Earth Group, 2016), the potential impacts of the USTs on the SCPS and BPS construction is low. However, the report states that any excavation near the locations of these sites may still contain some residual contaminants. Therefore, appropriate measures for handling and disposal should be used if these contaminants are encountered

3.3.2 Geotechnical investigation

As part of previous geotechnical investigations, Jacob Associates drilled a single boring at the BPS to a depth of 25 ft and another one at SCPS to a depth of 50 ft in June 2012 (Jacobs Associates, 2013; Appendix C). Moisture content, unit weight, Atterberg limits, grain size analysis, hydrometer with sieve analysis, unconfined compression, direct shear tests, consolidation, and corrosion tests were performed on soil samples retrieved from the test borings to evaluate their physical characteristics and engineering properties. In addition to the test borings, Jacobs reviewed historical geotechnical investigations on the project sites.

A Pre-Design Geotechnical Interpretive Report (GIR) was also completed by DCM Consulting, Inc. using the test boring data provided by Jacob Associates (DCM Consulting, Inc., 2013; Appendix D). The conclusions and recommendations from the GIR are further discussed in Section 5 as part of the design considerations for final design.

3.3.3 Corrosivity investigation

A soil corrosivity investigation was performed at SCPS by BC’s subconsultant, V&A Consulting Engineers, Inc. (V&A Consulting Engineers, Inc., 2014; Appendix E). The investigation included field soil resistivity testing, reviewing existing corrosion data, performing chemical analyses of selected soil samples, and recommending corrosion control methods for buried yard piping and concrete structures. The results of the corrosivity investigation and recommendations at the SCPS state the soil resistivity at a depth of 5 to 20 ft ranges from 140 ohm-cm to 377 ohm-cm. The saturated soil resistivity of the sample was 84 ohm-cm. These soils are considered moderately corrosive to very highly corrosive to metal piping. Corrosion control measures are further discussed in Section 5.

As of November 2016, corrosivity investigations were only performed at SCPS since the BPS Rehabilitation will primarily be within the existing BPS building. In addition, the Belmont FM will be lined within the existing force main with corrosion resistant material.

3.3.4 Noise survey and regulations

A noise and vibration assessment was completed as part of the Draft EIR in November 2016 by Illingworth & Rodkin, Inc. (SVCW, 2016). The following section summarizes the results of their survey.

City of Belmont. The City of Belmont Noise Ordinance is contained in the Municipal Code Chapter 15 Article 8, Section 15-102-c and establishes the following limits that cannot be exceeded by any source of sound emitted and measured at any non-residential building: “Nighttime hours” – 55 dBA; “Daytime hours” – 65 decibels (dBA) where daytime is defined to be the period from 8:00 a.m. to sunset, Monday through Friday; and 10:00 a.m. to sunset, Saturday, Sunday and Holidays; and, nighttime means the period outside the hours of “daytime” as herein defined. The City of Belmont Municipal Code (Chapter 15, Article 8, Section 15-102-f) exempts construction activities from quantitative noise limits but establishes allowable hours of construction: “All construction and related activities, which require a city permit, including the use of powered equipment in connection with such activities, shall be allowed only during the hours of 8:00 a.m. to 5:00 p.m. Monday through Friday, and 10:00 a.m. to 5:00 p.m. on Saturdays. No construction activity or related activities shall be allowed outside of the aforementioned hours or on Sundays and holidays. All gasoline-powered equipment shall be equipped with an operating muffler or baffling system as originally provided by the manufacturer, and no modification to these systems is permitted.”

City of San Carlos. The City of San Carlos Municipal Code (Chapter 18.21.050) establishes the following exterior noise limits as measured from a residential property line: “Nighttime hours” – 45 dBA L_{50} and 60 dBA L_{max}; “Daytime hours” – 55 dBA L_{50} and 70 dBA Lmax (where daytime is defined to be the period from 7:00 a.m. to 10:00 p.m., and nighttime is defined as the period from 10:00 p.m. to 7:00 a.m.). The City of San Carlos Municipal Code (Chapter 9.30.070) exempts construction activities from the above quantitative noise limits during the allowable hours of construction. Construction activities are limited to the hours of 8:00 a.m. to 6:00 p.m., Monday through Friday and 9:00 a.m. to 5:00 p.m. on Saturdays and Sundays. Construction is prohibited without prior authorization on the following holidays: New Year’s Day, Martin Luther King Jr. Day, President’s Day, Memorial Day, 4th of July, Labor Day, Veteran’s Day, Thanksgiving Day and Christmas Day.

A summary of the maximum allowable noise levels is summarized below in Table 3-4.

Table 3-4. City of Belmont and San Carlos maximum allowable noise levels or exemption

Item	Maximum	
	City of Belmont	City of San Carlos
Construction	Construction activities are exempt from quantitative noise limits. However, construction is limited to 8:00 AM to 6:00 PM Monday through Friday and 10:00 AM to 5:00 PM on Saturdays. Construction is prohibited on Sundays and holidays.	Construction activities are exempt from quantitative noise limits. However, construction is limited to 8:00 AM to 6:00 PM Monday through Friday and 9:00 AM to 5:00 PM on Saturdays and Sundays. Construction without prior authorization is prohibited on holidays.
General	Not more than 55 dBA during nighttime hours and not more than 65 dBA during daytime hours. Daytime is defined to be the period from 8:00 AM. to sunset, Monday through Friday; and 10:00 AM. to sunset, Saturday, Sunday and Holidays; and, nighttime means the period outside the hours of "daytime"	Not more than 45dBA L50 and 65 dBA Lmax during nighttime hours. Not more than 55 dBA L50 and 70 dBA Lmax during daytime hours. Daytime is defined to be the period from 7:00 AM. to 10:00 PM, nighttime is defined to be the period from 10:00 PM to 7:00AM.

Construction of the Belmont Conveyance Project is expected to occur in phases, possibly over three years during the dry seasons. Tie-ins and the last part of construction would need to be done during low-flow conditions (i.e., generally April to October). Construction activities would occur between the hours of 8:00 a.m. and 6:00 p.m. on weekdays, with the exception of some work, such as electrical switchovers, lining activities and piping connections completed at night during low flow periods.

The maximum worst case day for construction for the Belmont Conveyance Project is anticipated to be during major excavation efforts and during large concrete pours due to the large presence of equipment and vehicles onsite. No night time work is anticipated, except for special conditions listed above, for construction, but some weekend work may be needed to complete installation of key components.

During normal operation and maintenance of the BPS and SCPS Improvements, the following noise mitigation measures are proposed:

- Design alternatives such as fan silencers, enclosures, and screen walls will be explored at each of the sites.
- Low velocity ventilation systems (which are quieter than standard ventilation systems) and other ancillary noise controls will be incorporated into the designs, as necessary, to meet the noise performance standards.
- The sound level from non-emergency operation of the diesel engine-generator will not exceed 60 dBA when measured on any real property outside the property lines of the facility (excluding roadways).

Section 4

Project Specific Analyses

This section discusses the alternatives analysis, site evaluation, and hydraulic analysis conducted for the Belmont Conveyance Project.

4.1 Alternatives Analysis and Refinement

SVCW completed the CSMP in August 2011 to plan and program the projects required for improving its conveyance system (Winzler & Kelly, 2011). Chapter 7 of the CSMP developed conceptual-level requirements for replacing and rehabilitating the SVCW pump stations that served as the baseline for developing the original BPS predesign. However, the selection of the proposed Conveyance System Project greatly changed the conditions for rehabilitation of BPS.

The selection of the proposed Conveyance System Project included several evaluations and refinements. The alternatives analysis for BPS, Belmont FM and SCPS Improvements are discussed below.

4.1.1 BPS alternatives

The CSMP originally recommended relocating the BPS to a property owned by Nikon and rehabilitating the SCPS. Initially, BC evaluated additional sites for the BPS beyond the three evaluated in the CSMP as part of TM 10.1 – Belmont Siting Evaluation (Brown and Caldwell, 2013c), hereinafter referred to as TM 10.1. Seven potential sites were identified and discussed with Belmont representatives at a meeting on February 6, 2012. Figure 4-1 shows the location of the sites, which also includes the CSMP-recommended site (Site 4).

The seven sites were evaluated based on physical requirements, mechanical requirements, property impacts, safety, permitting and constructability. Of the sites evaluated in TM 10.1, the Nikon Precision, Inc. property, which was the site recommended in the CSMP, was again identified as the best location for the BPS.

Following development of TM 10.1, the City of Belmont determined that the Nikon site was not available for construction because of other planned long-term uses for the sites. Therefore, additional options for relocating the BPS were evaluated. In TM 10.2 – Belmont Alternative Siting Evaluation (Brown and Caldwell, 2013d), hereinafter referred to as TM 10.2, was completed, prior to the proposed Conveyance System Project selection, when the Nikon site was no longer feasible that included: (1) relocation to Sem Lane, (2) relocation to Industrial Road, and (3) routing Belmont flow to a new pump station at SCPS. These sites are displayed in Figure 4-2. Option 3, combining the BPS and SCPS into one pump station by routing the BPS flow to the SCPS through a 36-inch gravity sewer was selected at that time based on non-economic and economic factors.

Upon selection of the proposed Conveyance System Project, further hydraulic analysis was completed. Based on the results and locations of the inlet structures, it was decided that BPS would be rehabilitated to convey flow from the Belmont Collection System to the San Carlos Inlet Structure for conveyance by the gravity pipeline to the WWTP. The combination of rehabilitating BPS and the Belmont FM utilizes the existing facilities and infrastructure and minimizes the disruption to businesses along Shoreway Road.

4.1.2 Belmont FM alternatives

The Belmont FM Rehabilitation was initially identified to develop an alignment for a micro tunneled gravity sewer that would convey wastewater from the BPS to either a mid-point inlet structure for the gravity pipeline or to the SCPS. Either location would then include a connection to the deep gravity sewer to convey the Belmont wastewater flows along with the other Member Agency wastewater flows to the WWTP. Options for routing the 36-inch gravity pipeline from the BPS to the SCPS were then explored and are shown in Figure 4-3.

After the start of the Belmont Conveyance Project, a separate parallel conveyance system alternatives analysis was performed that resulted in the selection of the proposed Conveyance System Project. The selection of the proposed Conveyance System Project included rehabilitating and repurposing a portion of the existing force main in Shoreway Road to pump the Belmont flow to the SCPS.

4.1.3 SCPS alternatives

An alternative analysis was conducted for the entire SVCW conveyance system. This alternatives analysis identified overall 140 combinations of pipeline alignments and pump station locations that included different construction methods and modes of operation (e.g., gravity and pressure conveyance and configuration and location of conveyance system storage). A systematic feasibility assessment was conducted on the alternatives to reduce the number of alternative to 15 for a more detailed evaluation. Alternative 4BE was selected as the best alternative. This alternative included the elimination of the SCPS with a gravity sewer connection to the San Carlos Inlet Structure into the gravity pipeline and then repurposing the SCPS site for flow metering, sampling and odor control facilities.

Figure 4-1. TM 10.1 Belmont Conveyance Project siting alternatives

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Figure 4-2. TM 10.2 Belmont Conveyance Project siting alternatives

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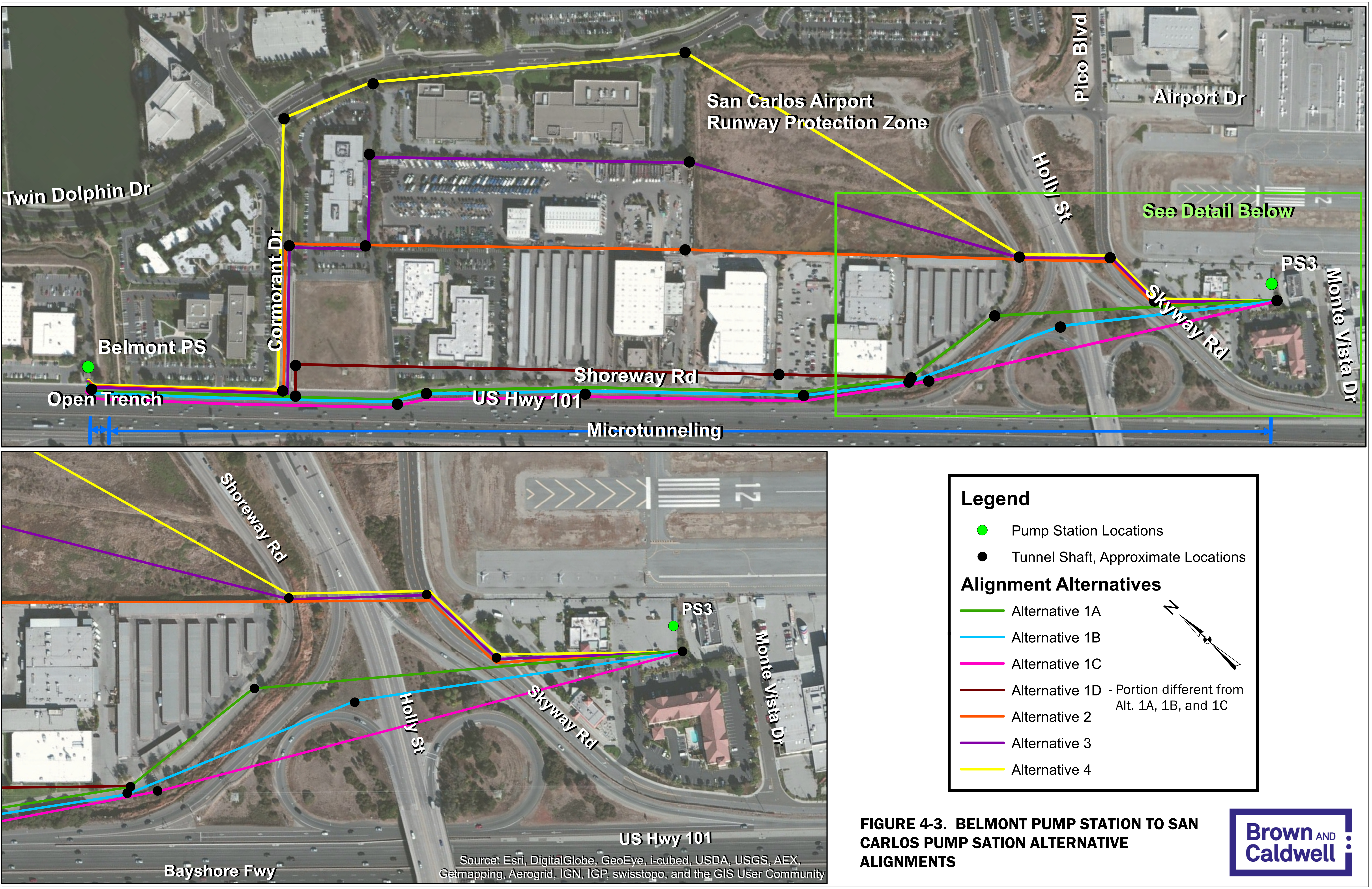
Path: P:\142000\142399 - SBSA Pump Station Predesign\10-Belmont PS Siting Eval\Draft TM\Belmont G4 Alignment\BelmontG4Alignment.mxd



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

FIGURE 4-3. BELMONT PUMP STATION TO SAN CARLOS PUMP SATION ALTERNATIVE ALIGNMENTS

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4.2 Siting Evaluation

The selection of the proposed Conveyance System Project did not affect the BPS and SCPS locations. However, it did affect the design of the BPS and SCPS themselves as discussed in Section 4.1. No additional site evaluations for the BPS and SCPS sites were conducted during conceptual design following the selection of the proposed Conveyance System Project.

4.3 Hydraulic Analysis

BC modeled the SVCW conveyance system using InfoWater V10.0 by Innovyze, Inc. (InfoWater) both during predesign in 2014 and after selection of the proposed Conveyance System Project in 2015. InfoWater is a commercially available hydraulic analysis program that calculates and tracks various hydraulic elements such as flow, velocity and pressure of a fluid through a pipe network.

During predesign, the model was used to develop hydraulic grade lines for the force main, determine the maximum operating pressure in the force main at key locations, develop system curves for pump selection and determine storage requirements. The model is built as a dynamic model, and can analyze the complex hydraulics of multiple pump stations simultaneously discharging into a single force main. Details on the hydraulic analysis from the original predesign are presented in TM 6.1 – Hydraulic Evaluation (Brown and Caldwell, 2013b), hereinafter referred to as TM 6.1, though it should be noted that the analyses discussed in TM 6.1 assume the entire conveyance system would consist of force main.

Model runs completed for the original conveyance system predesign included combinations of the following elements:

- **Force mains.** The existing force mains will be replaced in stages, which results in existing force mains and new force mains operating in conjunction with the new pump stations. The existing force mains are limited to a pressure of approximately 20 pounds per square inch (psi).
- **Existing booster stations**. The existing force main pressure limitations require that the SVCW Booster Station and the WWTP ILS remain in service until all the new force mains are installed.

After selection of the proposed Conveyance System Project, the model was revised to account for the proposed gravity pipeline and other changes to the conveyance system as follows:

- **Gravity pipeline.** Inlet structures and the several sizes of gravity pipeline (diameters ranging from 11 ft to 13 ft) were analyzed. The model will need to be refined pending final selection and operation of the gravity pipeline.
- **Headworks Facility**. The new pump stations will need to operate with the existing inlet structure and new Headworks Facility at the SVCW WWTP. The new Headworks Facility will have a hydraulic grade approximately of an assumed water surface elevation of 118 ft (NGVD29 + 100 ft).

The recommendations discussed in this project planning report are for the Belmont Conveyance Project under the proposed Conveyance System Project. Results of the proposed Conveyance System Project hydraulic analyses are discussed further in Section 4.3.1.

4.3.1 Belmont Conveyance Project operations

As part of the update to the hydraulic model following selection of the proposed Conveyance System Project, BC modeled the projected PWWF in the Belmont FM. Results from the hydraulic model are presented in Figure 4-1. Pressure remains below 20 psi for the entire length of the Belmont FM.

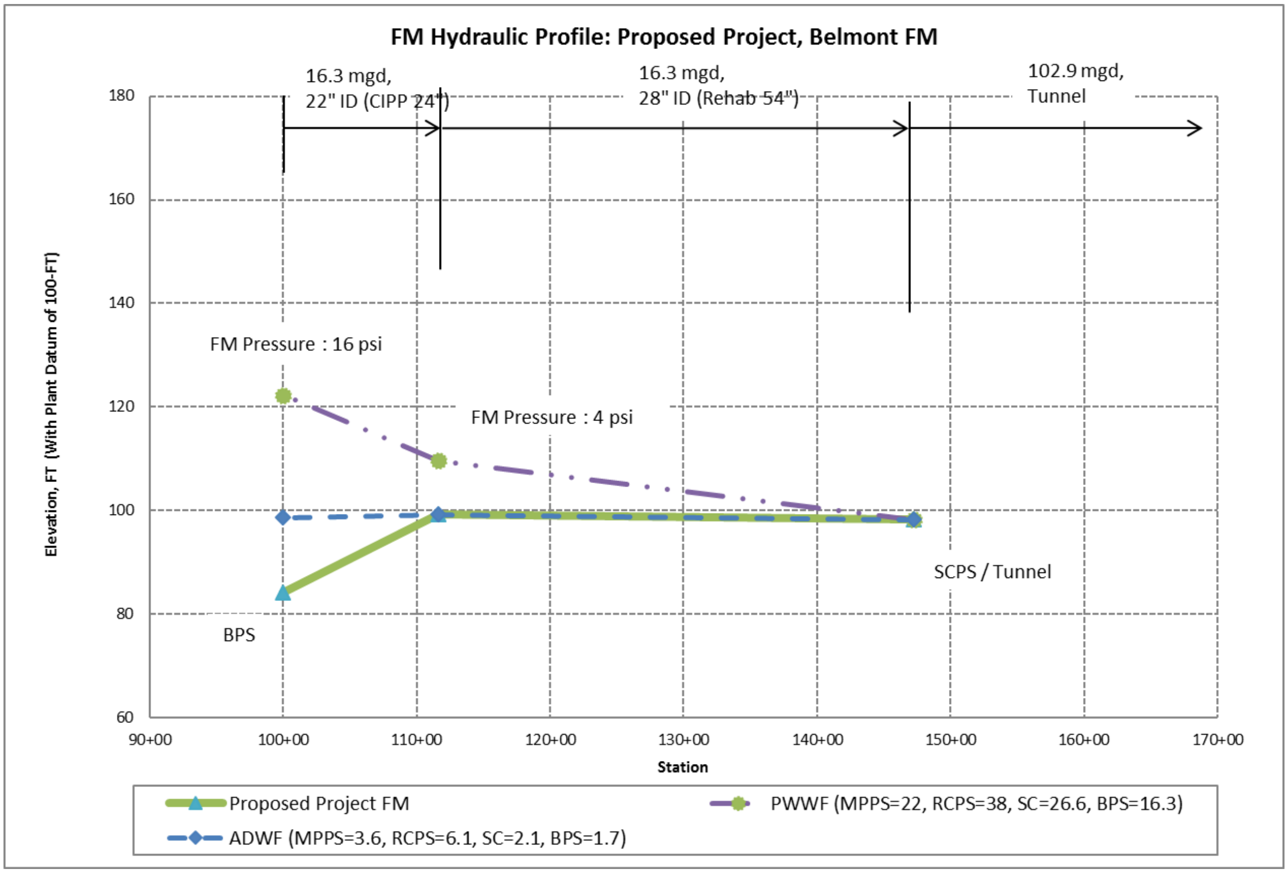

Figure 4-1. Belmont FM hydraulic profile

Notes:

- *The Proposed Project FM line represents the elevation of the force main between BPS and SCPS under the proposed Conveyance System Project. The diameter of the force main for each segment is displayed above the hydraulic profile.*
- *The flow rates included on the top of the hydraulic profile are the PWWF for each segment of force main.*
- *PWWF line represents the hydraulic grade during PWWF, i.e. the maximum expected hydraulic grade in the force main between BPS and SCPS.*
- *The ADWF line represents the hydraulic grade during ADWF, i.e. the hydraulic grade expected under normal operating conditions in the force main between BPS and SCPS.*
- *The pressure in the force main during PWWF and ADWF is equal to the hydraulic grade minus the elevation of the force main divided by 2.31 psi/ft.*

4.3.2 Pump selection

Following selection of the proposed Conveyance System Project, the hydraulic model was revised and used to develop system curves for pump selection under the proposed Conveyance System Project. Table 4-1 shows that the range of flow that the BPS needs to pump is 0.3 mgd to 16.3 mgd. Due to the limited available space within BPS, the flow range will need to be conveyed by three pumps. Figure 4-4 shows the hydraulic analysis and pump selection. Table 4-1 summarizes the results of the pump selection analysis.

Table 4-1. Summary of BPS pump selection and hydraulic conditions for the proposed Conveyance System Project

Predesign Pump Model Selection	Pump Size and HP	PDWF[1]/ PWWF	MDWF[2]	Peak Flow per Pump	Head at PWWF	Pressure[3]
Fairbanks-Morse Model 5410 dry-pit submersible pumps	Three 25- inch Impeller, 75-HP Pumps	PDWF = 3.6 mgd/ PWWF = 16.3 mgd	0.3 mgd	5.5 mgd	50 ft	22 psi

1. *Peak Dry Weather Flow (PDWF) and Peak Wet Weather Flow (PWWF) 2040 are hourly flow rates and are from the Member Agency Master Plans and CSMP.*
2. *Minimum Dry Weather Flow (MDWF) current are hourly flow rates*
3. *This is the pressure observed at the pump, the pressure in the force main will be slightly less with the difference being static head between the wet well water surface and the force main elevation.*

Pump selection should be based on a range of operating conditions that the pump will frequently experience and not on a single, worst case point. The operating conditions for pump selection shall fall within the pump's Preferred Operating Range (POR) as shown in the shaded regions within Figure 4-4. At a minimum, the ADWF, PDWF and PWWF shall be located within the POR. The POR for one pump, two pumps and three pumps in operation are shown in Figure 4-4 in red, green and blue shaded regions, respectively. As shown in Figure 4-4, the pump selection shown barely covers the ADWF and is not able to convey the minimum flow within the POR.

Pump selection will require further refinement during subsequent design. One option would be to select one small pump and two large pumps such that the smaller pump can convey the minimum and ADWF within the POR. However, under this scenario, the smaller pump has no redundancy and will be operating most often, leading to a higher likelihood of failure. The current space within the wet and dry wells are tight and likely cannot accommodate a second small pump for redundancy. Two small submersible pumps within the wet well may be an option to handle the lower flows and achieve redundancy, but will need to be explored further during subsequent design.

Alternatively, three pumps of the same size can be used to cover the PDWF and PWWF conditions. During minimum and ADWF, the pumps may operate in a fill-draw mode to accommodate the lower range of flow. With gravity pipeline storage and operation of the RLS, the effect of operating in a fill-draw mode with hydraulic surges at BPS will be minimized. Then, PDWF and PWWF can be handled by the three pumps. This will allow the three pumps to have redundancy under PDWF and under most wet weather conditions with two duty pumps and one on standby. The PWWF does not occur often.

Further analysis during predesign will be needed. The space constraints within BPS are also an important factor in pump selection. Pump selection depicted in Figure 4-4 does not account for the available space with BPS. Selection of pumps that met the flow range was the primary selection criteria during conceptual design. Figure 4-4 represents the three operational pumps at the BPS.

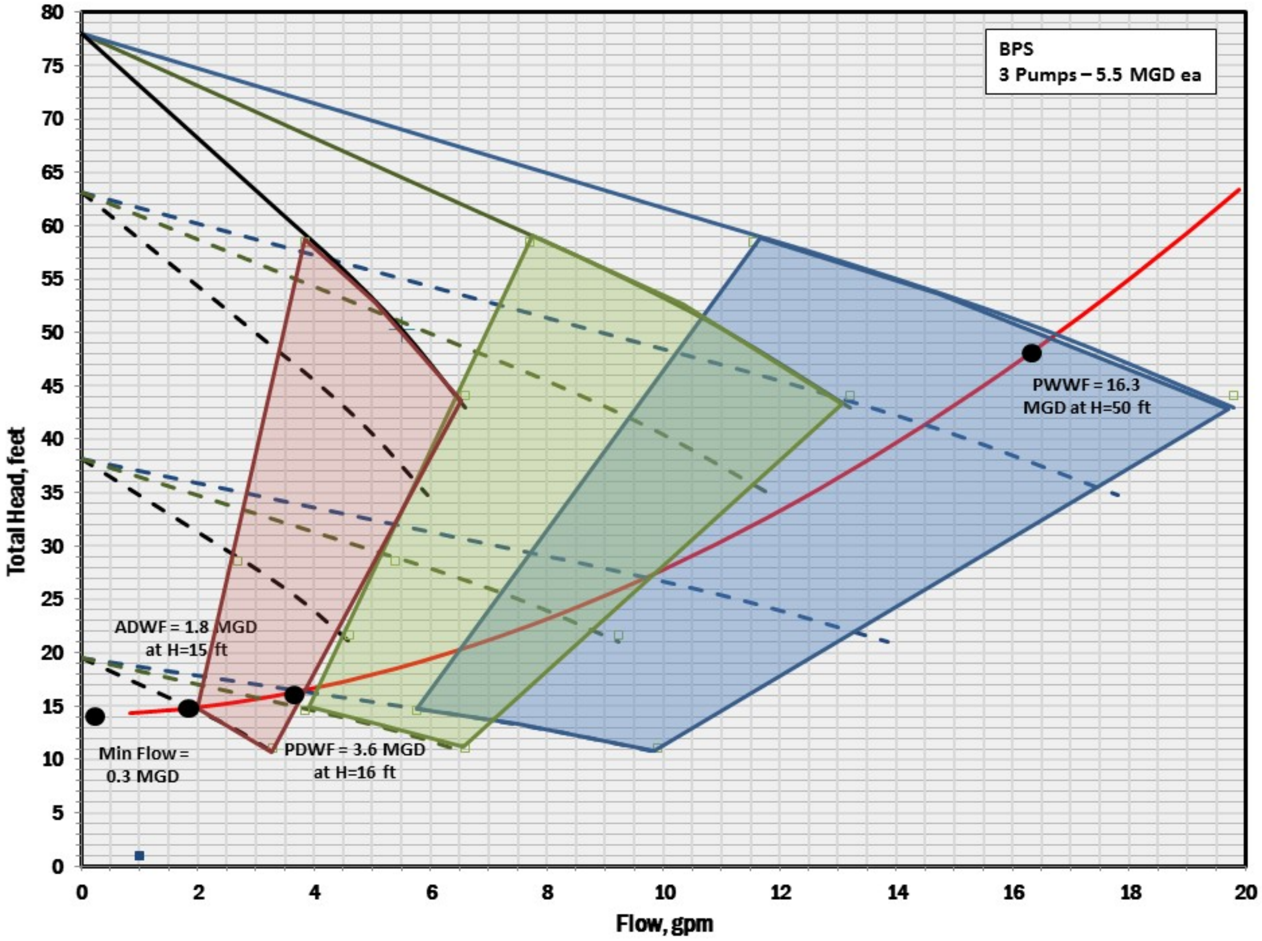

Figure 4-4. BPS system and pump curves

Notes:

- *The solid lines represent the pumps operating at 100 percent capacity with the blue line representing three pumps in operation, green is two pumps in operation and black is one pump in operation.*
- *Dashed lines represent the pumps operating at reduced speeds of 90 percent, 70 percent, and 50 percent, respectively.*
- *The shaded areas in the figure above depict the Preferred Operating Ranges (POR) for one pump, two pumps, three pump in red, green and blue, respectively.*
- *Operation within the pump's POR under normal operation conditions will extend the life of the pumps.*

4.4 Hydraulic Transient Analysis

A hydraulic transient analysis was completed in 2014 based on the refined wastewater flows and on the conveyance system consisting entirely of force main. A new hydraulic transient analysis was not completed following the selection of the proposed Conveyance System Project and will be required during subsequent design.

Section 5

Selected Project Description

This section provides an overview of the Belmont Conveyance Project and describes the pump station design elements of the recommended Belmont Conveyance Project alternative. Criteria and guidelines for updating these elements during detailed, final design are summarized below. Detailed design criteria are further discussed in TM 8.1 – Design Criteria, Guidelines, and Standards (Brown and Caldwell, 2015b; Appendix F), hereinafter referred to as TM 8.1. It is important to note that TM 8.1 was written during predesign of the 2014 force main conveyance system; therefore, some design criteria will need to be refined as part of the subsequent design of the proposed Conveyance System Project. A summary of the changes that occurred from predesign to the proposed Conveyance System Project conceptual design as it relates to TM 8.1 is provided in Appendix F.

5.1 Project Overview

The Belmont Conveyance Project includes three major components: BPS Rehabilitation, Belmont FM Rehabilitation, and SCPS Improvements. Figure 5-1 presents an overview of the entire Belmont Conveyance Project. Each component is described in more detail in the following sections.

Preliminary design documents for the Belmont Conveyance Project were developed previously and stopped in draft form in January 2015. The scope of the Belmont Conveyance Project changed significantly after the selection of the proposed Conveyance System Project. These changes are highlighted below:

- **BPS Rehabilitation.** Under the original conveyance system predesign, BPS was abandoned. Under the Belmont Conveyance Project, BPS will be rehabilitated.
- **Belmont FM Rehabilitation.** In the original conveyance system predesign, flows from the Belmont collection system would be conveyed by a new, gravity pipeline to SCPS for conveyance to the SVCW WWTP. In the Belmont Conveyance Project, the existing 24-inch force main and 54-inch force main will be rehabilitated to convey flow from BPS into the San Carlos Inlet Structure and into a gravity pipeline to the SVCW WWTP.
- **SCPS improvements.** SCPS would be rehabilitated under the original conveyance system predesign. With the selection of the proposed Conveyance System Project, SCPS will be repurposed into odor control facilities for the gravity pipeline. Flows from the San Carlos Collection System will be conveyed by gravity into the San Carlos Inlet Structure and into the gravity pipeline to the SVCW WWTP.

Design criteria and considerations for the major Belmont Conveyance Project components are discussed in Section 5.3. The expected replacement schedule for pump station equipment and a life cycle analysis is presented in Section 6. A summary of open items and the key decisions that must be made for this project as part of subsequent design of the Belmont Conveyance Project are discussed in Section 7.

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Figure 5-1. Belmont Conveyance System overview

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5.1.1 BPS Rehabilitation

The existing BPS includes the pump station building and three pumps. Currently, the BPS requires frequent hands-on maintenance. The existing equipment is at or near the end of its useful life. Despite system-wide repairs and regular maintenance, the conveyance system components like BPS need rehabilitation to provide safe and reliable operation to accommodate the future projected flows through the system.

The BPS will be rehabilitated to pump Belmont's wastewater to the new gravity pipeline. Figures 5-2 and 5-3 present the proposed improvements to the BPS, which includes the following major components:

- Replacement of the existing grinder
- Replacement of the existing three pumps and new discharge piping and valves
- Replacement of the existing electrical, instrumentation and controls equipment.
- Replacement of the standby generator
- Replacement of the HVAC system
- Installation of new odor control facilities

In addition, all internal piping, all electrical components, and all site security within the BPS will be upgraded to current SVCW standards at the time of construction.

Table 5-1 summarizes the major equipment included in the proposed BPS Rehabilitation. The equipment list and sizes are subject to change as the design is refined.

Table 5-1. BPS major equipment

Description	Facility Needs/Quantity
Wet Well	
Dry-Pit Submersible Pumps (75 HP)	3
Grinder (15 HP)	1
Odor Control	
Supply Fans (Size: TBD)	1
Exhaust Fans (Size: TBD)	1
Standby Power System	
Diesel Fuel Storage Tank (Size: TBD)	1
Diesel Fuel Day Tank (Size: TBD)	1
Standby Generator (500 kW)	1

TBD = to de determined.

The proposed BPS Rehabilitation will maintain the equipment shown in Table 5-1 and general configuration displayed in the Belmont Pump Station Record Drawings (Appendix G); however, the sizes of the equipment and additional equipment may be identified as part of the proposed BPS Rehabilitation predesign that differ than those shown on the predesign drawings.

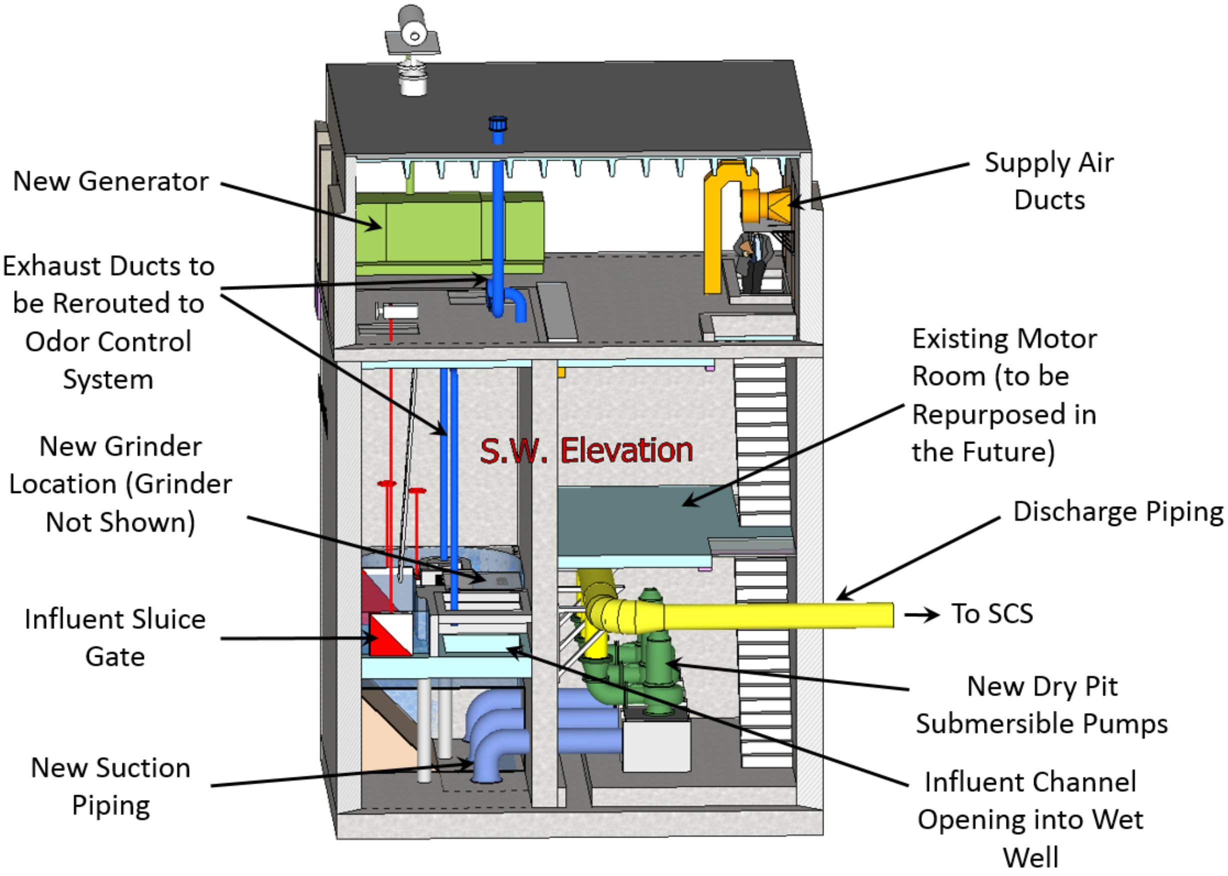

Figure 5-2. BPS Rehabilitation cross-section– view from southwest

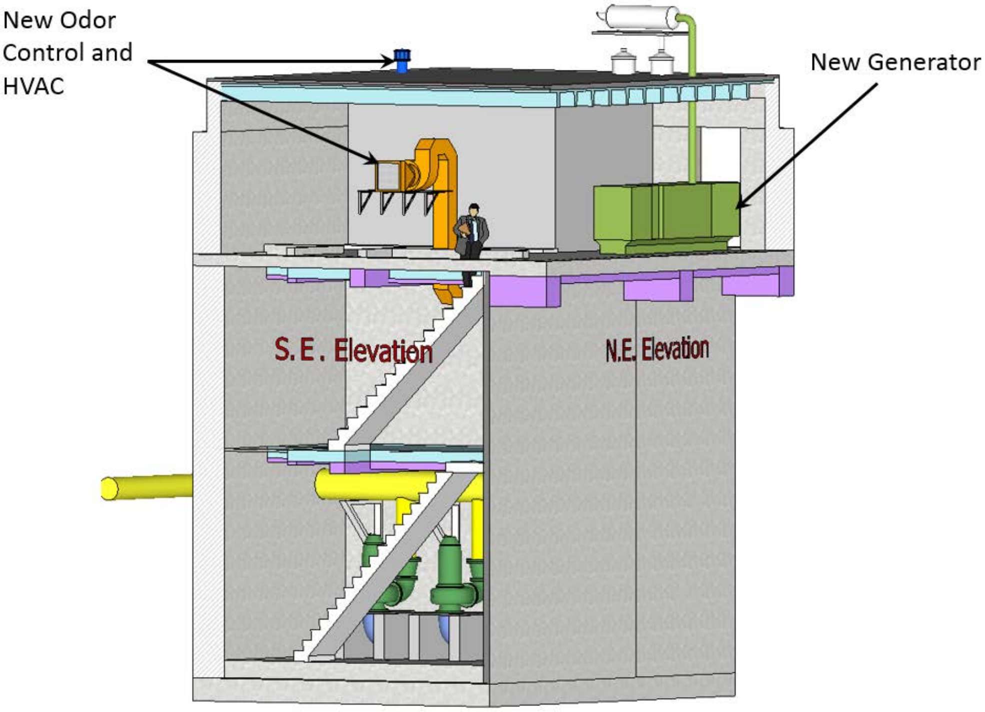

Figure 5-3. BPS Rehabilitation cross-section – view from east

5.1.2 Belmont FM Rehabilitation

Changes are needed for the Belmont system to function with the proposed gravity pipeline. These changes include extension and rehabilitation of the Belmont FM and changes to the existing 54-inch force main to improve hydraulic conditions and water quality by preventing leaks, and achieve structurally sound performance. As proposed, this portion of the 54-inch force main would only carry Belmont flows from BPS to the SCPS; this would result in an overall reduction in flows from current operations, and flows would be in the reverse direction. Figures 5-4 and 5-5 present the key locations of the Belmont FM Rehabilitation, which will include the following components:

- Rehabilitation of 1,150 lf of 24-inch diameter force main using CIPP will require some open cut construction and CIPP access pits next to BPS (Figure 5-4).
- Rehabilitation of 3,550 lf of 54-inch diameter force main using sliplining will require a sliplining insertion pit just south of Shoreway Road and an additional slipline pull pit within Caltrans right-of-way on Holly Street. Another sliplining insertion pit will be located on SCPS. (Figure 5-5)
- Installation of combination air-release/vacuum breaker valves along the rehabilitated Belmont FM where needed to control vacuum related surge conditions.

The rehabilitated 24-inch and 54-inch pipes will be used to connect the BPS to the SCPS site. The remaining portion of the 54-inch force main that is not rehabilitated will be abandoned, but may be used in the future if required.

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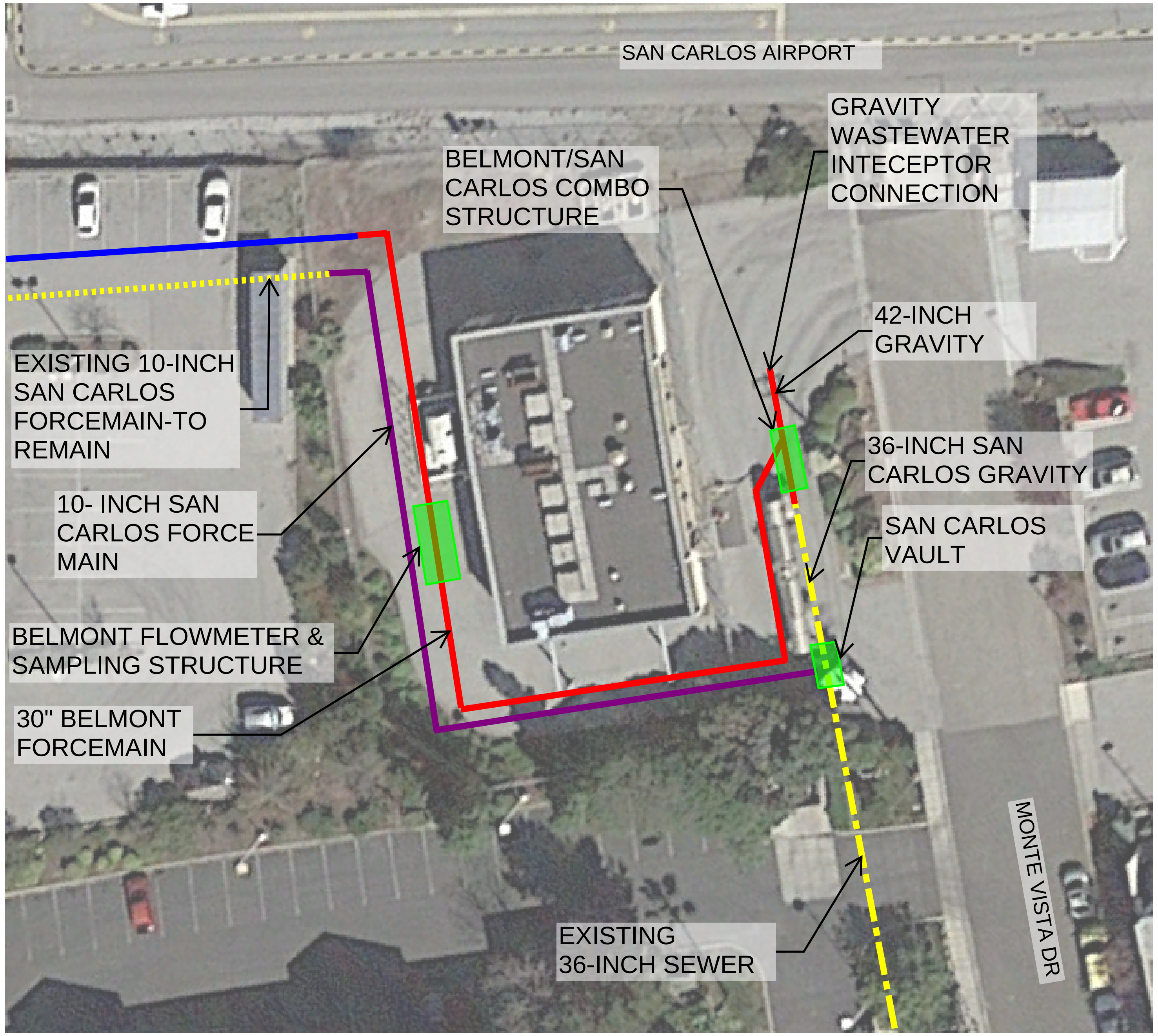
PLAN-BELMONT PUMP STATION

NOT TO SCALE



PLAN-SAN CARLOS PUMP STATION

NOT TO SCALE

LEGEND

━ · ━	EXISTING SAN CARLOS 36-INCH SEWER	🟦	OPEN CUT/BELOW GROUND DISTURBANCE AREA
┈┈┈	EXISTING 10-INCH SAN CARLOS FORCEMAIN	🟦	CIPP ACCESS PIT
━━	RELOCATED SAN CARLOS 10-INCH SS FM (OPEN CUT)	🟩	STRUCTURE
━━	SLIPLINE 54-INCH FM	🟪	SLIPLINE INSERTION PIT
━━	CIPP 24-INCH FM		
━━	OPEN CUT		

NOTE: DIMENSIONS ARE APPROXIMATE

FIGURE 5-4. BELMONT CONVEYANCE SYSTEM REHABILITATION COMPONENTS AT BPS AND SCPS

Brown AND Caldwell

P:\146000\146228 - SVCW 36-inch gravity PDR\08-Project Description\Figures\Combined Figures.pdf

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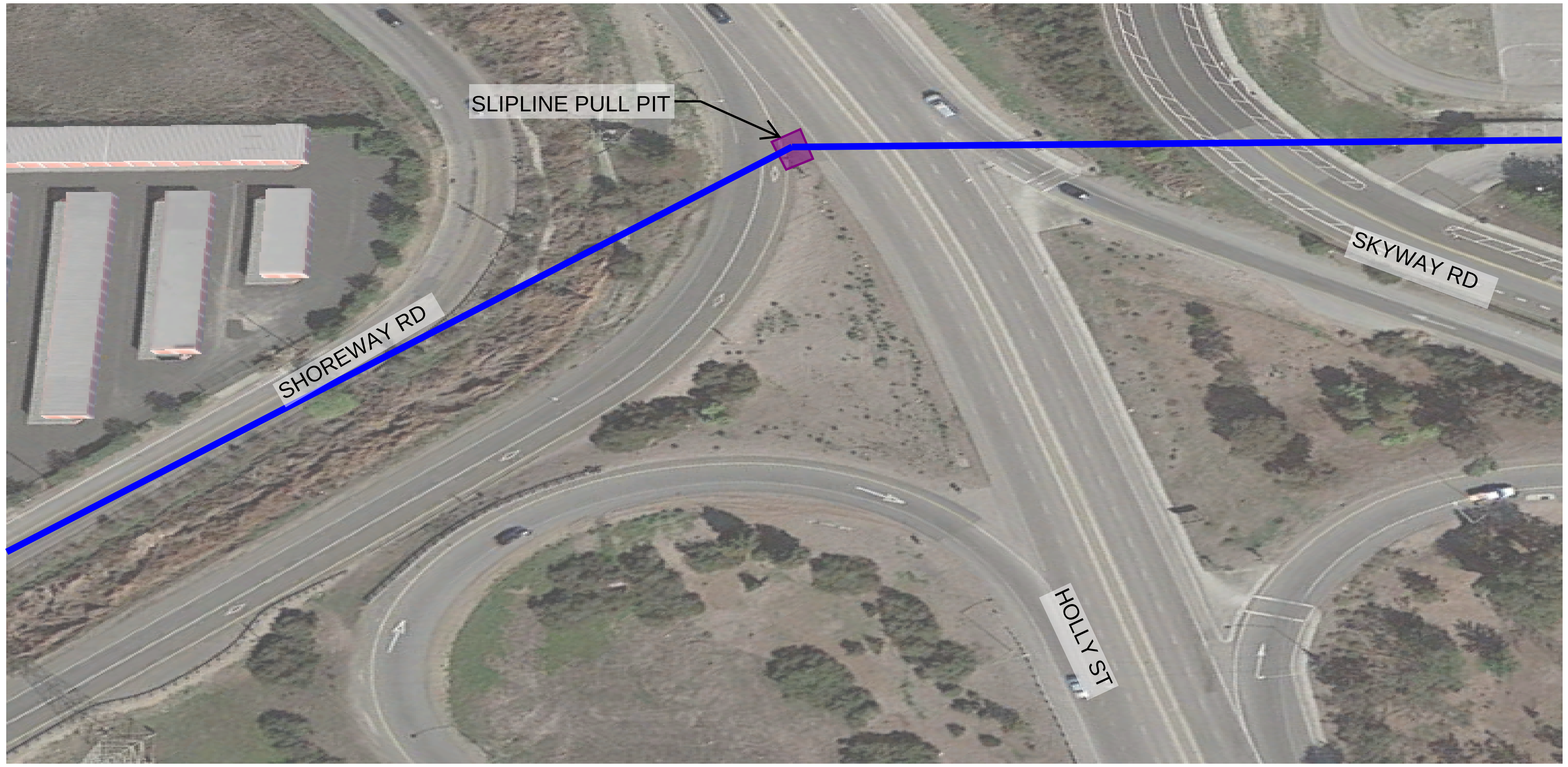
PLAN-BELMONT TEE AREA
NOT TO SCALE



PLAN-HWY 101/HOLLY ST INTERCHANGE
NOT TO SCALE

LEGEND

━	SLIPLINE 54-INCH FM
┅	EXISTING 54-INCH FM- TO BE ABANDONED
━	OPEN CUT (CIPP/SLIPLINE CONNECTION)
▨	OPEN CUT /BELOW GROUND DISTURBANCE AREA
🟪	SLIPLINE PIT
🟦	CIPP ACCESS PIT

NOTE: DIMENSIONS ARE APPROXIMATE

FIGURE 5-5. BELMONT CONVEYANCE SYSTEM REHABILITATION COMPONENTS AT REMOTE SITES

Brown AND Caldwell

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5.1.3 SCPS Improvements

The force main that currently conveys wastewater to the WWTP from SCPS will be replaced with a new gravity pipeline, thus, the SCPS will no longer be needed. The SCPS site will be decommissioned and portions of the pump station building and yard will be repurposed. Figure 5-4 presents an overview of the proposed changes for the SCPS site, which include the following major components:

- Installation of new odor control systems
- Relocation of a 10-inch influent force main on the SCPS site
- Extension of the Belmont FM to connect to the proposed gravity pipeline
- Installation of a Belmont flow meter and sampling structure
- Installation of the San Carlos Vault to combine flows from the 10-inch force main and 36-inch gravity sewer, including open channel flow meter.
- Installation of the Belmont/San Carlos Combination Structure including a trash rack and 48-inch diameter pipe at the San Carlos Inlet Structure stub-out to connect to the proposed gravity pipeline

Table 5-2 summarizes the major equipment included in the proposed SCPS Improvements Project. The equipment list and sizes are subject to change as the design is refined.

Table 5-2. SCPS major equipment

Description	Facility Needs/Quantity
Belmont Flow Meter and Sampling Structure	
Magnetic Meter (18-inch Diameter)	1
Composite Sampler	1
San Carlos Vault	
Trash Rack	1
Belmont/San Carlos Combination Structure	
Open Channel Flow Meter	1
Composite Sampler	1

The proposed SCPS Improvements will maintain the equipment shown in Table 5-2 and general configuration displayed in the SCPS Site Improvement Schematic (Appendix H). However, equipment sizes, types and quantities may change during subsequent design of the Belmont Conveyance Project that differ than those shown on the predesign drawings.

5.2 Site Layout

Figure 5-1 shows the locations of the BPS, Belmont FM and the SCPS in relation to one another.

The BPS is located on a 0.1-acre developed site on the east side of Shoreway Road in the City of Belmont. All proposed improvements to the BPS will be within the existing site and mostly within the existing pump station building. Additionally, some site improvements may be necessary to accommodate facilities located outside of the BPS building. Building these outdoor facilities at an elevation of 110 ft (NGVD29 + 100) will accommodate future sea level rise.

The Belmont FM improvements will be within Shoreway Road. Figure 5-4 and Figure 5-5 present the locations of the force main rehabilitation.

The SCPS Improvements will take place on the same property as the existing pump station. The existing site is 0.48 acres and is located on the north side of Monte Vista Drive in the City of San Carlos. The SCPS fronts on Monte Vista Drive and has two access points from Monte Vista Drive. Figure 5-4 displays the new SCPS Improvements site layout.

5.3 BPS Design Criteria

The following sections discuss design criteria specific to BPS. BPS will consist of one wet well, one dry well, a grinder, discharge piping and valves. These components are described below.

5.3.1 Influent channel and grinder

The existing 30-inch diameter approach pipe will be re-used. No modifications will be made to the approach pipe. The approach pipe discharges into a u-shaped channel, sluice gate, and grinder before dropping into the wet well as shown in Figure 5-6.

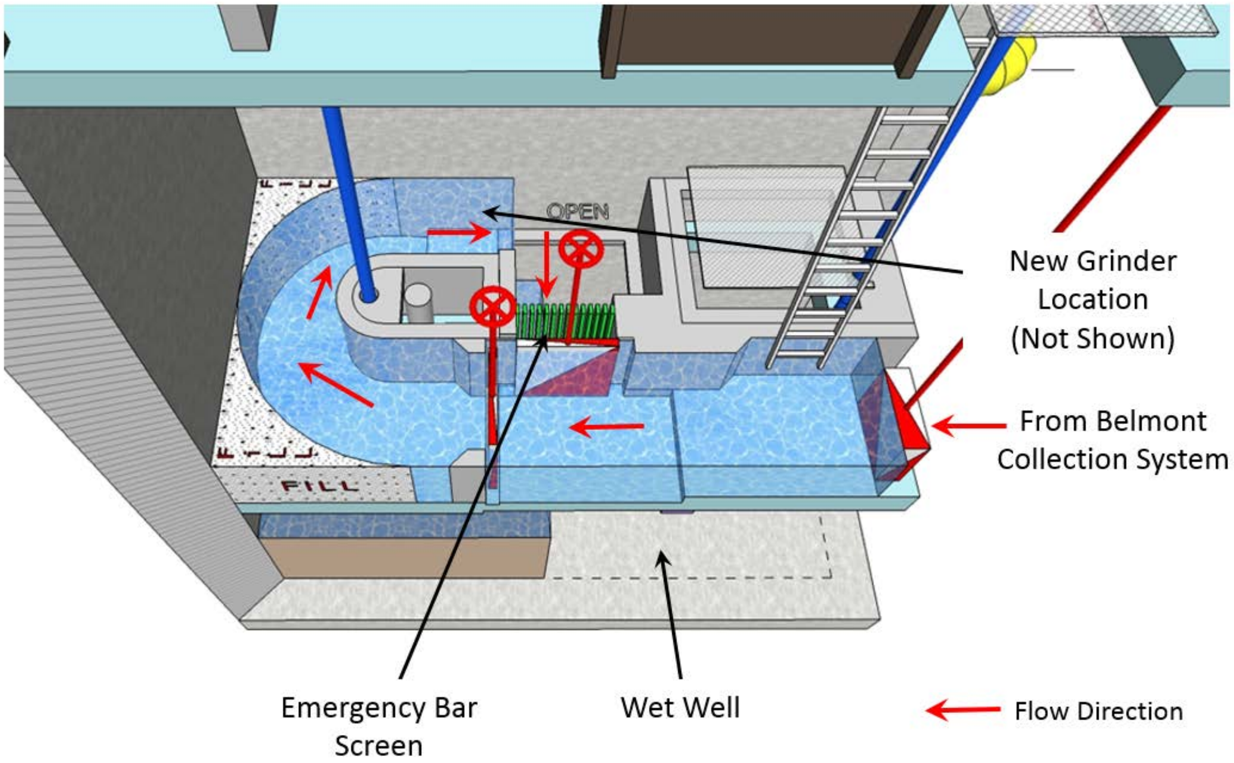


Figure 5-6. BPS influent channel

Note: Flow shown in blue for clarity of influent channel boundaries.

5.3.2 Wet and dry well design

The wet well design will remain the same. Currently, there is no safe access to the wet well; however, there is a single point of access via a stairwell available to the dry well (see Figure 5-2). There are currently no hatches situated directly above the pumps to lift the pumps to ground level. Pumps currently need to be disconnected and lifted through an offset hatch within the intermediate and ground floors. Confined space entry is required at the BPS to access the pumps as the dry well is considered a permitted confined space. Further analysis will be completed during pre-design to identify possibilities for creating better, safer access to the pumps.

Because of the configuration of the existing BPS wet well, no hydraulic improvements to conform with Hydraulic Institute (HI) standards will be completed. The record drawings for the existing BPS wet well is presented in Appendix G.

5.3.3 Pump selection

Pumps will be selected according to the requirements described in TM 8.1 (Appendix F). Table 4-1 provides a summary of the results from pump selection analyses completed after selection of the proposed Conveyance System Project. Fairbanks-Morse dry-pit submersible pumps were selected because they met the future flow conditions. Other pump manufacturers should be considered during pre-design. The pump motors will have variable frequency drives (VFDs). Pump selection also needs to consider the following items:

- Access to the pumps are limited
- Range of heads and flows during interim and final operating conditions
- Match existing pump layout and general piping configuration
- Available space limitations / constraints

The three existing pumps within the BPS may be replaced by one small pump and two larger pumps or three same-sized pumps. Pump selection will be refined during pre-design.

5.3.4 Suction piping

The existing suction piping may need to be replaced to meet HI and American National Standards Institute (ANSI) Standards for Rotodynamic Pumps for Pump Intake Design (HI/ANSI 9.8) requirements for maximum pump intake and suction pipe velocity. This will be refined during subsequent design.

5.3.5 Discharge piping and valves

The discharge piping will be sized for maximum velocities of 8 to 10 ft/sec at the maximum capacity of the pumps. Pipe will be replaced in the same place as the current pipe. A new check valve and isolation valve will be provided for the discharge piping. The swing check valves will be monitored through SCADA to ensure that they are open when the associated pump is operating.

5.3.6 Gas detection system

A gas detection system will be located within the BPS wet well, the San Carlos vault, and the combination vault to detect explosive and/or hazardous conditions. The gas detection system consists of field mounted sensing elements and monitoring assemblies to detect the lower explosive limit (LEL) of combustible gases or vapors, low and high oxygen levels, and high hydrogen sulfide (H_2S) levels.

The gas detection system alarms and alerts staff when the LEL, oxygen, or H_2S are outside of accepted ranges and may cause hazardous conditions. Alarms will be sent to SCADA. Audible and visual alarms will also be mounted outside of the building to alert staff of the hazardous conditions prior to entering the structures. However, these gas detection systems are not intended to replace personal protective equipment used as part of permitted confined space entry activities.

5.3.7 Odor control system

BPS does not have an existing odor control system. The BPS will be upgraded to include a new, on-site odor control system to treat odors from the wet well. Because of the limited space at the BPS, an activated carbon system will likely be used for odor control.

5.3.8 Standby generator

The current standby generator at the BPS will be replaced with a new generator. The new generator will be placed in the same location as the current one. Since the power demand at the BPS will be decreased, the new generator will be a smaller 500 kilowatt (kW) generator.

A permanently installed load bank will be provided for the generator. The load bank will be installed on the duct or the radiator of the generator. The load bank will be sized per manufacturer's recommendations. The load bank will be used to exercise the generator once a month, as allowed within the limits of the BPS air quality permit to operate.

The existing 2,000-gallon storage tank will be replaced. A dedicated diesel fuel storage tank with secondary containment will be provided. The fuel storage tank will be a belly tank with a 24-hour capacity at full generator load. Fuel storage tank and transfer pumps will be coordinated with the generator manufacturer during final design.

5.4 Belmont FM Design Criteria

The following section describes the two rehabilitation methods utilized for the Belmont FM Rehabilitation.

5.4.1 CIPP

Approximately 1,150 lf of the existing 24-inch diameter force main from BPS to the pipe connection near the existing 54-inch diameter force main, located near the north end of 75 Shoreway Road, would be rehabilitated through a CIPP construction method. Refer to Figure 5-5 for the location of the 24-inch diameter force main and the connection to the 54-inch diameter force main (named the "Belmont Tee"). Use of CIPP would be the preferred method of rehabilitation as the existing 24-inch does not require a change in diameter to function properly with the proposed changes to the conveyance system and only needs rehabilitation to improve the condition of the pipe.

The 24-inch diameter force main rehabilitation would require construction of three access pits (each approximately 15 ft wide by 15 ft long) along the 1,150-lf force main. The final inside diameter of the force main is anticipated to be approximately 22-inches. This segment of pipe is an average of approximately six ft in depth (as measured from ground surface to the bottom of the pipe), but is upwards of 16 ft deep near the BPS. The access pits would require excavating approximately one to two ft below the bottom of the force main; therefore, it is anticipated that CIPP Access Pit 1 would be 18 ft deep and Access Pits 2 and 3 would each be eight ft deep. Approximately 1,000 square ft of space at the surface would be needed around each access pit to support the CIPP installation and curing process but this area would not require any ground disturbance. Open cut trenching to replace an approximately 175-foot section of the 24-inch diameter force main may occur within Shoreway Road between CIPP Access Pit 1 and CIPP Access Pit 2; refer to Figure 5-4 for the location. If open cut construction is utilized, CIPP Access Pit 1 will no longer be needed.

The CIPP process installs a resin (polyester, or vinylester) impregnated liner that is pulled or inverted into position and then cured in place with hot water or steam. For this project, it is assumed that the liner would be inserted using water to help maintain a tight fit of the liner within the host pipe. The internal diameter of the existing pipe, when installed, would be reduced based on the thickness of the CIPP liner. CIPP liners typically range from 0.5 to 1.0 inches in thickness depending on the diameter, condition of the existing pipe, depth, groundwater level, and type of resin used. Of all the rehabilitation methods, CIPP lining provides the lowest profile and maintains the largest inside diameter in the host pipe.

CIPP installation requires full bypassing of the wastewater flow around the section of pipeline being rehabilitated. For the Belmont FM Rehabilitation, an existing gravity bypass into the San Carlos sanitary sewer system would be available at the intersection of Harbor Boulevard and Karen Road and would be utilized for all dry weather flow diversions. This is the current practice used by SVCW maintenance crews when access to the BPS wet well is required. In locations with high groundwater, soil grouting, groundwater draw-down, or spot repairs could be necessary prior to the insertion of the liner. Spot repairs involve excavating down to the bottom of the pipe to replace and/or repair a section of the pipe. Soil grouting and groundwater draw-down would require some drilling into the ground to either install grout or to pump down the groundwater.

A water source would be required for inserting and curing the CIPP. Styrene from the uncured resin enters the water as part of the curing process and could disrupt biological treatment at the SVCW WWTP; therefore, the curing water must be treated prior to discharging into the sewer. The treatment process would use carbon filter towers that would be installed on a flat-bed trailer.

5.4.2 Sliplining

Approximately 3,550 lf of the 54-inch force main, from the pipe connection at the Belmont Tee (located near the north end of 75 Shoreway Road) to the SCPS, would be sliplined. As previously discussed, the 54-inch force main requires rehabilitation since the purpose of the force main is being revised as part of the overall proposed gravity pipeline changes to the conveyance system. As proposed, this portion of the force main would only carry Belmont flows from BPS to the SCPS; this would result in an overall reduction in flows from current operations of the 54-inch pipe, and flows would be in the reverse direction. To accommodate the changes, the 54-inch force main must be reduced in diameter to function properly with the proposed revised hydraulics, and sliplining with a smaller diameter pipe is the preferred method for accomplishing this change. This is a trenchless rehabilitation method that would require the construction of two slipline insertion pits (each 40 ft long by 15 ft wide) and one slipline pull pit (20 ft long by 20 ft wide). The sliplined pipe would have an inside diameter of 28 inches to function within the hydraulic constraints and outside diameter of approximately 30 inches. This segment of pipe averages approximately 9.5 ft in depth, but is more than 18.5 ft deep near US-101 and Holly Street area. The insertion and pull pits would require excavating up to two ft below the bottom of the force main invert; therefore, it is anticipated that Insertion Pit 1 would be 11 ft deep, Insertion Pit 2 would be 10 ft deep, and the Pull Pit would be 14 ft deep.

Sliplining involves inserting a new liner pipeline within the existing pipeline. Continuous sliplining requires the pipe liner to be continuously fused together and inserted through an insertion pit and then grouted into place along its entire alignment. Installation requires construction of insertion pits and a staging/laydown area to field weld the joints prior to installation. A pull pit is required to assist in the pulling of the new liner pipe into the existing pipe. After the liner is installed within the pipeline, grout is used to secure the liner within the existing pipe. The lining process requires the full bypass of the sewage from the section of pipeline being rehabilitated. After lining is completed, there would be approximately 24 inches of space between the outside of the liner and the inside of the existing pipe that would be grouted. This would provide a nearly 28-inch diameter pipe.

5.4.3 Air release valves

Both segments of the force main would require the installation of air release valves. These valves would be less than five ft in height and located outside of sidewalks or out of the travel way where no sidewalks exist along Shoreway Road.

5.5 SCPS Improvements Design Criteria

The following sections describe the major equipment and structures at SCPS, which are highlighted in Figure 5-4.

5.5.1 Flow measurement

At the SCPS site, flow meters will be installed to measure flows separately from the City of Belmont and the City of San Carlos. The flows meters will be used by SVCW for billing purposes. The Belmont flow will be measured by a magnetic meter installed above ground on the Belmont FM. The San Carlos flow will be measured using an open channel flow meter installed in the new San Carlos vault. The flow meter instrumentation and related SCADA controls will be stored in temporary buildings along with the sampling equipment until the SCPS is decommissioned to allow for the placement of the equipment and controls into the existing SCPS building.

Currently, at the BPS site, there is a vault with a flow meter. This flow meter will be abandoned and flows will be measured at the SCPS site. The flow meter will be removed and a spool piece installed and the access to the pipe will likely be used for the CIPP installation for that portion of the force main.

5.5.2 Composite sampling

Separate sampling points will be installed for the Belmont and San Carlos flows. The samplers will consist of a complete assembly consisting of the sampling equipment, a refrigerator, a signal interface converter, signal and power wiring, appurtenances, and controls. The sampler will be capable of collecting sequential and composite samples at equal flow volume intervals measured by an external flow meter (flow pacing) or at timed intervals (time pacing). These facilities will likely be housed in small temporary buildings until the SCPS can be decommissioned to the point where the sampling facilities and electronics for the flow metering instrumentation can be housed in separate vaults and structures outside of the existing SCPS building.

5.5.3 San Carlos structures

The SCPS site will have three structures on-site, named the Belmont Flow Meter and Sampling Structure, San Carlos Vault and the Belmont/San Carlos Combination Structure. Figure 5-4 shows the location of the new proposed vaults. Appendix H includes schematic drawings (plans and sections) of the new SCPS structures described below.

Belmont Flow Meter and Sampling Structure. The Belmont Flow Meter and Sampling Structure will house a magnetic flow meter and composite sampler as discussed in the previous sections.

San Carlos Vault. The relocated 10-inch force main from a City of San Carlos lift station and the existing 36-inch sewer will be routed to the San Carlos Vault. The San Carlos Vault will contain an open channel flow meter. The existing 36-inch sewer will exit the San Carlos Vault.

Belmont/San Carlos Combination Structure. The 30-inch Belmont FM and 36-inch San Carlos gravity sewer will enter an irregular-pentagon shaped structure to combine the flows and provide one connection point to the proposed gravity pipeline. A trash rack will be installed in the combination structure on the inlet for the San Carlos flows to allow for the removal of large debris. A new approximately 25-foot long, 42-inch diameter gravity pipe, will connect the combination structure to the proposed gravity pipeline at the drop structure stub-out.

5.5.4 Odor control system

The existing SCPS building will remain and house the new San Carlos Odor Control Facility for the gravity pipeline, which is part of another project and discussed in a separate project planning report. Foul air (FA) ducting with a diameter of 24 inches will be installed between the new Belmont Flow Meter and Sampling Structure, San Carlos Vault and the Belmont/San Carlos Combination Structure to remove FA when the structures are entered.

5.6 Energy

The energy changes and opportunities for energy savings are discussed below.

BPS. Currently, the BPS has a power consumption of approximately 161,500 kWh annually, or on average, 13,500 kWh per month. The proposed modifications to the pump station discussed in the previous sections decrease BPS electrical demands. Estimated electrical demands following the rehabilitation of the BPS are approximately 100,400 kWh annually. Most of the decrease in power demand is because a much lower pressure is required for the Belmont flows to be pumped to the gravity pipeline than what is required to pump Belmont flows to the WWTP.

SCPS. The SCPS has a power consumption of approximately 316,700 kWh annually, or on average 26,400 kWh per month. The repurposing of the SCPS site will decrease electrical demands. Estimated electrical demands for the repurposed SCPS are approximately 130,700 kWh annually, which includes the San Carlos Odor Facility demands. The existing SCPS will no longer be an active pump station but will primarily be used to house the San Carlos Odor Control Facilities to contain and treat odors venting from the San Carlos Inlet Structure and the miscellaneous power demands for the flow metering and sampling equipment; hence, the large decrease in projected energy consumption. The standby generator for the SCPS will be replaced with a smaller unit within the existing SCPS building to power the new San Carlos Odor Control Facilities, but this will occur as part of the San Carlos Odor Facility Project, which is a separate project from the Belmont Conveyance Project.

Table 5-3. Annual power consumption

Pump Station	Existing[1] (kWh)	Proposed[2] (kWh)	Difference (kWh)
San Carlos	316,700	130,700	-186,000
BPS	161,500	100,400	-61,100

1. *Existing kWh is based on 2015 actual PG&E billings.*
2. *Projected kWh is based on 2015 average annual flow calculated by multiplying 694.44 to convert Gallons Per Minute (GPM) to Millions of Gallons per Day (mgd). 1 mgd = 694.44 GPM.*

Where possible, energy efficient equipment will be incorporated into the design of the BPS and SCPS repurposing, including:

- VFDs for all pumps
- LED light fixtures
- Premium efficiency motors

Additional energy efficient measures for operations and construction will explored further during predesign.

5.7 Surge Control System

At this time, a surge analysis has not been completed for the proposed Conveyance System Project. Combination air-release/vacuum breaker valves will most likely be used for hydraulic transient control in the rehabilitated force main. Use of this type of vacuum relief valving on long flat force mains is typical to avoid negative pressure surges that could result in the collapse of the HDPE and CIPP force main pipe materials expected to be used for rehabilitation. A complete surge analysis should be completed during design.

5.8 Additional Design Considerations

The following considerations will be included in the final design and construction of BPS, Belmont FM Rehabilitation and SCPS Improvements.

5.8.1 Civil

No major new facilities will be constructed at the BPS. The existing pump station will remain intact. All equipment will be replaced with newer equipment that meets SVCW standards.

At the SCPS site, three structures will be constructed along with ancillary yard piping for sampling equipment and flow metering. The following objectives will be included in the San Carlos civil site improvements:

1. Provide vehicle and pedestrian access to new and upgraded facilities and structures
2. Provide connections to existing and new force mains
3. As part of the civil design, the following will be provided during design:
    a. Utility coordination
    b. Driveway layout/traffic access
    c. Survey control
    d. Site grading
    e. Drainage
    f. Site security/access

5.8.2 Geotechnical

A TM for the Pre-Design Geotechnical Interpretive Report (GIR) was completed by DCM Consulting, Inc. for SCPS (DCM Consulting, Inc., 2013). The GIR is based on project information provided by Brown and Caldwell and on a Predesign Geotechnical Data Report (GDR) completed by Jacobs Associates on October 22, 2013 (Jacobs Associates, 2013). The following geotechnical information will be considered during the final design. Additional geotechnical investigations may be needed.

5.8.2.1 Existing conditions

All predesign test borings for the Belmont Conveyance Project encountered artificial fill. The composition and consistency of artificial fills is highly variable and can range from non-cohesive sands and gravels to cohesive clays with oversize natural and manmade materials. Typically, in this Bay margin area, the artificial fills are underlain by Young Bay Mud (YBM), characterized by extremely high water content, low dry density, low shear strength, and high compressibility. The YBM is underlain by much stiffer (and older) alluvium referred to as Old Bay Clay, characterized by lower water content, higher dry density, higher shear strength and lower compressibility.

5.8.2.2 Excavations

CIPP and pull pit excavations will vary in depth from 8 to 18 ft. All Belmont Conveyance Project excavations will require vertical shoring. All Belmont Conveyance Project excavations can be completed by appropriately sized conventional excavation equipment. For purposes of shoring design, groundwater should be assumed to be at the ground surface. All Belmont Conveyance Project excavations must be fully shored and supported with "watertight" shoring such as internally braced interlocking sheet piles. Any gaps in shoring, such as at pipeline penetrations, must be fully sealed to maintain excavation "water tightness." Jet grouting is the preferred method for sealing shoring gaps. With a "watertight" shoring system, external dewatering should not be required. External dewatering is not advisable as it can cause subsidence of soft ground and settlement of nearby pipelines, utilities, and structures. Internal dewatering can be kept to a minimum by establishing adequate toe embedment of sheet piles to form a cutoff to groundwater inflows. The minimum toe embedment for sheet piles in the project soil and groundwater conditions is 15 ft below the base of excavation.

5.8.2.3 Pipelines

Pipelines will be constructed at various elevations and underlain by a variety of soil conditions from fill to soft YBM to stiff Old Bay Clay. The force mains should be underlain by a minimum of 12 inches of foundation rock (3/4-inch by 1 ½-inch crushed rock) wrapped in non-woven geotextile filter fabric. Foundation rock is to be compacted in place by a minimum of three passes of a vibraplate compactor. Pipeline embedment material should extend from foundation rock to 12 inches over the top of the pipeline. Pipe embedment material should consist of Class 2 aggregate base rock compacted to a minimum of 90 percent relative compaction. Trench backfill should also consist of Class 2 aggregate base rock compacted to 90 percent relative compaction, except for SCPS where shallow and intermediate depth pipelines (e.g., at valve vault and flow meter structures) will be underlain by YBM. At all locations where pipelines are underlain by YBM, trench backfill must consist of lightweight aggregate with a maximum saturated surface dry unit weight of 60 pounds per cubic foot. As an alternative to lightweight backfill, all YBM could be removed from below the pipeline and backfilled with foundation rock wrapped in nonwoven geotextile fabric.

The pipelines should be designed to accommodate up to one inch of differential movement at the interface of the pump structure and pipeline.

5.8.2.4 Pavement

The asphalt pavement section should consist of a minimum of three inches of asphaltic concrete over 12 inches of Class 2 aggregate base rock. The pavement subgrade soil must be scarified to a depth of eight inches, moisture conditioned to near optimum moisture content and compacted to a minimum of 95 percent relative compaction per ASTM D1557. Use of lime treated base may be considered during final design where soft soils are present in paved areas.

Asphalt pavement section replacement in City streets must match existing but in no case should be less than three inches of asphaltic concrete over 12 inches of aggregate base rock (compacted as described above). Final pavement sections and required traffic index ratings should be determined and reviewed by the Cities of Belmont and San Carlos as part of the final design.

5.8.3 Corrosion mitigation

BC's Subconsultant, V&A Consulting Engineers, Inc., performed a soil corrosivity investigation for corrosion control of the buried metallic piping at SCPS (V&A Consulting Engineers, Inc., 2014). The objectives of the investigation were to perform field soil resistivity testing, review existing corrosion data, perform chemical analysis of selected soil samples, and provide corrosion control recommendations for the buried yard piping and concrete structures at SCPS.

Based on the average field soil resistivity data, the soil is highly corrosive to buried metallic piping. The soils are located in areas of high chlorides. The area east of US-101 is located on land reclaimed from the bay and contains bay mud and high chloride (salty) soils. The soil analysis confirmed that the soils at SCPS are highly corrosive to both buried steel and reinforced concrete.

The following recommendations are for corrosion control:

- **Corrosion control measures for buried metallic structures.** Recommendations include applying a bonded dielectric coating, electrically isolating the piping, installing imposed current cathodic protection, and bonding non-welded, non-insulating pipe joints.
- **Application of coatings for buried applications.** Buried infrastructure will be coated with 100 percent solids polyurethane and fusion bonded epoxy and taped wrapped.
  - **Cement mortar coated pipelines.** These pipelines will have cementitious mortar coatings on steel appurtenances, mortar coating on exposed steel to a minimum of two inches, electrical isolation of yard piping, installation of impressed current cathodic protection, and bonded non-welded, non-insulating pipe joints.
  - **Buried concrete structures.** Buried concrete structures will include cast-in-place concrete structures with a minimum of three inches of concrete over rebar, a minimum of two inches over rebar for precast piles (if used), water-to-cement ratios of less than 0.4, application of applicable corrosion inhibitors, and adhere to specific concrete, sand, and water.
- **Corrosion control measures for rehabilitated pipe.** The rehabilitated force main will utilize pipe materials such as CIPP and HDPE that are impervious to potential corrosion identified during the field work. Special metallic connections, fittings, etc. will all be Type 316 stainless steel.

Regarding corrosion mitigation on structure and pipeline interiors due to H_2S gas exposure from the sewage, the following mitigation measures are recommended:

- **Corrosion control measures for concrete structures.** Recommendations include applying a coating to all interior surfaces not typically submerged in wastewater. All metal components exposed to sewage will be Type 316 stainless steel. In addition, odor control measures will be used to reduce the buildup H_2S gas within the wet wells.
- **Piping.** Where possible, piping comprised of corrosion-resistant material shall be used. If not feasible, coatings and other means of corrosion protection shall be implemented.

A corrosivity investigation was not performed at the BPS. All BPS Rehabilitation is occurring within the existing structure; therefore, soil corrosivity is not a concern at the BPS.

5.8.4 Safety issues

The BPS property will be surrounded by a new fence and gated access to prevent unauthorized personnel from entering the property. SVCW will decide the property limit of the fence during the detailed design phase. The fence surrounding the SCPS will remain since all structures are located within the existing fence line.

O&M staff will follow all safety protocols and procedures established by SVCW's safety program. SVCW will identify opportunities to improve site safety that should be addressed as part of the final design at the rehabilitated BPS and SCPS sites.

5.8.5 Property acquisition needs

No permanent property acquisition is required for the Belmont Conveyance Project. All construction on both the BPS and SCPS sites will be on the same property as the existing pump stations.

Significant temporary property acquisition will be needed for staging areas along the Belmont Conveyance Project. These areas are identified in Section 5.9.5.2.

5.8.6 Operational plan

The BPS will have three pumps. The pumps will consist of two larger and one smaller pump, or three pumps sized the same. Final pump selection for the BPS will be completed during detailed design. When flows are below the ADWF, the pumps will operate in a fill and draw mode, where the wet well will operate between pump on and off set points.

5.8.7 Permits required for project implementation (federal, state, regional, local)

The following permits and approvals are anticipated to be required for construction of the improvements to the BPS and SCPS. The following list is not inclusive of all permits that will be required:

- California Department of Transportation (Caltrans) – Encroachment Permit, Easement
- City of Belmont – Street Excavation and Encroachment Permit, Traffic Control and Shoreway Road temporary closure, Permanent and Temporary Easements. Coordination with Public Works related to use of the gravity bypass to the Industrial Road trunk sewer.
- City of San Carlos - Street Excavation and Encroachment Permit, Permanent and Temporary Easements, and Traffic Control Monte Vista Drive temporary closure. Coordination with Public Works related to use of the gravity bypass to the Industrial Road trunk sewer.
- City of Redwood City – Coordination is needed because some work may occur in the City of Redwood City
- FAA – Work on the SCPS site and the Belmont FM in the area of FAA influence will require FAA review and approval.
- San Francisco Bay Conservation and Development Commission (BCDC) – Likely a permit requirement for protection and maintaining temporary access to the existing shoreline trails adjacent to the BPS and the force main rehabilitation access pits.
- Bay Area Air Quality Management District – Authority to Construct

5.8.8 Site security

Currently, there are two access point to the SCPS and security fencing. The BPS currently has no security fencing. New fencing is proposed as part of the BPS Rehabilitation. SVCW will determine the property limits of the new fencing at BPS.

5.8.9 Structural and architectural

Dead loads will consist of the weight of the structure and all equipment of a permanent or semi-permanent nature including but not limited to pumps, cranes, and HVAC equipment. A superimposed dead load of 20 pounds per square foot (psf) will be included in the design of floors and roof structures to account for HVAC ductwork, piping, electrical wiring and lighting. Partition loading allowance will be computed on the basis of materials used.

Architectural criteria will be incorporated as part of the final design with the intent to repurpose existing buildings and minimize changes to the existing structures while providing seismic upgrades where needed. The Cities of Belmont and San Carlos will be advised about potential structure changes during final design.

5.8.10 Electrical

The existing power supply for the BPS and SCPS site will remain. Because peak electrical demands will decrease for both sites as a result of the rehabilitation of the BPS and repurposing of the SCPS, the existing PG&E service does not need to be upgraded.

The BPS motor control center (MCC) will be replaced with a new MCC to meet SVCW standards. The current pump station has a switchgear, which will be replaced with a switchboard. Some electrical upgrades may be required at the SCPS site (e.g. new circuits to proposed flow meters). Required electrical upgrades at the SCPS will be determined during detailed design.

5.8.11 Lighting

Temporary lighting during construction will be provided. Night lighting during construction will average 25-foot-candles and in accordance with SVCW minimum safe night illumination standards.

The BPS and SCPS site will likely use LED lights and illuminate to a level equivalent to the existing lighting for permanent lighting fixtures. The lights will be directed downward and oriented so that lights will not directly be visible from nearby residences and businesses, or located on the sides of the buildings away from nearby residents and businesses, to minimize light and glare effects where it is practical to do so.

5.8.12 Instrumentation and controls/SCADA

The existing control systems will be replaced in their entirety with new equipment to match SVCW's Automation Standards. The pump station will be remotely monitored and controlled from the SCADA human machine interface (HMI) work station at the WWTP.

Redundancy will be provided for some critical instrumentation (i.e., dual wet well level control). Additional requirements for redundant instruments are included in SVCW's "Level Instrumentation Configuration for Pump Station Wet Wells" document.

The requirements for interfacing packaged equipment to the pump station control system including implementation of programmable logic controllers (PLCs) and the SCADA HMI monitoring and control requirements will need to be evaluated during final design.

Automation strategies will be developed during subsequent design. The automation strategies describe the operation of the major processes at the pump stations including pump control, flow metering, odor control, standby power supply, and surge control.

Automation strategy development will include the following tasks:

- Development of control narratives that describe the major process systems at the pump stations.
- Development of process and instrumentation diagrams (P&IDs) including SVCW's standard equipment, valving, and instrumentation conventions.

SVCW's automation standards are currently being revised; therefore, the final designs will incorporate the new automation standards.

5.8.13 Interim operations, bypass requirements

Conveyance system improvements will be implemented over several years as discussed. Sequencing and interproject coordination are further discussed in Section 5.9.

5.8.14 Stakeholders

Close coordination with the Cities of Belmont and San Carlos will be required to identify impacts of planned developments, construction and zoning changes. Currently, near the BPS there is a drainage channel and the Bay Access Walking Trail. Jameco Electronics and Nikon. are also in close proximity, along with other businesses that use Shoreway Road for access. Near the SCPS site there are various restaurants, hotels and the San Carlos airport.

5.8.15 Environmental impacts and mitigations

Environmental impacts and mitigation measures were identified by the proposed Conveyance System Project Draft EIR (SVCW, 2016). A list of the major significant impacts related to the Belmont Conveyance Project and a summary of the proposed mitigation measures extracted from the Draft EIR are presented in Table 5-4. For the sake of completeness, the entire text has been copied for each relevant impact and mitigation measure, although some of the description may not be specifically relevant to the Belmont Conveyance Project.

Table 5-4. Belmont Conveyance Project environmental impacts and mitigations

Impact	Mitigation Measures
AIR-1: The proposed Project construction emissions would exceed the average daily threshold of 54 pounds per day for NO_x for calendar year 2018 which is a significant impact.	The construction contractor shall implement the following measures at the Project sites: • Ensure that all construction equipment (including generators) larger than 25 horsepower (HP) and used at the Project site for more than two work days meet, at a minimum, U.S. EPA Tier 2 engine emission standards; • Ensure that all stationary equipment larger than 25 HP (e.g., generators and hydraulic power packs) meet California Air Resources Board's (CARB's) most recent certification standard for off-road heavy duty diesel engines; • Portable diesel-powered equipment (including generators) larger than 25 HP and used at the project site for more than two work days meet, at a minimum, U.S. EPA Tier 3 engine emission standards for NOx; • Portable diesel-powered equipment used at the RCPS construction sites for more than two days shall include diesel particulate matter control devices in the form of CARB currently Verified Diesel Emission Control Strategies (VDECS); • All exposed surfaces shall be watered two times per day, or as necessary to control dust; • All haul trucks transporting soil, sand, or other loose material off-site shall be covered; • All visible mud or dirt tracked-out onto adjacent public roads shall be removed using wet power vacuum street sweepers at least once per day. The use of dry power sweeping shall be prohibited; • All vehicle speeds on unpaved roads shall be limited to 15 miles per hour; • All paving shall be completed as soon as possible after pipeline replacement work is finished; • Idling times shall be minimized either by shutting equipment off when not in use or reducing the maximum idling time to five (5) minutes (as required by the California airborne toxics control measure Title 13, Section 2485 of California Code of Regulations (CCR)). Clear signage shall be provided for construction workers at all access points; • All construction equipment shall be maintained and properly tuned in accordance with the manufacturer's specifications. All equipment shall be checked by a certified mechanic and determined to be running in proper condition prior to operation; and • Post a publicly visible sign with the telephone number and person to contact regarding dust complaints. This person shall respond and take corrective action within 48 hours. The BAAQMD's phone number shall also be visible to ensure compliance with applicable regulations.

Table 5-4. Belmont Conveyance Project environmental impacts and mitigations

Impact	Mitigation Measures
Impact BIO-8: Project construction activities in the Project footprint for the BPS Improvements have the potential to result in direct impacts or indirect disturbance to special-status nesting birds and other native nesting birds protected by the MBTA and CFGC. Construction could directly destroy active nests or cause disturbance that results in nest abandonment.	MM BIO-4 (applicable to Impact BIO-10): Potential significant impacts to nesting special-status and other native nesting birds will be mitigated through avoiding disturbance to active nests. Initiation of construction activities during the avian nesting season (February 1 through August 31) will be avoided to the extent feasible. For areas where direct impacts to vegetation will occur, vegetation removal will be conducted outside of the nesting season to avoid potential delays in construction schedule due to nesting activity, as is feasible. Additionally, if water is present in the ornamental ponds prior to construction and it is necessary to drain one or both ponds, the ornamental ponds will be drained during the non-breeding season (i.e., they will be drained between September 1 and January 31). If construction initiation and/or ornamental pond draining during the nesting season cannot be avoided, pre-construction nesting bird surveys will be conducted within 14 days of initial ground disturbance or water/vegetation removal to avoid disturbance to active nests, eggs, and/or young of nesting birds. Surveys can be used to detect the nests of special-status as well as non-special-status birds. Surveys will encompass the entire construction area and the surrounding 500 ft. An exclusion zone where no construction would be allowed will be established around any active nests of any avian species found in the Study Area until a qualified biologist has determined that all young have fledged and are independent of the nest. Suggested exclusion zone distances differ depending on species, location, and placement of nest, and will be at the discretion of the biologist and, if necessary, USFWS and CDFW. These surveys would remain valid as long as construction activity is consistently occurring in a given area and will be completed again if there is a lapse in construction activities of more than 14 consecutive days during the breeding bird season.
Impact BIO-9: Project construction activities in the Project footprint for the SCPS Repurposing Project have the potential to result in direct impacts or indirect disturbance to native nesting birds protected by the MBTA and CFGC. Construction could directly destroy active nests or cause disturbance that results in nest abandonment.	Implementation of mitigation measure MM BIO-4 will reduce this potential impact to a level that is less than significant.
Impact BIO-16: Construction activities adjacent to northern coastal marsh and unvegetated waters adjacent to the BPS may result in unintentional fill or discharge into wetlands or non-wetland waters	MM BIO 5 (Applicable to Impact BIO-16): Prior to ground disturbing activities, flagging of sensitive habitats adjacent to Project construction areas and silt fencing shall be installed with oversight from a qualified biologist in the areas adjacent to wetlands or non-wetland waters. It should be noted that this fencing can be the same as the wildlife exclusion fencing described in MM BIO-1.1. MM BIO-1.1: Prior to ground disturbing activities adjacent to potential SMHM and SMWS habitat, exclusion barriers and/or fencing shall be installed to exclude individuals of these species from areas of active construction. The design of the exclusion barriers and fencing will be approved by a qualified biologist and shall be installed in the presence of a qualified biological monitor. The fence will be made of a material that does not allow SMHM or SMWS to pass through, and the bottom will be buried to a depth of a minimum of four (4) inches so that these species cannot crawl under the fence. All support for the exclusion fencing will be placed on the inside of the Project footprint. Additionally, it is not anticipated that removal of marsh or associated ruderal vegetation will be necessary for the proposed Project, but in the event removal of potential SMHM or SMWS habitat is necessary, it would be completed using only hand tools and in the presence of a biological monitor.
Impact CUL-2: Construction activities associated with the proposed Project could disturb unknown buried archaeological resources.	MM CUL-2: In the event cultural resources are encountered during construction, work shall halt and the SVCW project manager shall be notified. • All construction activity within 50 ft (15 meters) of the find/feature/site will cease immediately. • If human bones are found, the appropriate County authority (Coroner) and the SVCW project manager shall be notified immediately. • In the event that Native American human remains or funerary objects are discovered, the provisions of the California Health and Safety Code shall be followed. Section 7050.5(b) of the California Health and Safety Code states: *In the event of discovery or recognition of any human remains in any location other than a dedicated cemetery, there shall be no further excavation or disturbance of the site or any nearby area reasonably suspected to overlie adjacent remains until the coroner of the county in which the human remains are discovered has determined, in accordance with Chapter 10 of Part 3 of Division 2 of Title 3 of the Government Code, that the*

Table 5-4. Belmont Conveyance Project environmental impacts and mitigations

Impact	Mitigation Measures
	remains are not subject to the provisions of Section 27492 of the Government Code or any other related provisions of law concerning investigation of the circumstances, manner and cause of death, and the recommendations concerning treatment and disposition of the human remains have been made to the person responsible for the excavation, or to his or her authorized representative, in the manner provided in Section 5097.98 of the Public Resources Code.
Impact GEO-1: The soil at the Project site is highly corrosive to buried steel and concrete. Therefore, buried reinforced concrete structure would require corrosion protection to reduce the impact to less than significant.	MM GEO 1: The following measures or equivalent measures are recommended for corrosion control and are proposed as part of the Project for the steel and concrete portions of the Project that are buried or are in direct contact with the soil. • Buried reinforced concrete structures should be constructed of durable concrete such as described in ACI Standards 201.2R and 222R. • The water/cement ratio should not exceed 0.45. • The concrete cover applied over all steel reinforcement bars should generally be a minimum of two (2) inches thick. • All concrete used in the area would be a mix of 50% Type II and 50% Type V cement. • Sand and water used in concrete mixtures should contain a maximum of 100 ppm of water-soluble chloride ions and water-soluble sulfate ions and have a pH in the range of 6.5 to 8.0. Water used in concrete mixtures should be potable water.

Impact HAZ-1: Construction of the proposed Project could expose construction workers to risks from hazardous materials contamination or from the storage, use and/or disposal of hazardous materials.	MM HAZ-1.1: Prior to initiating earthwork activities, sampling and laboratory analyses should be conducted at planned earthwork locations where spill incidents appear most likely to have impacted soil and/or groundwater, including at the BPS site, the northerly portion of the planned gravity pipeline alignment, and the northeastern portion of the SCPS site. This shall be done in order to establish specific,appropriate site management protocols, including handling and disposal alternatives for contaminated materials and health and safety protocols.
	MM HAZ-1.2: This measure shall be implemented before and during construction of the gravity pipeline and pump stations, as well as any demolition.
	• A Site Management Plan (SMP) and Health Safety Plan (HSP) shall be prepared by the project contractor(s) and submitted to SVCW for review.
	• The SMP and HSP shall include the following:
	  • Site control procedures to control the flow of personnel, vehicles, and materials in and out of the construction site;
	  • Measures to minimize dust generation, storm water runoff, and tracking of soil off-site;
	  • If excavation de-watering is required, protocols to evaluate water quality and discharge/disposal options;
	  • Protocols for completing earthwork activities in areas where impacted soils, soil vapor, and/or groundwater are present or suspected;
	  • Worker training requirements, health and safety measures and soil handling procedures;
	  • Protocols to be implemented if buried structures, wells, debris, or unidentified areas of impacted soil are encountered during construction activities;
	  • Protocols to evaluate the quality of soil suspected of being contaminated so that appropriate mitigation, disposal, or reuse options can be determined;
	  • Procedures to evaluate and document the quality of any soil imported to the construction site;
	  • Methods to monitor trenches for the potential presence of volatile chemical vapors;
	  • Protocols to reduce the potential for construction equipment and vehicles to release contaminated soil onto public roadways or other off-site transfer; and
	  • Stockpiling protocols for “clean” and “impacted” soil.

Impact HYD-1: Construction of the proposed Project could increase contaminants in storm water runoff, which could adversely affect the water quality of the San Francisco Bay.	MM HYD-1.1: Prior to the commencement of any ground disturbing activities outside the fenced WWTP site, the project will comply with the State Water Resources Control Board’s NPDES General Construction Activities Permit, to the satisfaction of the SVCW construction manager, as follows: • SVCW will control the discharge of storm water pollutants including sediments associated with construction activities;

Table 5-4. Belmont Conveyance Project environmental impacts and mitigations

Impact	Mitigation Measures
	• Permitting for storm water treatment could be obtained by one of two methods. The first option would be to obtain an Industrial Storm water General Permit by filing a Notice of Intent (NOI) with the SWRCB. The second option would be to reissue the existing individual permit that expires in December 2017 and file an application with revised storm drain discharge into wetlands or the bay. MM HYD-1.2: The project will include Best Management Practices (BMPs) to control the discharge of storm water pollutants including sediments associated with construction activities. Prior to installation, the contractor shall be required to prepare an Erosion Control Plan. The Erosion Control Plan may include BMPs as specified in the Manual of Standards Erosion & Sediment Control Measures for reducing impacts on the storm drainage system from installation activities. The following specific BMPs will be implemented to prevent storm water pollution and minimize potential sedimentation during construction: • Utilize on-site sediment control BMPs to retain sediment on the Project sites; • Utilize stabilized construction entrances and/or wash racks; • Implement damp street sweeping; • Provide temporary cover of disturbed surfaces to help control erosion during installation; • Provide permanent cover to stabilize the disturbed surfaces after installation has been completed; • Store, handle, and dispose of construction materials and wastes properly, so as to prevent their contact with storm water; • Control and prevent the discharge of all potential pollutants, including solid wastes, paints, concrete, petroleum products, chemicals, washwater or sediments, and non-stormwater discharges to storm drains and watercourses; • Utilize sediment controls or filtration to remove sediment from dewatering effluent; • Avoid cleaning, fueling, or maintaining vehicles onsite, except in a designated area in which runoff is contained and treated. • Delineate clearing limits, easements, setbacks, sensitive or critical areas, buffer zones, trees, and drainage courses with field markers. • Protect adjacent properties and undisturbed areas from construction impacts using vegetative buffer strips, sediment barriers or filters, dikes, mulching, or other measures as appropriate. • Limit and time applications of pesticides and fertilizers to prevent polluted runoff.
Impact HYD-2: Water quality impacts from shallow groundwater encountered during construction could occur under the proposed Project.	MM HYD-2: A detailed, design-level geotechnical investigation shall be completed and shall address the need for dewatering during construction. Project construction shall follow the recommendations of the investigation.

Impact NOI-1: Construction activities in relation to the ambient noise conditions over extended periods could result in a potentially significant impact.	MM NOI -1: The following measures will be required for all construction sites to ensure the exterior noise levels at sensitive receptor locations stay within these thresholds when feasible:
	• Daytime (7:00 a.m. to 10:00 p.m.)
	  • Residential districts: 60 dBA Leq (hr)
	  • Commercial districts: 70 dBA Leq (hr)
	  • Locations with ambient noise near thresholds: 5dBA Leq higher than ambient noise
	• Nighttime (10:00 p.m. to 7:00 a.m.)
	  • Residential districts: 45 dBA Leq (hr)
	  • Commercial districts: 52 dBA Leq
	  • Locations with ambient noise near thresholds: 5dBA Leq higher than ambient noise
	• Noise due to extreme noise-generating construction activities, such as pile driving activities which are necessary for the proposed Project, shall be minimized to the extent feasible. Pile driving activities and other noisy construction activities shall be completed as quickly as possible to limit noise exposure. Where conditions allow, vibratory pile drivers shall be used to drive sheet piles. Pile holes shall be pre-drilled to minimize the number of blows required to seat the pile.
	• All equipment driven by internal combustion engines shall be equipped with mufflers, which are in good condition and appropriate for the equipment. Quieter internal combustion equipment or equipment powered by electrical motors shall be selected to reduce noise levels, where feasible.

Table 5-4. Belmont Conveyance Project environmental impacts and mitigations

Impact	Mitigation Measures

	• The construction contractor shall utilize "quiet" models of air compressors, ventilation fans, and other stationary noise sources where technology reasonably exists.
	• Unnecessary idling of internal combustion engines shall be prohibited.
	• Construction staging areas shall, where practical, be established at locations that will create the greatest distance between the construction-related noise sources and receptors nearest the Project site during all Project construction.
	• Locate stationary noise sources as far from receptors as feasible. If they must be located near receptors, adequate muffling (with screens and enclosures where feasible and appropriate) will be used as necessary to stay within the above noise level thresholds. Any enclosure openings or venting will face away from receptors.
	• Locate material stockpiles, as well as maintenance/equipment staging and parking areas, as far as feasible from residential receptors.
	• Neighbors located adjacent to the construction site shall be notified of the construction schedule in writing and of significant changes to the schedule.
	• Designate a project liaison that will be responsible for responding to noise complaints during the construction phase. The name and phone number of the liaison will be conspicuously posted at construction areas and on all advanced notifications. This person will take steps to resolve complaints, including periodic noise monitoring, if necessary. Results of noise monitoring will be presented at regular Project meetings with the Project contractor, and the liaison will coordinate with the contractor to modify any construction activities that generated excessive noise levels to the extent feasible.
	• Require a reporting program that documents complaints received, actions taken to resolve problems, and effectiveness of these actions.
	• Hold a preconstruction meeting with the job inspectors and the general contractor/on-site project manager to confirm that noise mitigation and practices (including construction hours, construction schedule, and noise coordinator) are completed.
	• Implement a construction noise monitoring plan which includes a provision for noise monitoring at the nearby receptors to confirm that daytime and nighttime construction noise levels meet daytime and nighttime noise level thresholds at residential and commercial land uses. Construction monitoring shall occur weekly during the first month of general construction at a given site and on a monthly basis, thereafter, to show compliance with the construction noise level thresholds. Additional noise monitoring shall be completed on a more frequent basis if needed, in response to complaints. In the event of noise complaints, the contractor will provide information to SVCW within 48 hours of being notified of the complaint, regarding the noise levels measured and activities that correspond to the complaints, as well as the proposed changes at the site to reduce the noise levels to below the thresholds.
	• In the event the above noise thresholds are not being met, additional noise mitigation measures will be implemented to further reduce noise from construction activities. A site-specific noise control plan shall be developed to identify the specific construction noise control features that will be implemented at the construction site(s). These additional noise mitigation measures could include, but not be limited to, the following
	    • Erecting permanent or temporary noise barriers (at least 12 ft in height) and other noise control features at the perimeter of the construction site(s) between the construction activity and sensitive receptors and/or around major construction noise sources (i.e., noisy equipment) to provide shielding for nearby sensitive receptors. Permanent or temporary noise barriers could include, but would not be limited to, concrete, precast walls, plywood noise barriers, noise control blankets, cargo containers, or hay bales. The exact material, height, and configuration of these barriers shall be decided in consultation with the acoustical consultant, based on the specific equipment or activity that is causing the excessive noise.
	    • Scheduling specific high noise-generating construction activities for the middle of the day.
	• Additional noise monitoring shall be completed after the installation and completion of such measures, to confirm their effectiveness at achieving the above thresholds. If the noise thresholds are still not being met, an acoustical consultant shall make further recommendations to be implemented immediately to reduce noise levels at the construction site(s).

Impact NOI-2: Operational noise from regular operations at the WWTP	MM NOI-2: The following noise performance standards shall be applied to noise from regular operations at the WWTP and at the specified pump stations:

Table 5-4. Belmont Conveyance Project environmental impacts and mitigations	
Impact	Mitigation Measures
and the specified pump stations as discussed above would lead to a potentially significant impact.	• Noise resulting from regular (non-emergency) operations of SCPS equipment shall not exceed 52 dBA Leq at night (10 p.m. to 7 a.m.) at any point on the common property line of SCPS and the Fairfield Inn and Suites hotel. Design alternatives, such as locating the fans on the exterior walls facing the airport, would reduce fan noise from the new odor control facility to levels at or below ambient conditions at the nearest hotel façade. Fan enclosures would be another potential mitigation measure. • Low-velocity ventilation systems (which are quieter than standard ventilation systems) and other ancillary noise controls shall be incorporated into the designs, as necessary, to meet the noise performance standards. • The following noise performance standard shall be applied to noise from diesel engine-generator operations at WWTP and each of the pump stations: • The sound level from non-emergency operation of the diesel engine-generator at each facility shall not exceed 60 dBA when measured on any real property outside the property lines of the facilities (excluding US Highway 101 (U.S. 101), other roadways, and San Carlos Airport).
Impact UTIL-1: The relocation and modification of existing utilities could result in short-term service disruption impacts during construction.	MM UTIL-1: The project will incorporate the following measures into the Project construction documents: • Prior to and during construction of the gravity pipeline alignment and the proposed connections, all utility work shall be completed with approval and coordination with the respective utility providers to minimize any potential disruption in service. • All utility modifications and relocations shall comply with respective utility providers' notification process for any disruption of service, including USA North requirements.

5.8.16 Utility modifications

The following sections discuss the utility modifications needed for each of the sites.

BPS Rehabilitation. There are no known utility modifications required for the rehabilitation of the BPS. Final determination of any required utility modifications will be part of detailed design.

Belmont FM Rehabilitation. The open cut construction along portions of Shoreway Road for the Belmont FM Rehabilitation component (access pits) and Monte Vista Drive for SCPS Improvements may require temporary utility support or relocation. With all of the utility relocations, the exact modifications will be determined during final design. Nonetheless, relocation and modification of existing utilities could result in short-term service disruption. All utility modifications and relocations shall comply with respective utility providers' notification process for any disruption of service, including USA North requirements.

SCPS Improvements. As a result of the changed operations and the installation of the proposed gravity pipeline, an existing 10-inch diameter force main from a City of San Carlos lift station, located near the on-ramp to northbound US-101 from westbound Holly Street, will be relocated on the SCPS site. This force main, currently routed around the north and east sides of the building and discharging to the SCPS wet well, will be rerouted around the west and south sides of the SCPS building, terminating in the new San Carlos inlet manhole upstream of the flow meter and sampling structure. The 275-foot force main will be constructed using traditional open cut methods in an approximately five-foot deep, vertically shored trench. The existing SCPS building will remain and house the new San Carlos Odor Control Facility as described previously; however, the pump and equipment will be removed, as needed. FA ducting with a diameter of 24-inches will be installed between the new structures to remove FA when the structures are entered.

5.9 Construction and Sequencing

The construction of the Belmont Conveyance Project will take place in stages and will need to account for the construction of equipment and design considerations discussed previously in Sections 5.1 through 5.8. A constructability review, proposed schedule, sequencing, and interim pump operation are described in this section

5.9.1 Constructability review

The SCPS Improvements will occur first, then the Belmont FM Rehabilitation and finally, the BPS Rehabilitation. SCPS Improvements construction must be complete prior to San Carlos Inlet Structure construction commencing, currently scheduled to start in October 2019. SCPS will remain operational through most of the SCPS Improvements. However, San Carlos flows will need to be bypassed during construction on San Carlos Vault that requires work on the San Carlos influent pipe. Prior to the Belmont FM Rehabilitation construction, the gravity pipeline/RLS must be fully constructed and operational. Additionally, Belmont flows will need to be bypassed in the dry season using the existing Industrial Road bypass line. Construction must occur during the dry season of approximately April 15 through October 15. The BPS Rehabilitation will require the removal and demolition of existing facilities within the BPS during construction and it will also be scheduled during the dry construction season.

5.9.2 Existing facilities

BPS Rehabilitation and Belmont FM Rehabilitation will include the rehabilitation of existing facilities. The SCPS Improvements include the extension of existing force mains and gravity pipelines. However, the majority of the SCPS Improvements will involve new structures.

5.9.3 Constraints

The following constraints have been identified for the design and construction of BPS and SCPS repurposing. Constraints include the relocation and connection of utilities, noise and vibration restrictions and sequencing restrictions.

- **Noise restrictions.**
  - For the BPS, construction noise will be limited to normal working hours between the hours of 8:00 a.m. and 5:00 p.m. Monday through Friday, and 10:00 a.m. to 5:00 p.m. on Saturdays. The City of Belmont Municipal Code (Chapter 15, Article 8) establishes the following noise regulations for all sources of sound measured from any non-residential building: “nighttime hours” – 55 dBA; “Daytime Hours” - 65 dBA.
  - For the SCPS site, construction noise will be limited to normal working hours between the hours of 8:00 a.m. and 6:00 p.m. Monday through Friday, and 9:00 a.m. to 5:00 p.m. on Saturdays and Sundays. The City of San Carlos Municipal Code (Chapter 18.21.050) establishes the following noise limits as measured from a residential property line: “nighttime hours” – 45 dBA; “Daytime Hours” - 60 dBA.
- **PG&E**. Clearance requirements and potentially onsite inspection may be required as related to the high voltage transmission lines adjacent to the BPS.
- **AT&T.** Coordination with the provider to identify and protect conduit bundles in the vicinity of the BPS will be needed.
- **Caltrans.** Work restrictions within Caltrans right-of-way will need to be coordinated for the Belmont FM Rehabilitation.

- **City of San Carlos and City of Belmont.** Traffic restrictions along Shoreway Road for the Belmont FM Rehabilitation will need to be incorporated into the rehabilitation design. Night work may be required to reduce impacts to traffic and access to businesses.
- **Clear channel sign.** Clearance and vibration requirements in proximity to the Clear Channel sign will need to be coordinated.

5.9.4 Geotechnical requirements

The following geotechnical recommendations were made by the geotechnical engineer for the BPS and SCPS site.

- **Groundwater.** Groundwater was encountered at 9 ft below the surface at the SCPS site and 19 ft below the surface at the BPS site in the predesign boring performed by Jacobs Associates. Per the geotechnical report, the groundwater level should be assumed to be at ground surface for design and construction purposes.
- **Shoring.** Excavations at the BPS and SCPS sites will be approximately 0.5 ft to 15 ft deep. All Belmont Conveyance Project excavations will require vertical shoring (i.e., no side-sloped excavations) and supported with “watertight” shoring such as internally braced interlocking sheet piles. All gaps in shoring, such as pipeline penetrations, must be fully sealed to maintain a watertight system. External dewatering is not recommended by the geotechnical engineer due to the risk for subsidence of soft ground and settlement of nearby pipelines, utilities and structures. Instead, the geotechnical engineer recommends that the sheet pile toe be embedded a minimum of 15 ft below the excavation to form a cutoff to groundwater inflows. Internal dewatering may be used to keep the excavation dry.

5.9.5 Coordination issues

Work will need to be sequenced to maintain operation of BPS and SCPS until ready to be taken offline. The following sections discuss the work sequencing for the Belmont Conveyance Project.

5.9.5.1 Shutdowns

Multiple shutdowns will be required for BPS as the pump station does not have a redundant wet well to maintain partial operation. BPS will need to be bypassed during the duration of the rehabilitation.

The Belmont FM Rehabilitation will also require bypassing as the force mains will need to be completely dry to perform lining installation.

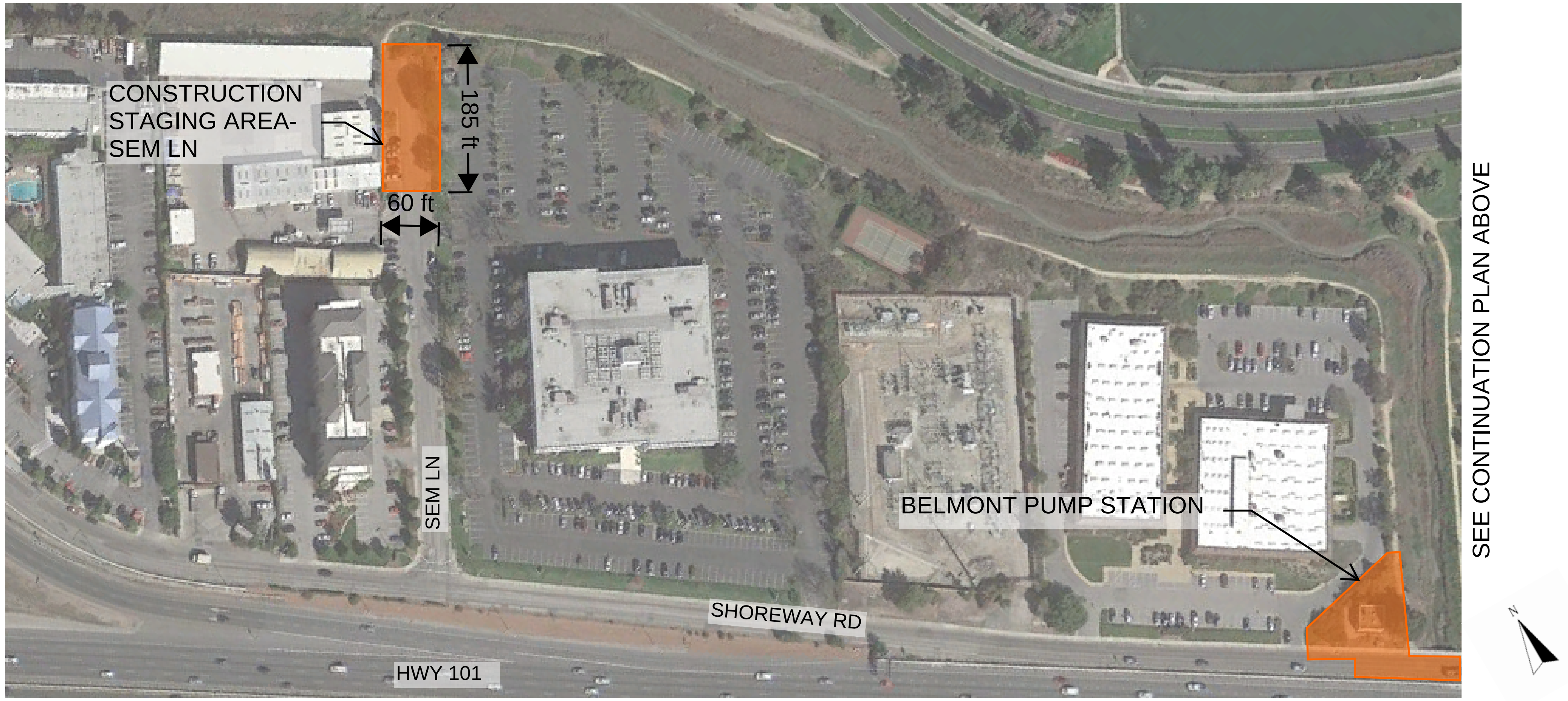
SCPS can remain in operation during the majority of the SCPS Improvements. However, portions of the incoming flow (gravity and force main) will need to be bypassed during modifications and/or extensions.

5.9.5.2 Construction staging, laydown areas and access

Five staging areas, as shown in Figure 5-7, have been identified for the BPS, Belmont FM, and SCPS sites. Construction staging may include construction trailers, storage of pump station equipment, laydown for pipe segments, storage of construction equipment and similar activities. The decision as to which of the staging areas will be used and the exact extent of use will be determined during predesign and following negotiations with the respective property owners.

Sem Ln ROW - 10,330 SF
Belmont PS Area - 11,220 SF
Springfield Suites - 24,350 SF
Belmont Tee - 3,870 SF
US 101/Holly St - 16,200 SF
SCPS Area - 36,500 SF

OVERVIEW PLAN
NOT TO SCALE



PLAN-SEM LN CONSTRUCTION STAGING AREA

LEGEND

▬ · ▬	EXISTING SAN CARLOS 36-INCH SEWER
▬	SLIPLINE 54-INCH FM
▬	CIPP 24-INCH FM
▬	OPEN CUT
·······	EXISTING 54-INCH FM- TO BE ABANDONED
▨	CONSTRUCTION STAGING AND STORAGE AREA

NOTE: DIMENSIONS ARE APPROXIMATE

FIGURE 5-7. BELMONT CONVEYANCE SYSTEM CONSTRUCTION STAGING AREAS

Brown AND Caldwell

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5.9.5.3 Construction sequencing

A schematic of the current flows and structures is shown in Figure 5-8. The flows from Belmont and San Carlos will need to continue to be pumped to the WWTP while the improvements occur. Currently, Redwood City and WBSD flows enter the conveyance system at their respective pump stations and are conveyed toward SVCW in the 48-inch force main. At the SCPS, the force main size increases to 54-inch to accommodate San Carlos flows entering the conveyance system. The 54-inch force main continues to SVCW WWTP. The Belmont flows enter the conveyance system via the 24-inch force main which connects to the 54-inch force main at the Belmont Tee.

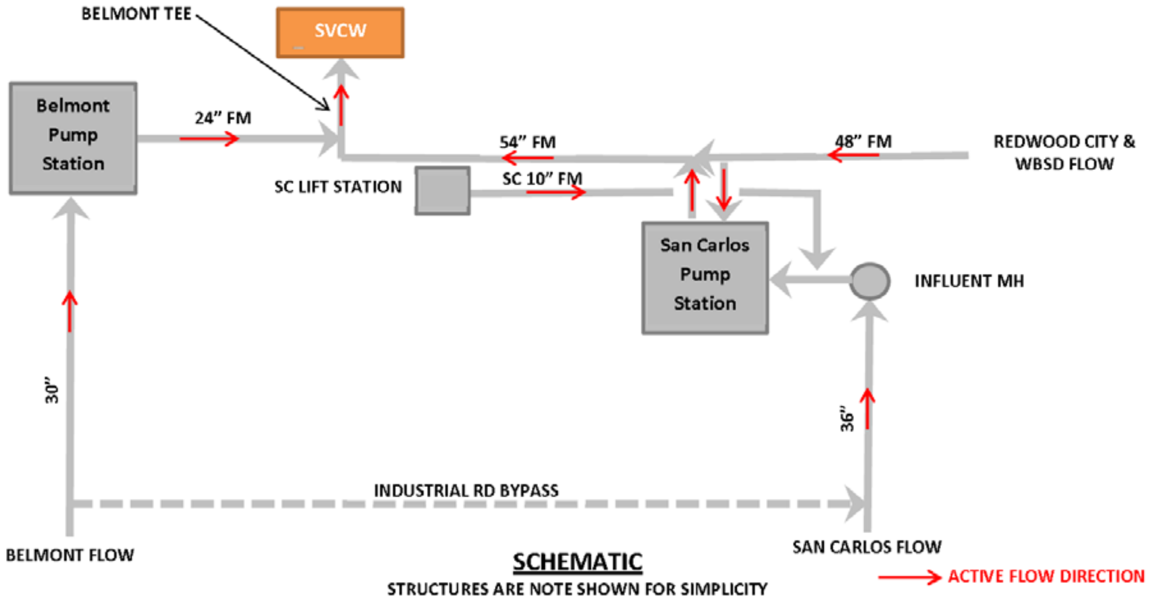


Figure 5-8. Schematic of existing configuration

As part of the Belmont Conveyance Project construction, the BPS Rehabilitation will be dependent on the SCPS Improvements and the Belmont FM Rehabilitation. The Belmont Conveyance Project will be constructed as three separate projects that are being referred to as units in this construction sequencing plan. The total construction duration is 23 months and occurs over a three-year period because the construction is not continuous. The construction duration for each unit is shown in Table 5-5. A schematic of the configuration after construction is complete is shown in Figure 5-9.

Table 5-5. Summary of construction activity

Construction Unit	Activity	Dependency	Duration (Months)	Begin Construction[1]	Complete Construction[1]
1	SCPS Improvements	Complete prior to San Carlos Inlet Structure	9	March 2019	December 2019
2	Belmont FM Rehabilitation	After tunnel/RLS in service Dry weather	11	September 2022	August 2023
3	BPS Rehabilitation	After Belmont FM Rehabilitation Dry weather	7	January 2024	August 2024

1. *Begin Construction and Complete Construction dates are based on the proposed Conveyance System Project schedule, and are subject to change.*

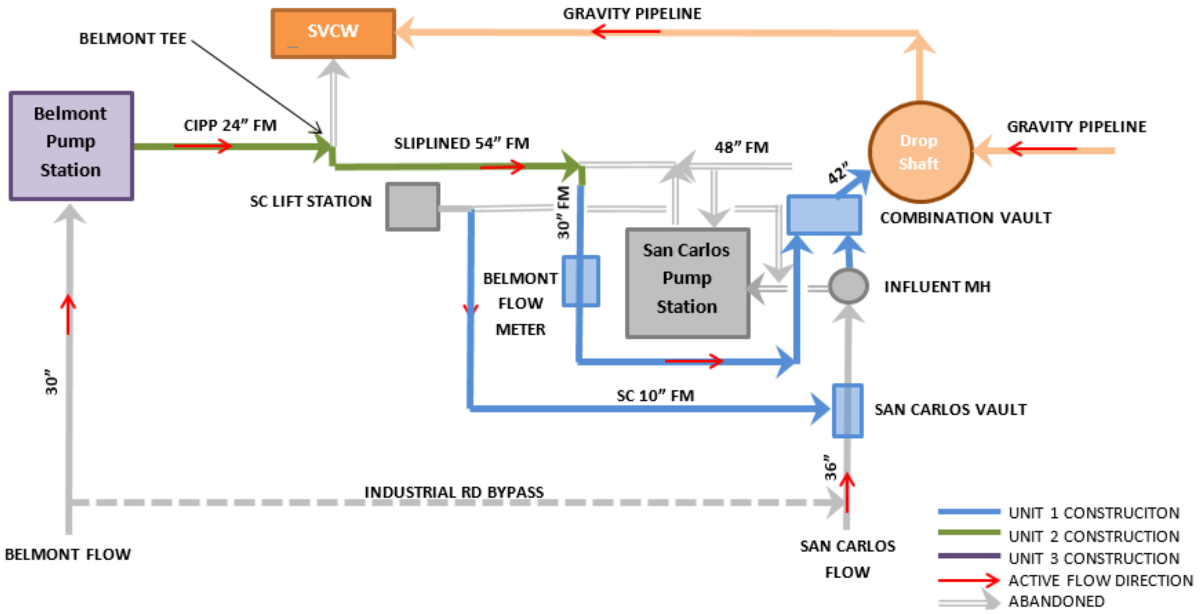


Figure 5-9. Post construction configuration

Unit 1

The first phase of construction will be the SCPS Improvements (Unit 1), March 2019 to December 2019. During construction of Unit 1, modifications will be made at the SCPS site necessary to allow for Belmont and San Carlos flows to connect to the gravity wastewater interceptor once the gravity pipeline is complete. A schematic of the configuration during construction is shown in Figure 5-10. The following improvements will be completed in series over nine months (i.e. not concurrently constructed) with SCPS remaining in operation:

- Construct the Belmont 30-inch force main; relocate the San Carlos 10-inch force main; construction of the Belmont Vault which will house a flow meter and sampling facilities (2-month duration).
- Construction of the San Carlos Vault, which will house a trash rack and provide a location for the San Carlos 10-inch force main to connect to the San Carlos system (3-month duration).

- Construction of the Combination Vault and 42-inch diameter pipe to combine Belmont and San Carlos flows prior to discharging to Drop Shaft; this structure will include the San Carlos flow meter and sampling facilities, and leachate receiving location (four-month duration).

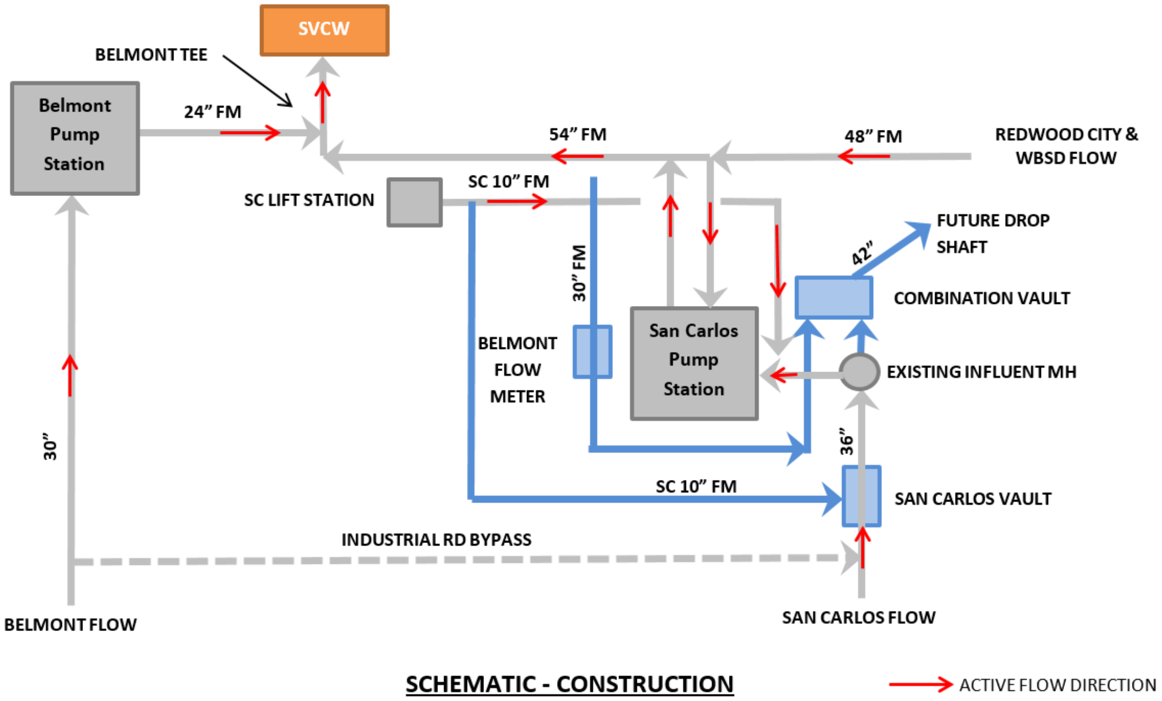


Figure 5-10. SCPS site work construction schematic

The following bypass requirements and schedule constraints should be taken into consideration:

- Construction must be complete prior to Drop Shaft construction commencing, currently scheduled to start in October 2019.
- SCPS will be operational; therefore, San Carlos flows will need to be bypassed during construction on San Carlos Vault that requires work on the San Carlos influent pipe. Bypass will be via a temporary diversion at an upstream manhole located in the Fairfield Inn parking lot and discharge directly into the SCPS. These construction activities must occur during the dry season.
- Bypass of the San Carlos 10-inch force main will not be required and connection to the existing 10-inch force main will consist of a hot tap.
- Permits and/or coordination from the FAA and City of San Carlos will be required for construction of this Unit.
- Leachate discharge location will need to be temporarily unavailable or relocated outside of the site.
- Upon completion of this Unit, the conveyance system will continue to operate as it currently does with the exception of the San Carlos 10-inch force main, as shown in Figure 5-11.

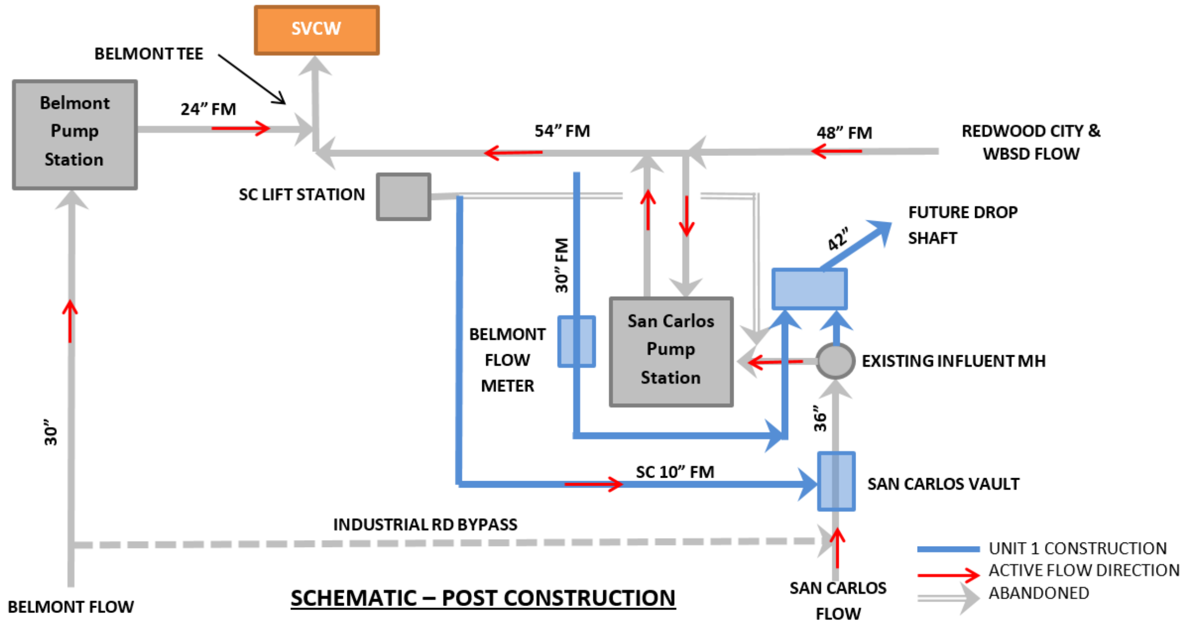


Figure 5-11. SCPS site post construction schematic

Unit 2

The second phase of construction will be the Belmont Pipeline Rehab (Unit 2), which is scheduled to occur from September 2022 to August 2023. This Unit changes how the Belmont and San Carlos flows enter the SVCW conveyance system. A schematic of the configuration during construction is shown in Figure 5-12. The following improvements will be completed in series (i.e. not concurrently constructed) over 7 months:

- Rehabilitate approximately 3,550 lf of the existing 54-inch force main using sliplining method with 30" HDPE; final inside diameter of 28 inches (4-month duration, including pit construction).
- Rehabilitate approximately 1,150 lf of the existing 24-inch force main using CIPP method; estimated final inside diameter of 22 inches (two-month duration, including pit construction).
- Open cut construction at the Belmont Tee to connect the CIPP 24-inch force main to the sliplined 54-inch force main (one month duration).

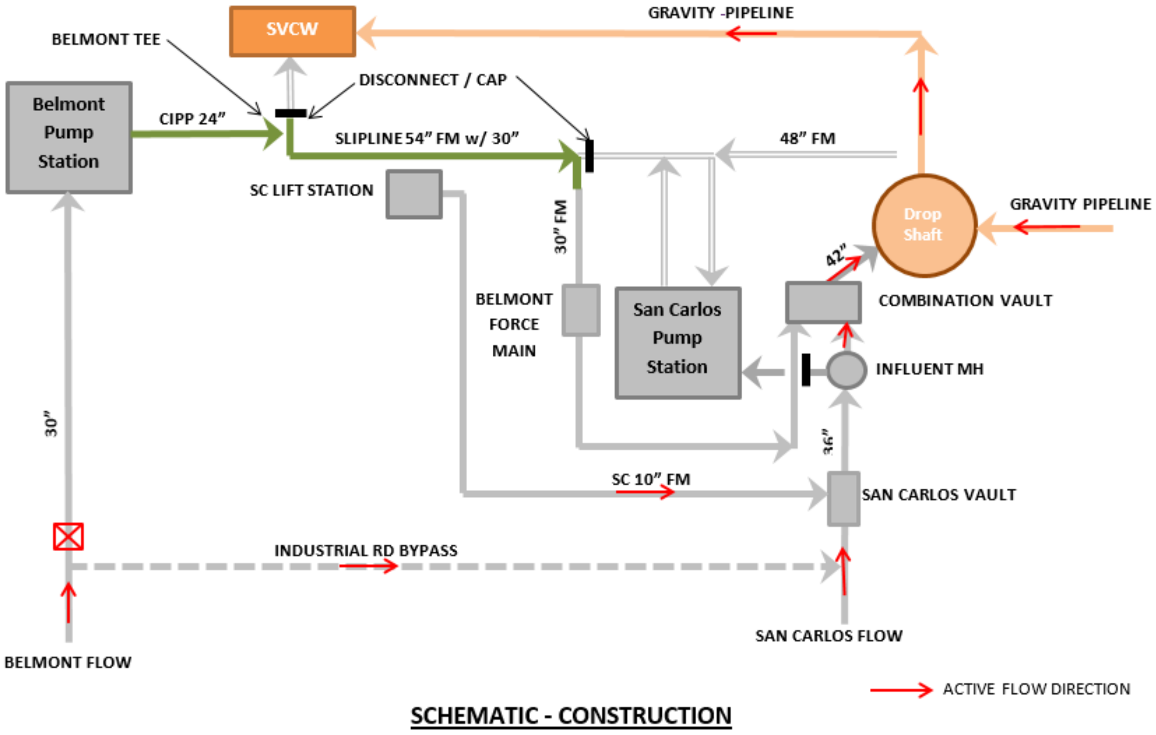


Figure 5-12. Belmont FM Rehabilitation construction schematic

The following bypass requirements and schedule constraints should be taken into consideration:

- The gravity pipeline/RLS must be fully constructed and operational prior to starting construction of this Unit.
- Requires Belmont flows to be bypassed using Industrial Road bypass line. Construction must occur during the dry season.
- Requires coordination and/or permits from FAA, Cities of San Carlos, Belmont and Redwood City, Caltrans, and BCDC. May require permits from PG&E, AT&T and Calwater.

Upon completion of this Unit, Belmont and San Carlos flows will enter the gravity pipeline, thus the existing conveyance system will no longer be used and SCPS will be offline. Belmont flows will be pumped through the rehabilitated force main using the existing pumps at BPS, as shown in Figure 5-13.

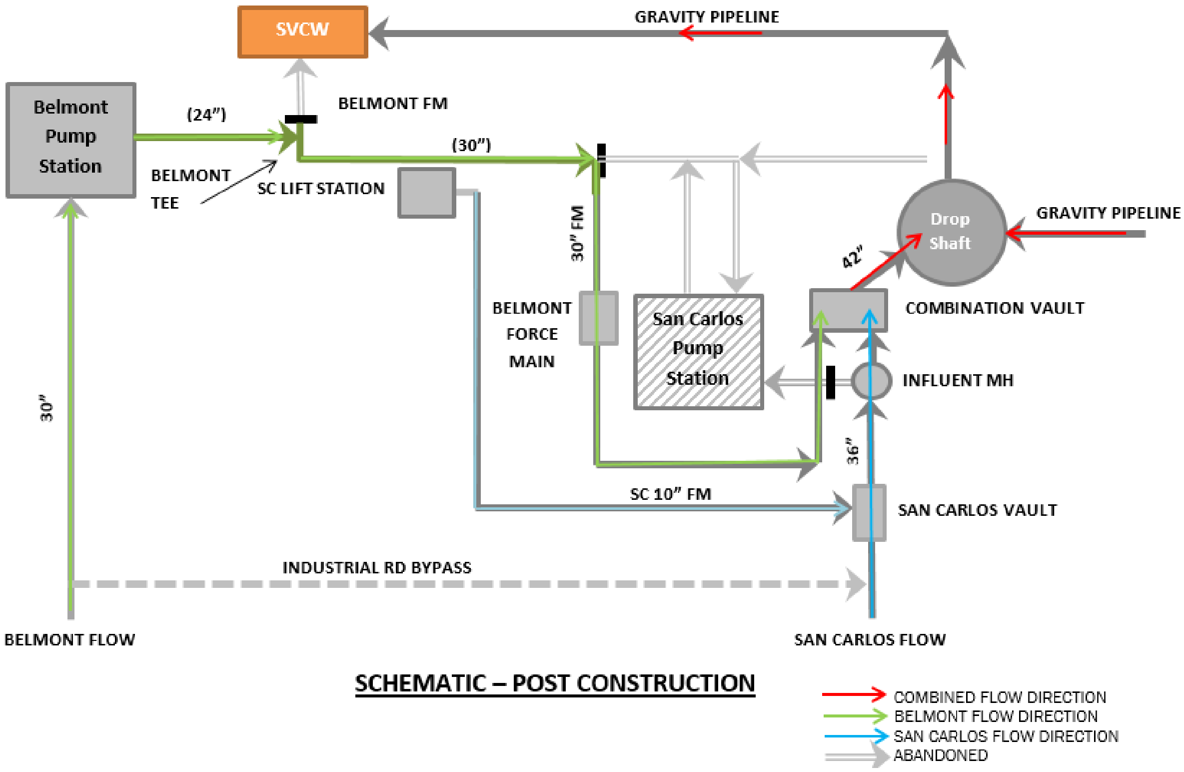


Figure 5-13. Belmont FM Rehabilitation post construction schematic

Unit 3

The third phase of construction is the BPS Rehab (Unit 3), which is scheduled to occur from January 2024 to August 2024. This Unit includes upgrading the BPS. Major work includes replacing the three existing pumps within the BPS with three new 85 HP pumps equipped with VFDs. A schematic of the configuration during construction is shown in Figure 5-14. The following are the sequence of construction activities at the pump station which will occur over a seven-month period and occur in series (i.e., not constructed concurrently):

- Demolition (one-month duration)
- Seismic and structural improvements (one-month duration)
- Pumps and piping replacement, HVAC and mechanical (1.5-month duration)
- Electrical and Standby power improvements (2.5-month duration)
- Start Up (one-month duration)

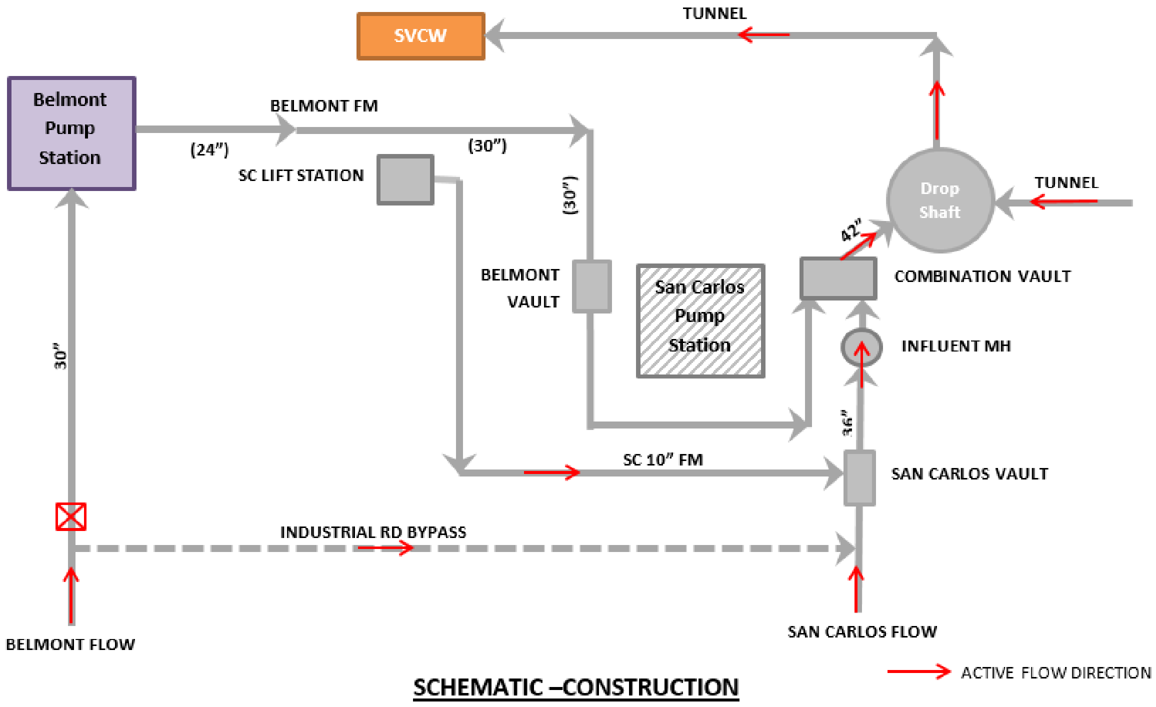


Figure 5-14. BPS Rehabilitation construction schematic

The following bypass requirements and schedule constraints should be taken into consideration:

- Belmont flows must be bypassed using the Industrial Road Bypass. Construction must occur during the dry season since the pump station must be taken offline.
- Requires coordination and/or permits from Cities of Belmont and Redwood City. May require permits from PG&E and BCDC.

Upon completion of this Unit, the final configuration of the new conveyance system will be complete, as shown in Figure 5-15.

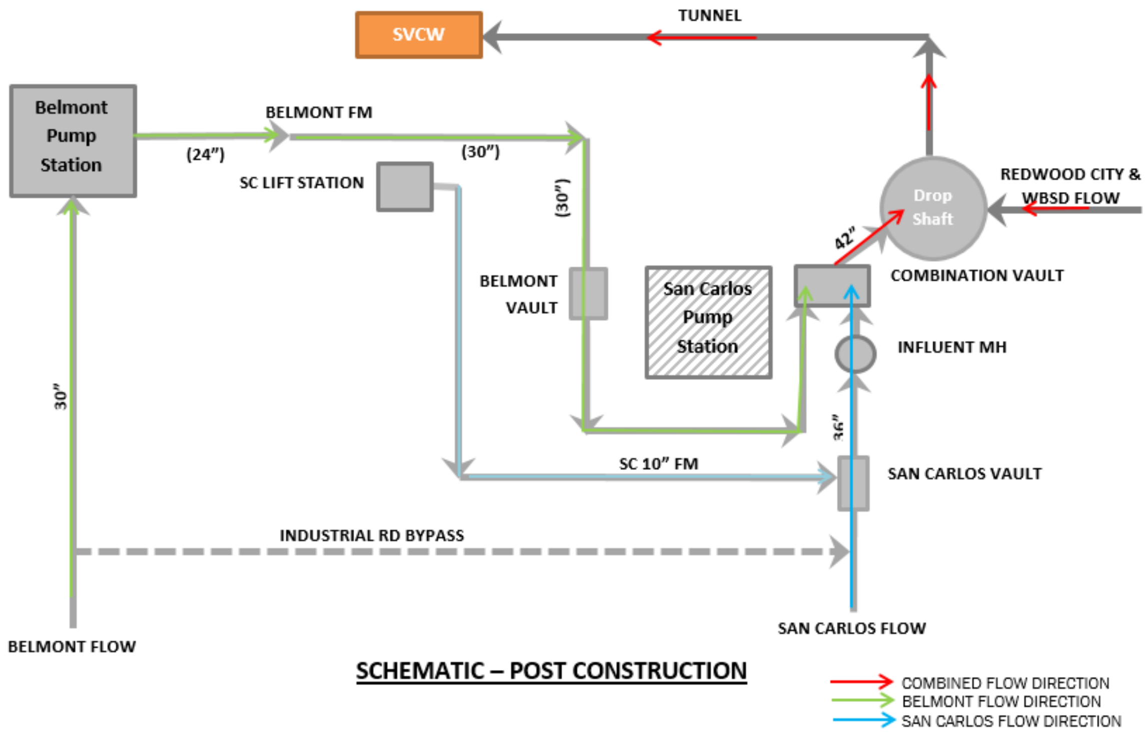


Figure 5-15. BPS Rehabilitation (and entire Belmont Conveyance) post construction

Section 6

Cost Estimate and Schedule

The Belmont Conveyance Project Life Cycle Cost (LCC) analysis model was used to estimate the LCC over the Belmont Conveyance Project's 50-year life. The project includes BPS Rehabilitation, Belmont FM Rehabilitation and SCPS Improvements. The model was completed in August 2016. The major considerations in developing the Belmont Conveyance LCC include capital cost, annual operation and maintenance (O&M) running costs, replacement/rehabilitation costs and overall Belmont Conveyance Project schedule. The following sections describe the different components of the LCC.

6.1 Construction and Capital Costs

AACE International Class 3 construction costs for the BPS Rehabilitation, Belmont FM Rehabilitation and SCPS Improvements were calculated by Brown and Caldwell. A summary of the construction costs by major project category is provided in Table 6-1. The detailed cost estimate is included in Appendix I. It should be noted that the estimate was prepared in May 2016, and the construction cost estimate is in 2016 dollars.

Table 6-1. Belmont Conveyance Project construction cost

Category/Phase	BPS Rehabilitation	Belmont FM Rehabilitation	SCPS Improvements	Total
Site Demolition	$0.2 M	$0.02 M	$0.02 M	$0.2 M
BPS Modifications	$3.8M	--	--	$3.8 M
SCPS Improvements	--	--	$1.0 M	$1.0 M
Conveyance Piping Rehabilitation	--	$4.9 M	--	$4.9 M
Site Civil Allowances	$0.1 M	$0.3 M	$0.1 M	$0.5 M
Total	$4.1 M	$5.2 M	$1.1 M	$10.5 M

Note: *Construction cost estimate is in 2016 dollars.*

The construction costs were converted into capital costs by applying soft costs, project contingencies, and market fluctuations to each individual cost component.

The construction contingencies, soft costs, and market fluctuations are summarized in Table 6-2. Market fluctuations are applied to capture the range of costs that could potentially occur over the construction period for the entire conveyance system program upgrade.

Table 6-2. Capital cost factors

Cost Factor	Markup	
	Belmont FM	BPS, SCPS
Construction Contingency[1]	25%	25%
Soft Costs[1]		
Construction Management, Engineering Services During Construction, Testing, Inspection	15%	18%
Contract Change Orders (CCO)	5%	5%
Planning	5%	5%
Design	10%	10%
Project Management	5%	5%
Soft Cost Subtotal	**40%**	**43%**
Market Fluctuations[2]		
Low	-5%	-5%
High	15%	15%

1 *Construction contingency developed by SVCW as presented in the comparison of construction cost estimates during the June 2, 2016 Department Head Meeting.*

2 *Market fluctuations developed by SVCW. Source: SVCW Conveyance System Construction Cost Analysis, Front of Plant, Revision Date: April 22, 2015, Revision 28b.*

Table 6-3 presents a summary of the Belmont Conveyance Project capital costs. The capital costs were originally developed in 2016 dollars. Costs for all three projects were escalated to the midpoint year of construction. The midpoints of construction for the BPS, Belmont FM, and SCPS are 2023, 2022, and 2019, respectively. For the LCC analysis, all life cycle costs were analyzed for 2022, which is the year of beneficial use. The LCC analysis is summarized in Section 6.6.

Table 6-3. Belmont Conveyance Project capital cost

	BPS	Belmont FM	SCPS
Total Construction Cost	$4.1 M	$5.2 M	$1.1 M
Contingency and Soft Cost Subtotal (25% Contingency and 40% of Construction Cost for Belmont FM and 43% of Construction Cost for BPS and SCPS)	$1.0 M $1.8 M	$1.3 M $2.1 M	$0.3 M $0.5 M
2016 Capital Cost	$6.9 M	$8.6 M	$1.9 M
2019 Capital Cost[2]	--	--	$2.1 M
Market Fluctuation Ranges[1]	--	--	$2.1 M – $2.3 M
2022 Capital Cost[2]	--	$10.9M	--
Market Fluctuation Ranges[1]	--	$10.5 M - $11.9 M	--
2023 Capital Cost[2]	$9.0 M	--	--
Market Fluctuation Ranges[1]	$8.7 M – $9.8 M	--	--
Year of Beneficial Use Capital Cost[3]	$8.4 M	$10.9M	$2.1 M
Market Fluctuation Ranges [1]	$8.1 M - $9.2 M	$10.5 M - $11.9 M	$2.1 M – $2.3 M

1. *Market fluctuation range of -5 percent (low) to 15 percent (high) developed by SVCW. Source: SVCW Conveyance System Construction Cost Analysis, Front of Plant, Revision Date: April 22, 2015, Revision 28b.*
2. *Capital costs are escalated to mid-point of construction years. These differ for each component of the Belmont Conveyance Project.*
3. *The Year of Beneficial Use is 2022. Where the mid-point of construction year occurs after the Year of Beneficial Use, the capital cost was discounted to the Year 2022. If the mid-point of construction year is less than or equal to the Year of Beneficial Use, the escalated capital cost to the mid-point of construction year was used. See Appendix J for further details regarding explanation of Year of Beneficial Use, escalation and discounting.*

6.2 O&M Costs

Separate O&M costs were developed for the BPS Rehabilitation, Belmont FM Rehabilitation, and SCPS Improvements.

6.2.1 BPS Rehabilitation

The BPS O&M annual costs were included as part of the MPPS and RCPS general maintenance costs; therefore, do not need to be accounted for in this analysis. Pump inspection is included in the general maintenance cost due to the size of BPS, per SVCW's direction during the original LCC analysis completed in May 2015. Odor control costs are included in this analysis and include costs for chemical and water to operate the system on an annual basis at an estimated cost of $13,500/year. Electrical costs are calculated using the location of the facility and the electrical rates, along with calculated equipment power usage. The electrical rate of $0.196/KWh will be used and is based on current SVCW electrical bills. The total BPS annual equipment power usage is 100,241 kW (11.4 kWh). All O&M costs mentioned above are in 2016 dollars.

6.2.2 Belmont FM Rehabilitation

Future annual O&M costs are assumed to be included in the conveyance system pump stations; therefore, do not need to be accounted for in this analysis. The force main does not require regular cleaning; therefore, there are no cleaning costs associated with the Belmont FM. Pipe inspections are completed by acoustic Doppler technology every ten years after rehabilitation. It is assumed that the cost to inspect is $10/foot, thus $47,000 annually. There are no power requirements at the Belmont FM, therefore no electrical costs were calculated. All O&M costs mentioned above are in 2016 dollars.

6.2.3 SCPS Improvements

Future annual O&M costs are assumed to be included in the conveyance system pump stations; therefore, do not need to be accounted for in this analysis. Annual odor control costs are to be included in San Carlos Odor Control Facility LCC, which is documented in a different project planning report. Electrical costs are calculated using the location of the facility and the electrical rates, along with calculated equipment power usage. The electrical rate of $0.161/KWh will be used and is based on current SVCW electrical bills. The total SCPS site annual equipment power usage is 76,200 kW (8.70 kWh), not including odor control electrical equipment power. All O&M costs mentioned above are in 2016 dollars.

6.3 Rehabilitation/Replacement Costs

Rehabilitation/replacement costs were developed for the BPS Rehabilitation, Belmont FM Rehabilitation, and SCPS Improvements. The rehabilitation and replacement costs are discussed in the following paragraphs.

6.3.1 BPS Rehabilitation

The following rehabilitation and replacement assumptions were made for the BPS:

1. The dry pit submersible pumps will be rebuilt once every 5 years. The cost to rebuild is assumed to be 50 percent of a purchase cost of $227,000 for all three pumps based on vendor supplied costs.
2. The pumps will be replaced once every 25 years. The cost to replace is assumed to be purchase cost of $227,000 for all three pumps, not counting the rebuild costs during that year.
3. Electrical equipment will be replaced once every 25 years and instrumentation and control once every 15 years. Electrical equipment replacement cost is assumed to be $1,604,000 and the instrumentation and control equipment replacement cost is assumed to be $178,000.
4. Structural rehabilitation or replacement will occur once every 30 years for BPS since it will not be a new station. The structural rehabilitation/replacement cost is assumed to be the construction cost minus pump rebuild and electrical replacement in that year. The structural rehabilitation/replacement includes piping, valves, HVAC, and odor control replacement costs as these are considered to be minor costs compared to pump and electrical replacement.
5. Comminutor/grinder replacement occurs once every 20 years at a cost of $83,490.

6.3.2 Belmont FM Rehabilitation

The anticipated design life for new the Belmont FM is 75 years; thus, no rehabilitation or replacement costs are assumed since the design life occurs outside of the analysis window of 50 years.

6.3.3 SCPS Improvements

Structural rehabilitation or replacement occurs once every 30 years for the SCPS site since it will reuse the existing building structure. The structural rehabilitation/replacement cost will assume the construction cost from the conceptual level, Class 3 estimated developed by BC in May 2016 (Appendix I). The structural rehabilitation/replacement includes piping, trash rack, HVAC, and structural modifications. The odor control replacement costs are assumed to be part of LCC for the tunnel odor control system.

6.4 Year of Analysis

For all LCCs, the Year of Analysis for the proposed Conveyance System Project is the Year of Beneficial Use. The Year of Beneficial Use is the year major facilities of the conveyance system (i.e., gravity pipeline, RLS and Headworks Facility) start up. Based on the current program-wide schedule (Version 20, dated February 1, 2017) developed by SVCW, the Year of Beneficial Use is the Year 2022.

6.4.1 BPS Rehabilitation

The BPS Rehabilitation construction is expected to begin in October 2023 and end in May 2024. Capital costs are applied in the LCC model at the midpoint year of construction. The Year 2023 is used as the midpoint year of construction. The end year of construction is used to establish the start of recurring O&M and rehabilitation/replacement costs.

6.4.2 Belmont FM Rehabilitation

The Belmont FM Rehabilitation construction is expected to begin in June 2022 and end in June 2023. Capital costs are applied in the LCC model at the midpoint year of construction. The Year 2022 is used as the midpoint year of construction.

6.4.3 SCPS Improvements

The SCPS Improvements construction is expected to begin in April 2019 and end in February 2020. Capital costs are applied in the LCC model at the midpoint year of construction. The Year 2019 is used as the midpoint year of construction. The end year of construction is used to establish the start of recurring inspection costs.

6.5 Escalation and Discount Rates

To determine the present value of costs for the Year of Analysis, their values are escalated to future values and discounted back to the Year of Analysis. The discount and escalation rates used in the BPS Rehabilitation, Belmont FM Rehabilitation and SCPS Improvements LCC Analysis were developed by SVCW based on current and projected investment return rates as summarized in Table 6-4.

Table 6-4. Escalation and Discount Rates

Factor	Rate
Escalation	4%
Capital Project and Rehabilitation/Replacement Discount	7%
O&M Discount	3%

6.6 LCC Analysis Summary

The LCC analysis summarizes all cost components over a 50-Year period ending in the Year 2066. A 50-Year period was selected as it the typical analysis period for municipal facilities.

The calculations for determining the BPS Rehabilitation, Belmont FM Rehabilitation and SCPS Improvements LCC is located in Appendix J. Table 6-3, 6-4, and 6-5 displays the BPS Rehabilitation, Belmont FM Rehabilitation and SCPS Improvements (respectively) LCC breakdown including O&M, rehabilitation/replacement, capital and life cycle costs. The LCC analysis completed for the Belmont Conveyance Improvements is included in Appendix J.

Table 6-3. BPS Rehabilitation LCC Summary by Cost Category

Cost Category	Cost
O&M	$1.4M
Rehabilitation/Replacement	$3.1M
Capital Cost	$8.1M - $9.2M
Total LCC	**$12.6M - $13.6M**

1. *Capital cost range is based on a market fluctuation factor as discussed in Section 6.1.*

The median total 50-year LCC for BPS Rehabilitation is $12.9 million with a range of $12.6 to $13.6 million accounting for market fluctuations.

Table 6-4. Belmont FM Rehabilitation LCC Summary by Cost Category

Cost Category	Cost
O&M	$320,000
Rehabilitation/Replacement	--
Capital Cost	$10.5M - $11.9M
Total LCC	**$10.9M - $12.2M**

The median total 50-year LCC for Belmont FM Rehabilitation is $11.2 million with a range of $10.9 to $12.2 million accounting for market fluctuations.

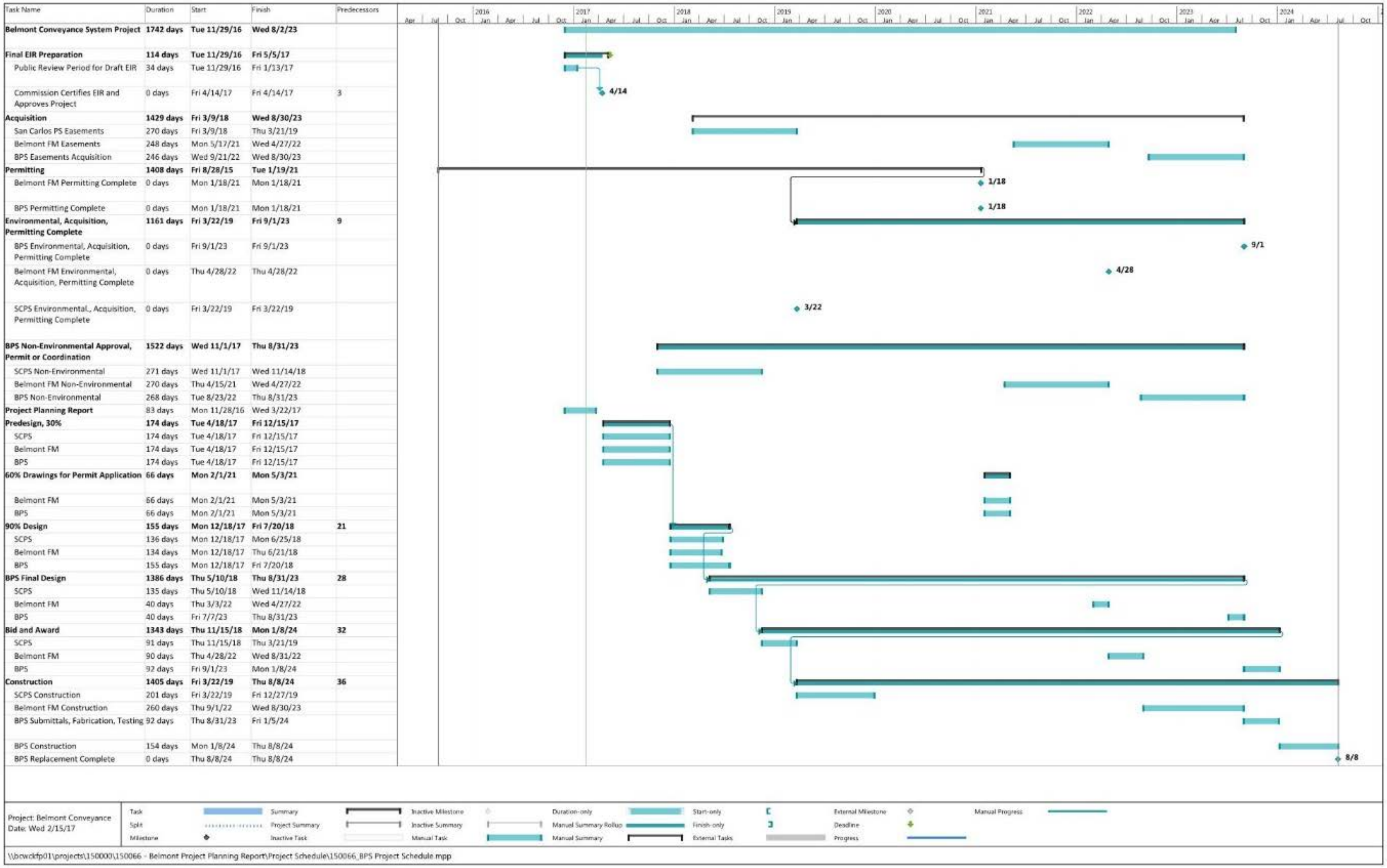
Table 6-5. SCPS Improvements LCC Summary by Cost Category

Cost Category	Cost
O&M	$0.7M
Rehabilitation/Replacement	$0.7M
Capital Cost	$2.1M - $2.3M
Total LCC	**$3.4M - $3.7M**

The median total 50-year LCC for SCPS Improvements is $3.5 million with a range of $3.4 to $3.7 million accounting for market fluctuations.

6.7 Schedule

A construction schedule indicating major construction activities is displayed in Figure 6-1. The estimated construction duration is five months for the BPS Rehabilitation, 12 months for the Belmont FM Rehabilitation, and nine months for the SCPS Improvements. The schedule originates from the overall program schedule; therefore, gaps in specific BPS Rehabilitation, Belmont FM Rehabilitation, and SCPS Improvements activity may occur.



Task Name	Duration	Start	Finish	Predecessors
Belmont Conveyance System Project	**1742 days**	**Tue 11/29/16**	**Wed 8/2/23**	
Final EIR Preparation	**114 days**	**Tue 11/29/16**	**Fri 5/5/17**	
Public Review Period for Draft EIR	34 days	Tue 11/29/16	Fri 1/13/17	
Commission Certifies EIR and Approves Project	0 days	Fri 4/14/17	Fri 4/14/17	3
Acquisition	**1429 days**	**Fri 3/9/18**	**Wed 8/30/23**	
San Carlos PS Easements	270 days	Fri 3/9/18	Thu 3/21/19	
Belmont FM Easements	248 days	Mon 5/17/21	Wed 4/27/22	
BPS Easements Acquisition	246 days	Wed 9/21/22	Wed 8/30/23	
Permitting	**1408 days**	**Fri 8/28/15**	**Tue 1/19/21**	
Belmont FM Permitting Complete	0 days	Mon 1/18/21	Mon 1/18/21	
BPS Permitting Complete	0 days	Mon 1/18/21	Mon 1/18/21	
Environmental, Acquisition, Permitting Complete	**1161 days**	**Fri 3/22/19**	**Fri 9/1/23**	**9**
BPS Environmental, Acquisition, Permitting Complete	0 days	Fri 9/1/23	Fri 9/1/23	
Belmont FM Environmental, Acquisition, Permitting Complete	0 days	Thu 4/28/22	Thu 4/28/22	
SCPS Environmental., Acquisition, Permitting Complete	0 days	Fri 3/22/19	Fri 3/22/19	
BPS Non-Environmental Approval, Permit or Coordination	**1522 days**	**Wed 11/1/17**	**Thu 8/31/23**	
SCPS Non-Environmental	271 days	Wed 11/1/17	Wed 11/14/18	
Belmont FM Non-Environmental	270 days	Thu 4/15/21	Wed 4/27/22	
BPS Non-Environmental	268 days	Tue 8/23/22	Thu 8/31/23	
Project Planning Report	83 days	Mon 11/28/16	Wed 3/22/17	
Predesign, 30%	**174 days**	**Tue 4/18/17**	**Fri 12/15/17**	
SCPS	174 days	Tue 4/18/17	Fri 12/15/17	
Belmont FM	174 days	Tue 4/18/17	Fri 12/15/17	
BPS	174 days	Tue 4/18/17	Fri 12/15/17	
60% Drawings for Permit Application	**66 days**	**Mon 2/1/21**	**Mon 5/3/21**	
Belmont FM	66 days	Mon 2/1/21	Mon 5/3/21	
BPS	66 days	Mon 2/1/21	Mon 5/3/21	
90% Design	**155 days**	**Mon 12/18/17**	**Fri 7/20/18**	**21**
SCPS	136 days	Mon 12/18/17	Mon 6/25/18	
Belmont FM	134 days	Mon 12/18/17	Thu 6/21/18	
BPS	155 days	Mon 12/18/17	Fri 7/20/18	
BPS Final Design	**1386 days**	**Thu 5/10/18**	**Thu 8/31/23**	**28**
SCPS	135 days	Thu 5/10/18	Wed 11/14/18	
Belmont FM	40 days	Thu 3/3/22	Wed 4/27/22	
BPS	40 days	Fri 7/7/23	Thu 8/31/23	
Bid and Award	**1343 days**	**Thu 11/15/18**	**Mon 1/8/24**	**32**
SCPS	91 days	Thu 11/15/18	Thu 3/21/19	
Belmont FM	90 days	Thu 4/28/22	Wed 8/31/22	
BPS	92 days	Fri 9/1/23	Mon 1/8/24	
Construction	**1405 days**	**Fri 3/22/19**	**Thu 8/8/24**	**36**
SCPS Construction	201 days	Fri 3/22/19	Fri 12/27/19	
Belmont FM Construction	260 days	Thu 9/1/22	Wed 8/30/23	
BPS Submittals, Fabrication, Testing	92 days	Thu 8/31/23	Fri 1/5/24	
BPS Construction	154 days	Mon 1/8/24	Thu 8/8/24	
BPS Replacement Complete	0 days	Thu 8/8/24	Thu 8/8/24	

Project: Belmont Conveyance
Date: Wed 2/15/17

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Figure 6-1. Construction schedule

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Section 7

Outstanding Project Issues

The following section summarizes the Belmont Conveyance Project issues that require resolution as part of the final design process. These issues consider the impact to the Belmont Conveyance Project schedule and overall Belmont Conveyance Project costs (design and construction), potential additional field investigations, Belmont Conveyance Project components requiring alternatives analyses to determine a final resolution, interproject coordination needs and decisions to be made by SVCW staff/management to move the Belmont Conveyance Project forward.

7.1 Outstanding Issues to Carry into Subsequent Design

Several items will need further refinement and coordination with SVCW. These items are listed below.

- **Hydraulic model and pump selection.** Pump selection was based on information available at the time of this planning report. As the design of the SCPS Improvements progresses, the hydraulic model will need to be updated and new system curves developed. The consultant updating the hydraulic model during final design will need to provide system curves for the detailed design team to use for pump selection.
- **Hydraulic transient control.** A hydraulic transient analysis was developed based on the information available at the time of the predesign report. As new information is developed, the hydraulic transient model will need to be updated. The consultant responsible for hydraulics will update the hydraulic transient model as new information is developed and provide the results to the detailed design teams.
- **Pump manufacturers.** Current pump selection was based on Fairbanks-Morse dry pit submersible pumps. Additional pump manufacturers should be contacted during final design.
- **Equipment removal and maintenance access.** Equipment removal and maintenance access to the pumps and equipment will need to be reviewed with SVCW O&M staff. The use of monorails and hoists will need to be considered. The local municipalities' and neighbor businesses' interests should also be considered.
- **Odor control.** Odor control field testing should be conducted in August/September timeframe to confirm odor control conceptual design assumptions. The odor control sizing should be updated as needed based on the new field data. An activated carbon system for BPS is proposed, but selection of the odor control system will be reviewed during pre-design. Odor control design at SCPS will be performed by others
- **Air exchange rates.** Air exchange rates for the wet well need to be finalized during final design.
- **SVCW design standards.** Updates to SVCW standards including automation standards and naming conventions will need to be incorporated into the detailed design. The detailed design teams will need to update the design documents to meet all of the new/updated design standards.
- **Environmental.** The Draft EIR released in November 2016 identified significant proposed Conveyance System Project impacts and proposed mitigation measures, which will need to be incorporated into the design of the Belmont Conveyance Project. Specific attention to air quality

impacts, biological resources, and cultural resources will be considered, in addition to the other impacts discussed in the EIR and summarized in this report.

- **SRF.** SVCW plans to fund the Belmont Conveyance Project through the SRF program. SRF requirements will need to be incorporated into the bid documents. Design engineer should also expect to provide project information for the SRF application.
- **Environmental permits.** Environmental permits required for construction will need to be finalized during detailed design. Permits identified during the environmental review included a BDCD permit for protection and maintaining existing access to shoreline trails, but additional permits may also be required.
- **Non-environmental permits.** Non-environmental permits required for construction will need to be finalized during detailed design. Permitting agencies identified as part of environmental review included Caltrans, the City of Belmont, the City of San Carlos, the City of Redwood City, and the FAA. Required permits will include, but are not limited to encroachment permits, easements, and temporary closures.
- **Land acquisition**. Land acquisition for staging and laydown areas, and temporary construction easements will need to be finalized and acquired during final design. Encroachment permits from Caltrans will also be critical for crossing the Holly Street on ramps and off ramps.
- **Bidding and construction**
  - Project schedule – The proposed Conveyance System Project schedule will need to be updated as design progresses.
  - Construction sequencing – The construction sequencing will need to be updated as the design develops and more information is obtained. Construction sequencing and timing will be critical as there are multiple existing utilities that have to remain online until the transition to gravity pipeline operation is in place. The construction sequencing will also need to be coordinated with the other projects ongoing for SVCW and the Cities of San Carlos and Belmont.
  - Construction staging – Construction staging locations will need to be finalized based on the environmental reviews and the results of the land acquisition efforts. Land acquisition efforts during predesign and design will be significant.
  - WWTP and pump station shutdowns – Shutdowns will need to be identified and coordinated with the O&M staff.
- **Technical specifications.** Technical specifications for the Belmont Conveyance Project should be developed during final design.

In addition to the items listed above, the following additional assessment, investigations and studies are recommended.

- **Geotechnical.** Additional geotechnical investigations will be required to support the Belmont FM Rehabilitation.
- **Seismic retrofit evaluation.** Seismic assessments will be required at BPS and SCPS to reflect the new California Building Code seismic requirements and any changes in the pump station conditions.

Section 8

Limitations

This document was prepared solely for Silicon Valley Clean Water (SVCW) in accordance with professional standards at the time the services were performed and in accordance with the contract between SVCW and Brown and Caldwell dated December 20, 2016. This document is governed by the specific scope of work authorized by SVCW; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work.

Further, Brown and Caldwell makes no warranties, express or implied, with respect to this document, except for those, if any, contained in the agreement pursuant to which the document was prepared.

All data, drawings, documents, or information contained this report have been prepared exclusively for the person or entity to whom it was addressed and may not be relied upon by any other person or entity without the prior written consent of Brown and Caldwell unless otherwise provided by the Agreement pursuant to which these services were provided.

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Section 9

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Appendix A: South Bayside System Authority Pump Station Pre-Design

Freyer & Laureta, September 2013

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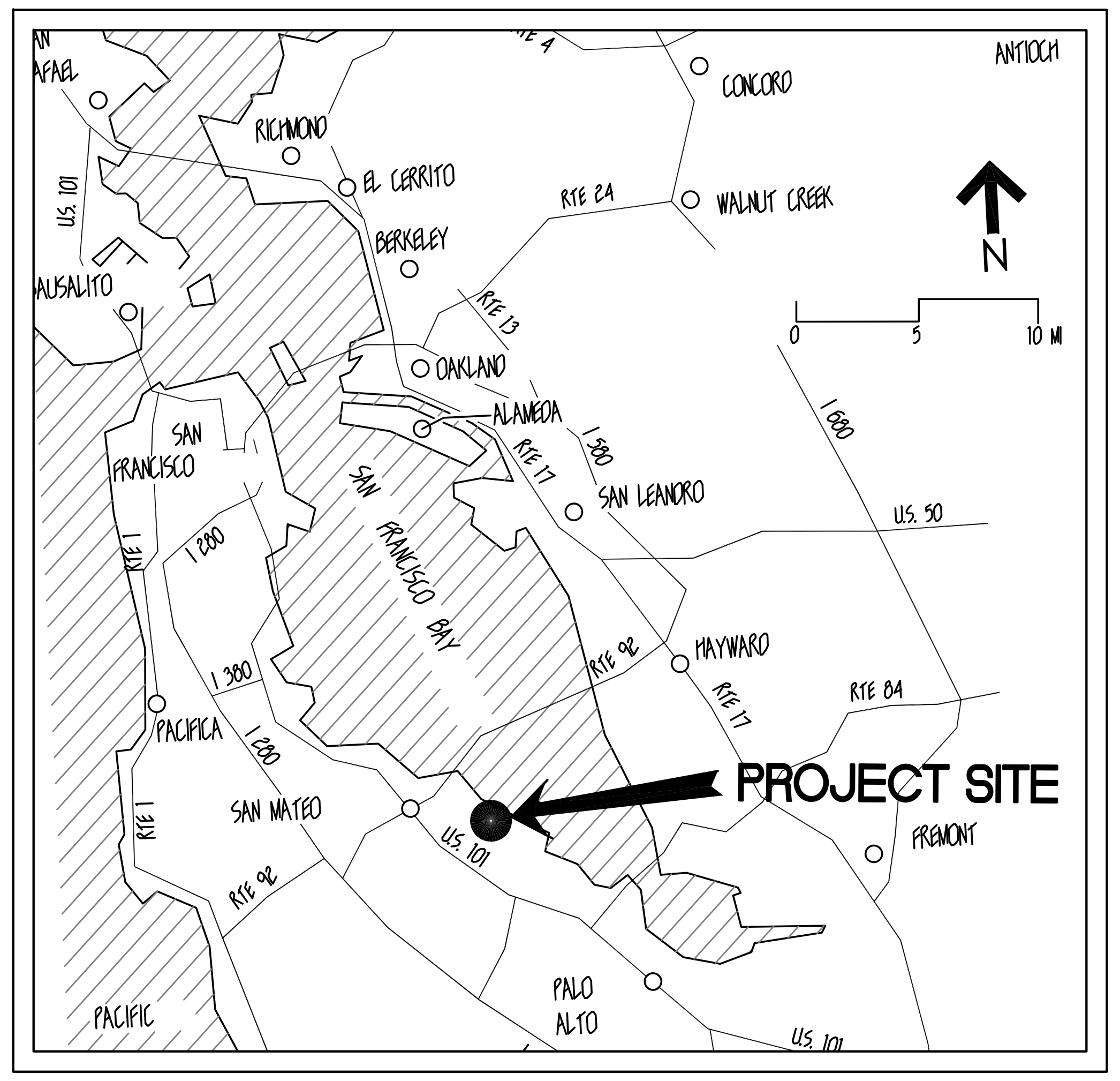
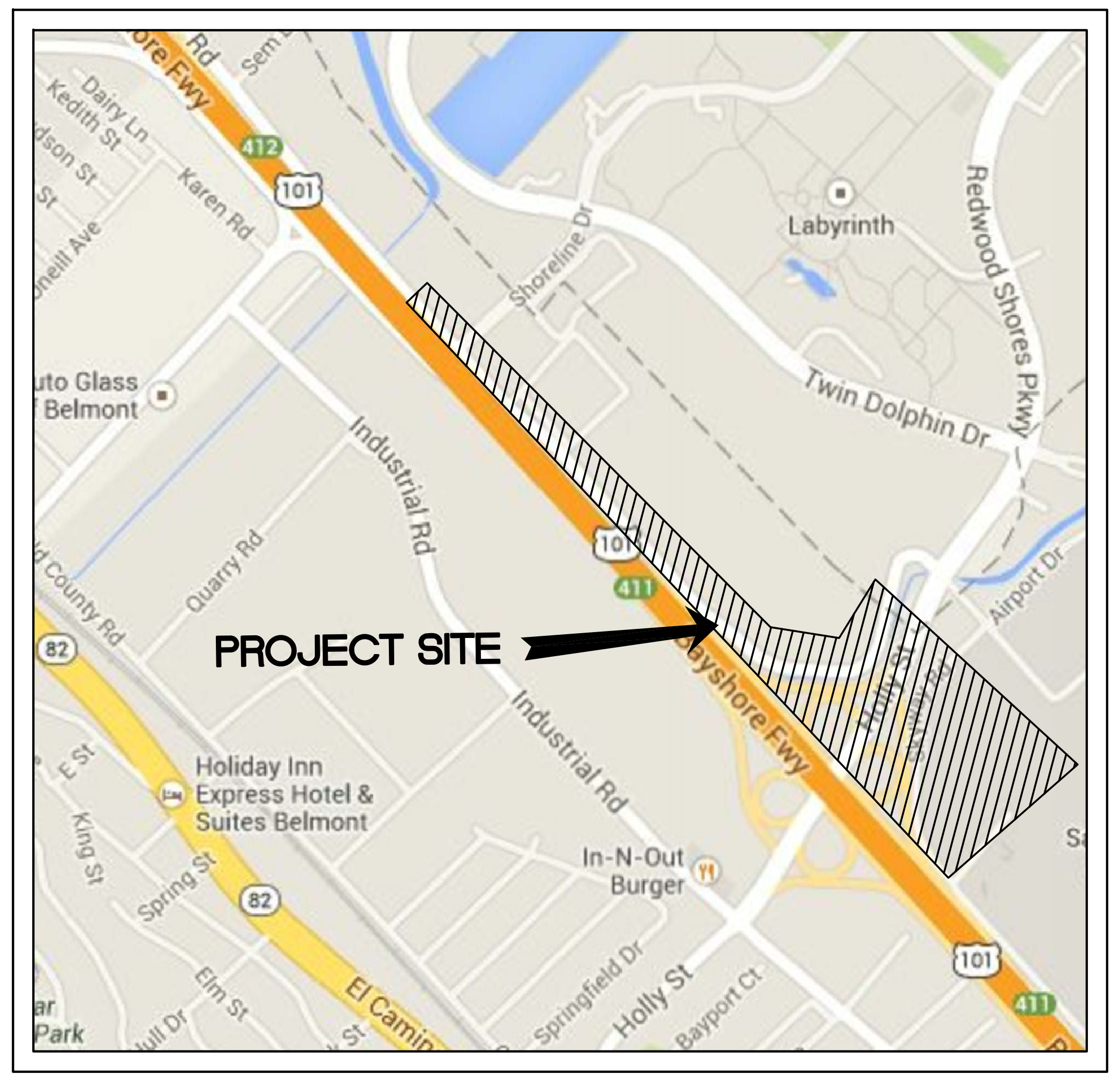
SOUTH BAYSIDE SYSTEM AUTHORITY
PUMP STATION PRE-DESIGN

BELMONT / SAN CARLOS , CALIFORNIA



REGIONAL LOCATION

NOT TO SCALE



VICINITY MAP

NOT TO SCALE

DRAWINGS

SHEET #	DESCRIPTION
1	COVER SHEET
2	SHEET INDEX
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7	SHOREWAY RD PLAN
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SAN MATEO COUNTY
CALIFORNIA

COVER SHEET

SOUTH BAYSIDE SYSTEM AUTHORITY
BELMONT/SAN CARLOS, CALIFORNIA

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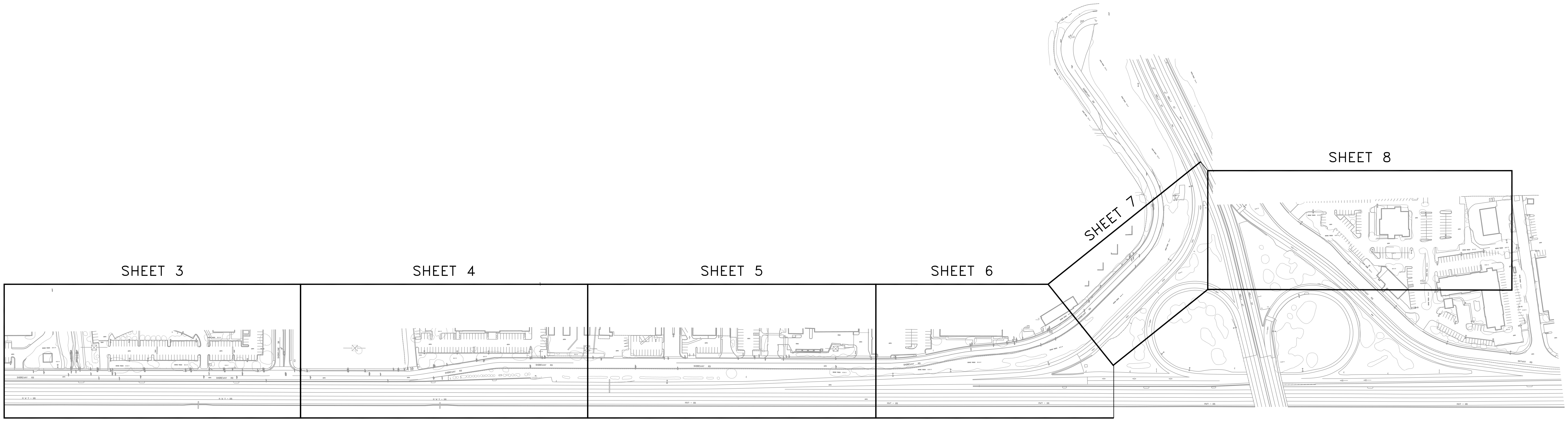

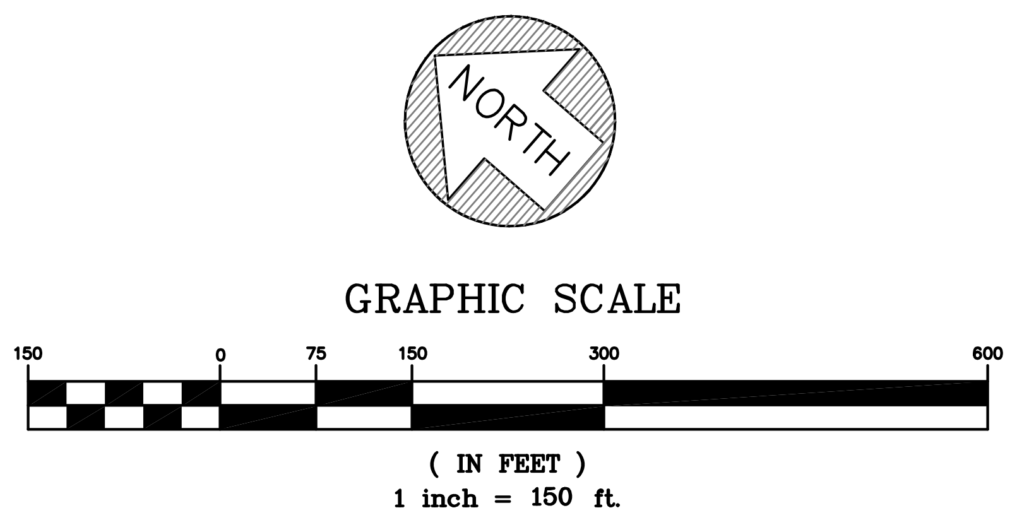

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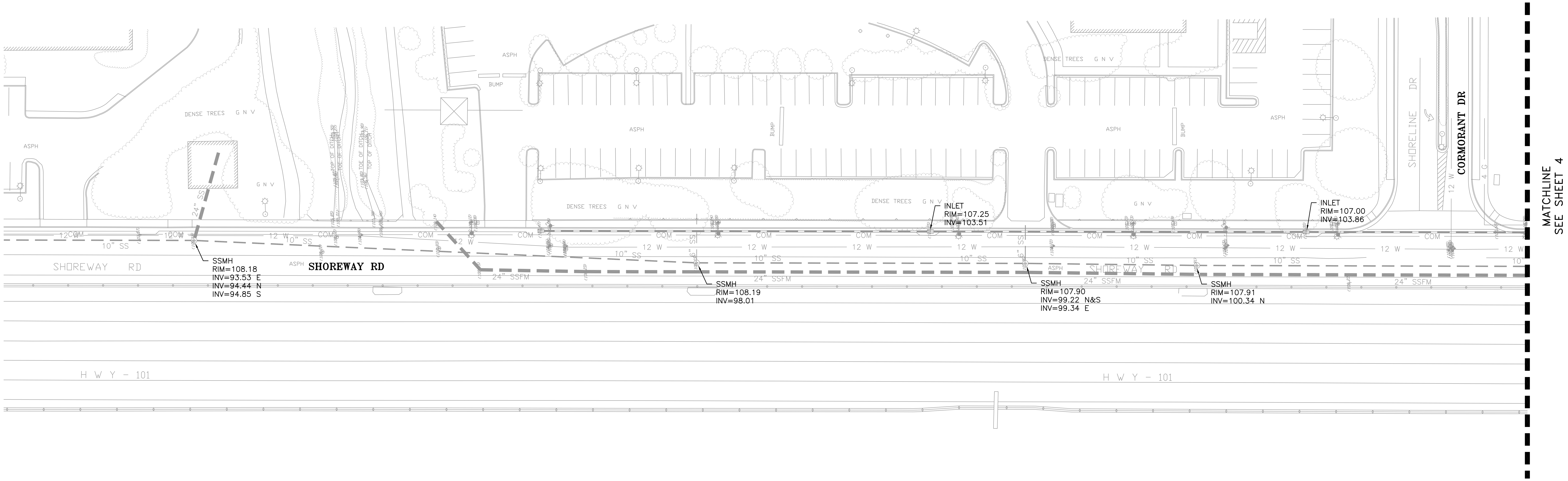

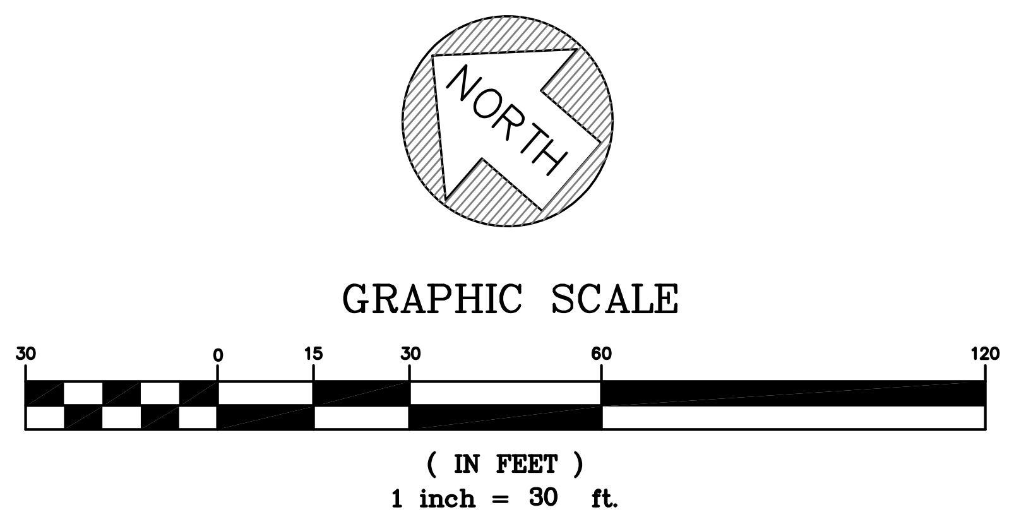

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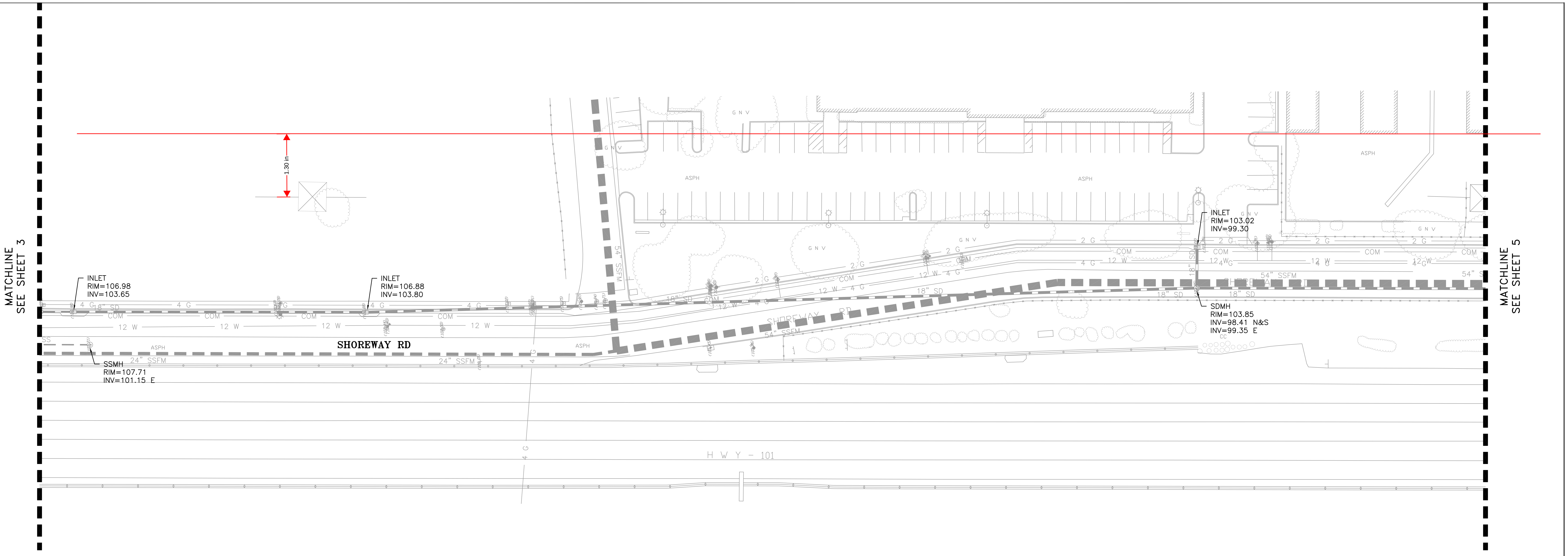

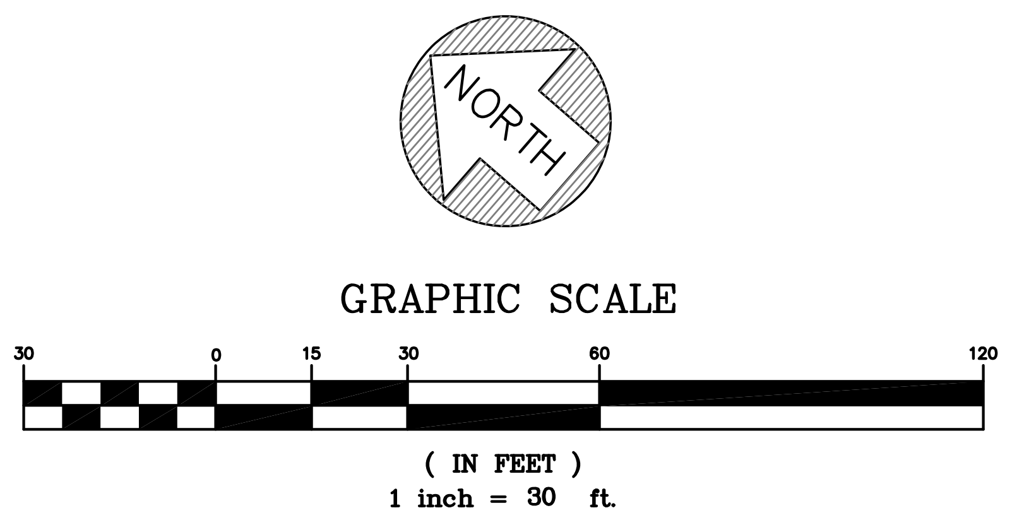

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SHOREWAY RD PLAN

SOUTH BAYSIDE SYSTEM AUTHORITY
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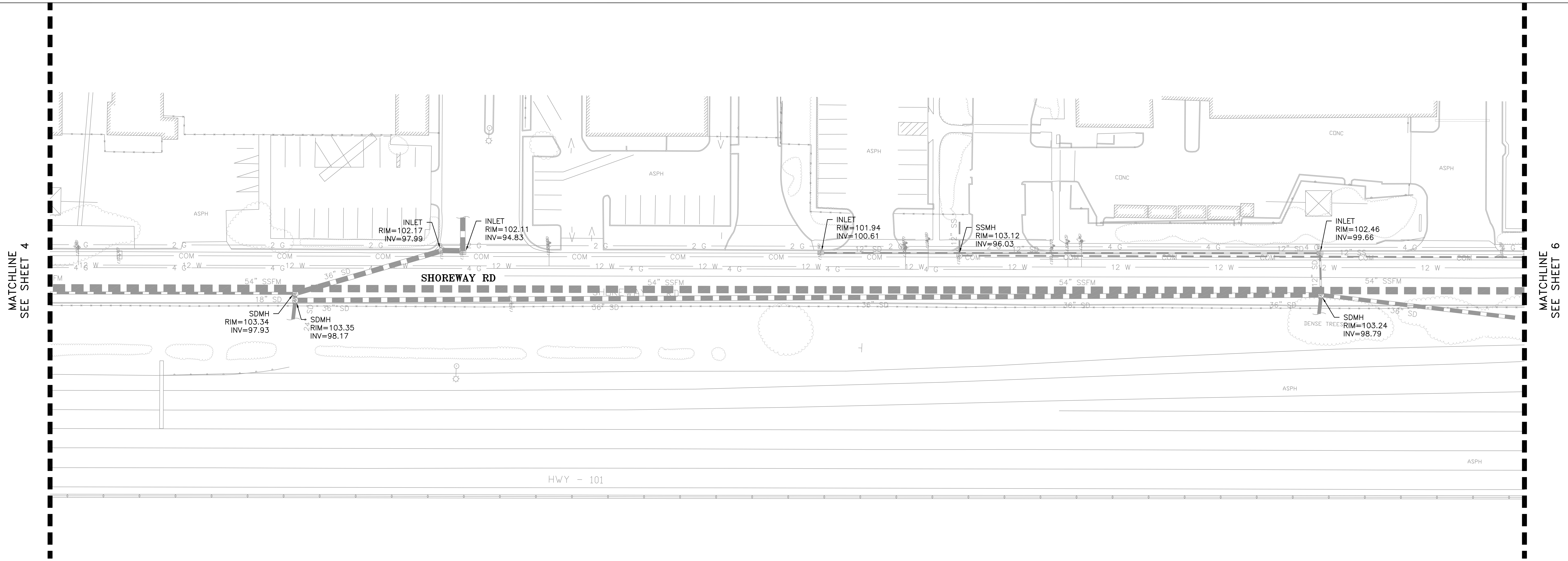

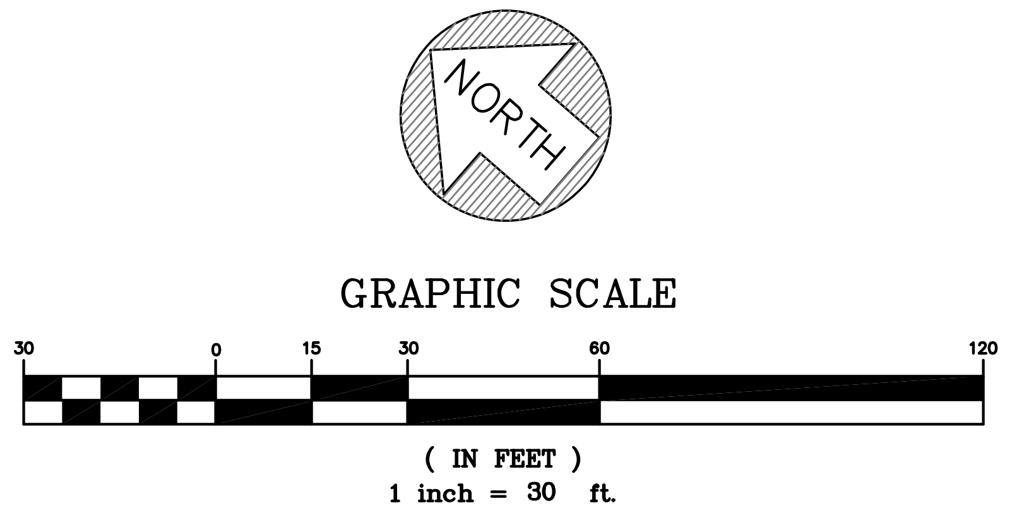

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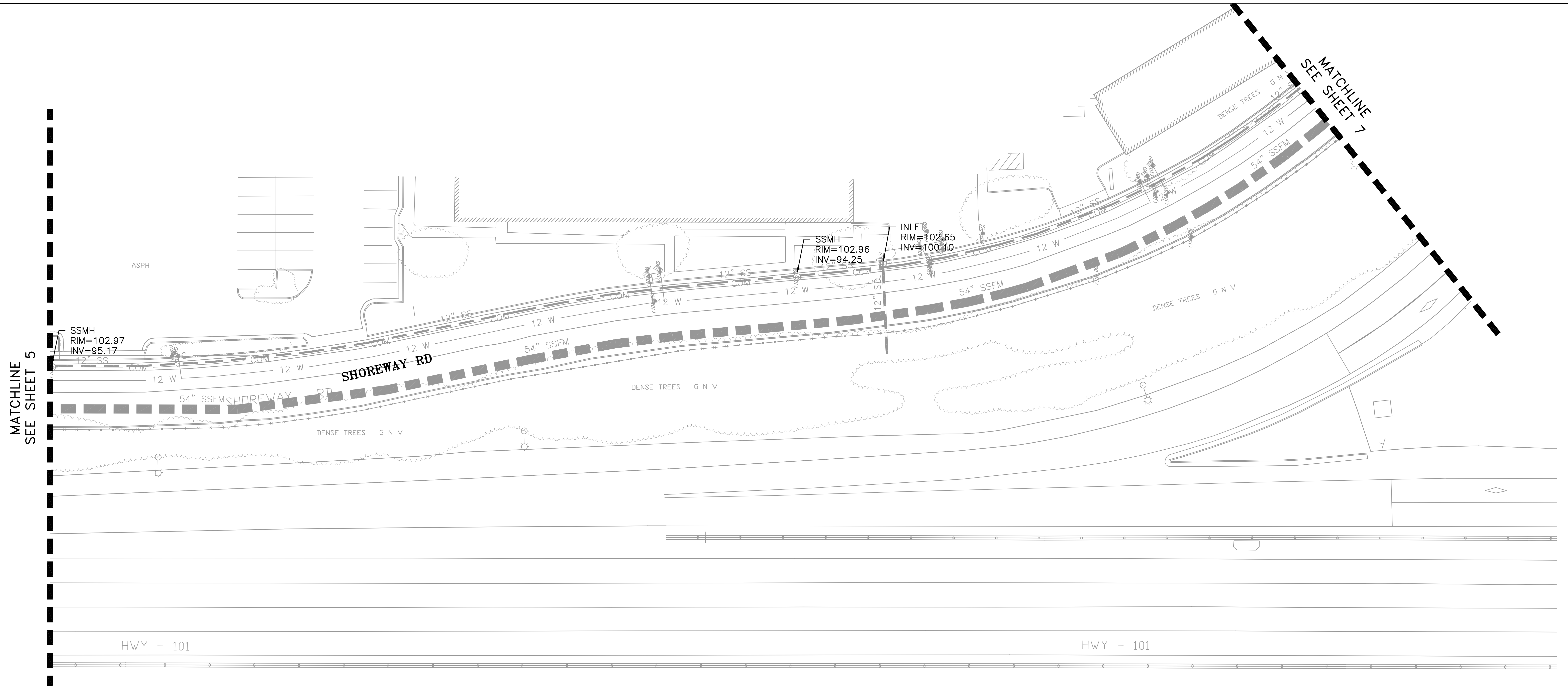

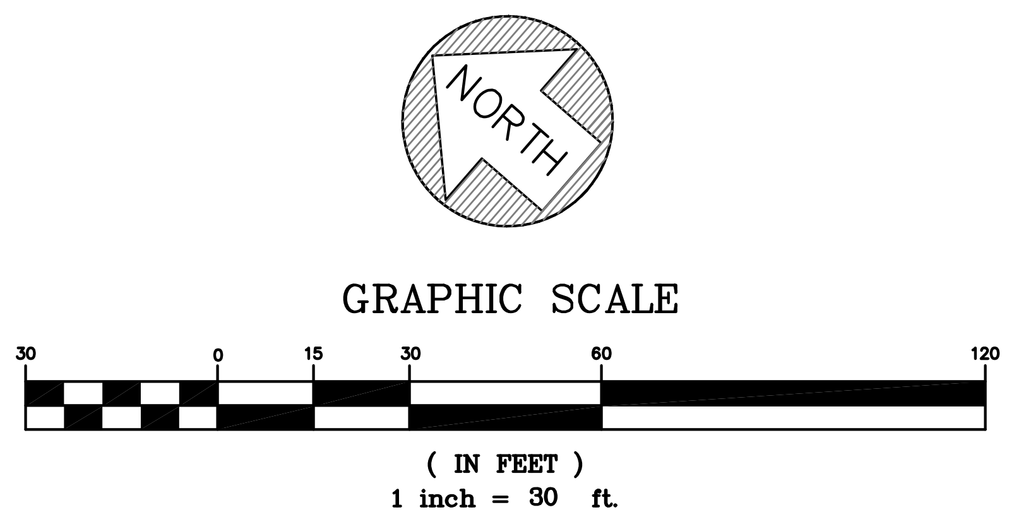

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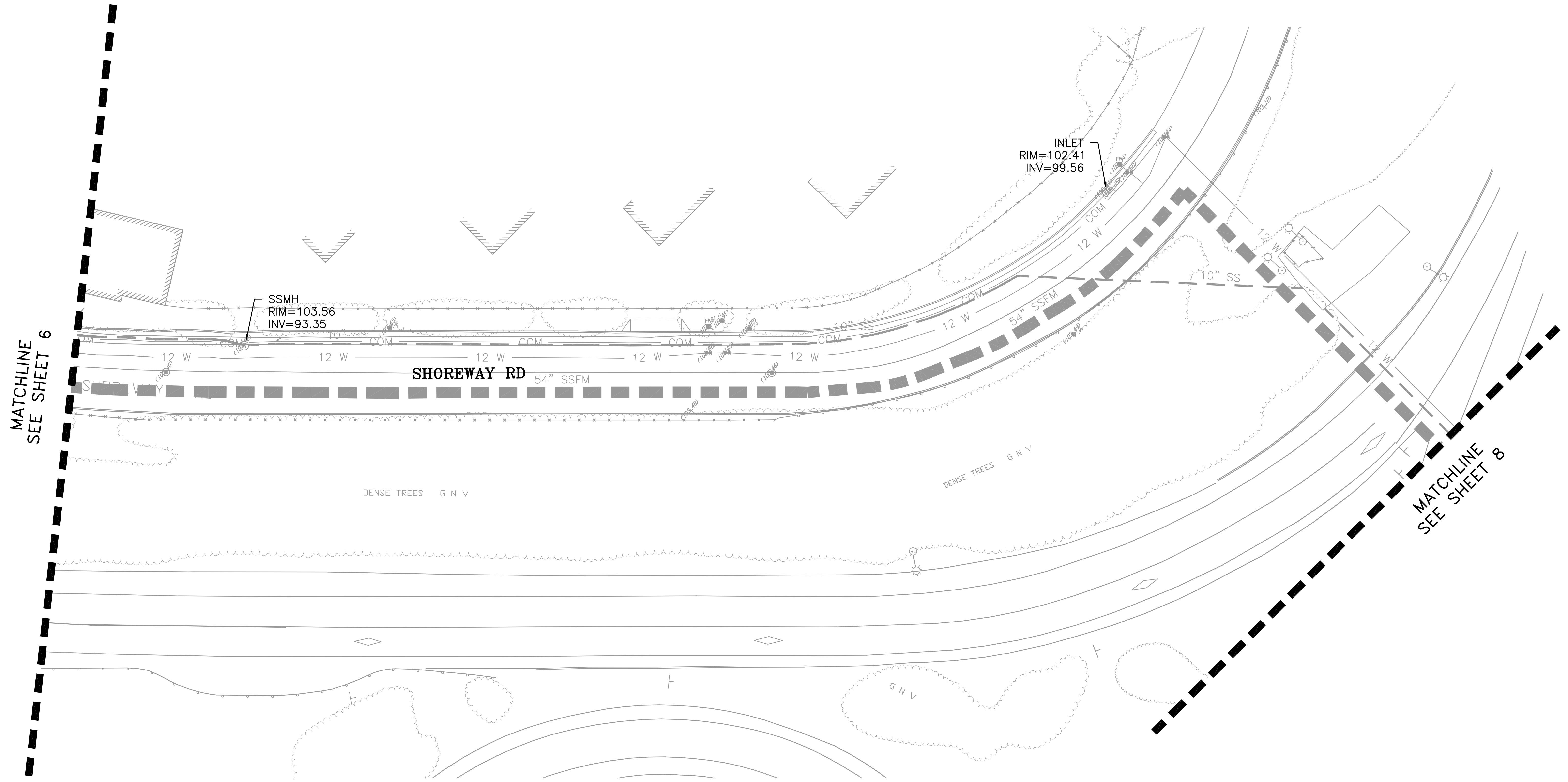

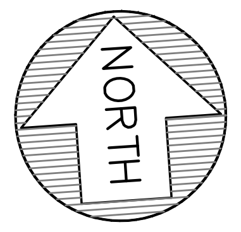

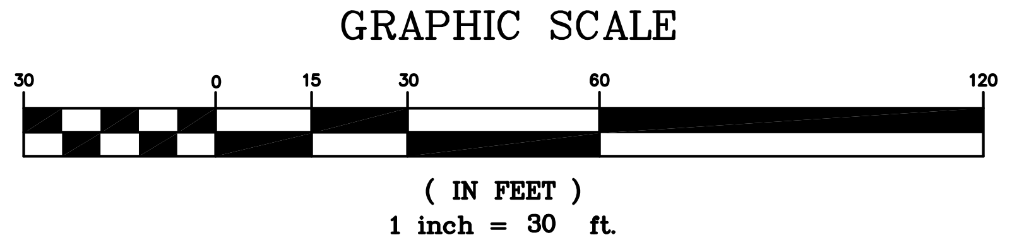

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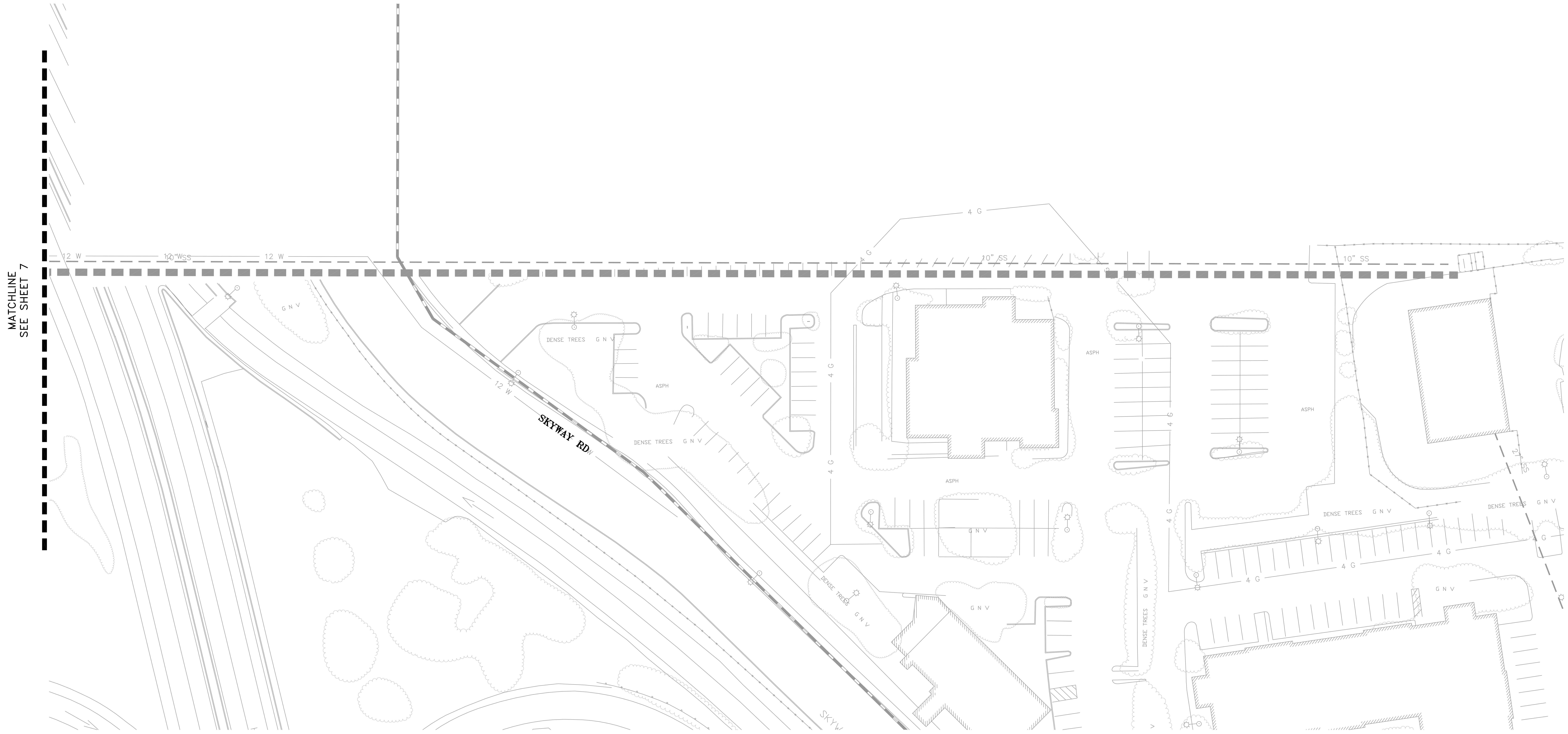

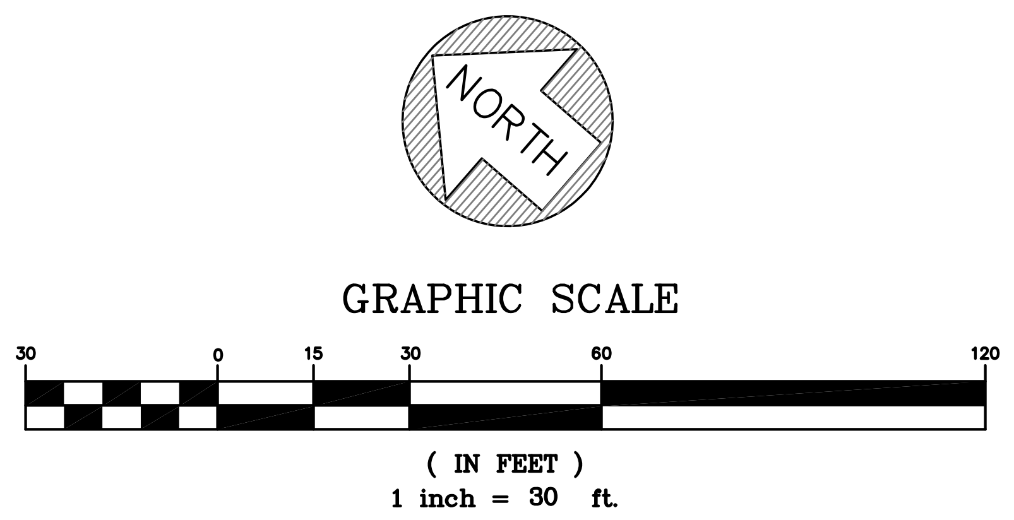

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Appendix B: TM 3.1 – Field Investigation Summary (Contaminated Materials Survey)

Brown and Caldwell, September 17, 2013

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201 North Civic Drive, Suite 115
Walnut Creek, California 94596
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Technical Memorandum

Prepared for: South Bayside System Authority

Project Title: Pump Station Predesign Project

Project No.: 142399

Technical Memorandum No. 3.1

Subject: Task 03 – Field Investigation Summary

Date: September 17, 2013

To: Kim Hackett, Project Manager, South Bayside System Authority

From: Charles Joyce, Project Manager, Brown and Caldwell

Prepared by: ________________________________
Alexandra Park, Senior Engineer
CA License No. C64117, Expiration 12/31/14
Engineer in Responsible Charge

Reviewed by: ________________________________
Timothy N. Banyai
CA License No. C60715, Expiration 12/31/14

Section 1: Introduction

This technical memorandum (TM) 3.1 summarizes the Contaminated Materials Survey completed by Forensic Analytical at the South Bayside System Authority (SBSA) Menlo Park Pump Station (PS), Redwood City PS, San Carlos PS, and Belmont PS. The purpose of the survey was to identify, sample, and analyze all suspect asbestos-containing materials that may be disturbed in the planned pump station demolition and to identify lead containing materials at the sites. Materials outside of the planned renovation areas were not tested. The survey results will be used to identify the extent of contaminated materials, provide information for the firm developing the detailed design to include in the Bidding Documents and provide a more realistic estimate of construction cost for removal and disposal of contaminated materials.

Section 2: Contaminated Materials Survey

A pre-demolition asbestos survey and lead testing for the four SBSA pump stations was conducted on July 26, 2012 by Forensic Analytical. This section summarizes the results presented in the reports. These reports are included in Attachment A.

2.1 Contaminated Materials Found

Asbestos was found at two of the four pump stations, Menlo Park PS and San Carlos PS. Lead was found in certain paints at all four pump stations. The description and locations of asbestos and lead found at the pump stations are summarized in Table 2-1.

Table 2-1. Contaminated Materials Found at Pump Stations

Pump Station	Asbestos	Location Description	Lead	Location Description
Menlo Park	12” Beige Vinyl Tile Floor and Mastic	West Utility Room, Office, Entry, and Bathroom	4 out of 9 Paints Tested	See Floor Plan Sketch in Attachment A for Locations
Redwood City	None Detected	N/A	7 out of 11 Paints Tested	See Floor Plan Sketch in Attachment B for Locations
San Carlos	12” Beige Vinyl Tile Floor and Mastic	Surface Level, West Utility Area, Office, and Bathroom	6 out of 8 Paints Tested	See Floor Plan Sketch in Attachment C for Locations
Belmont	None Detected	N/A	5 out of 7 Paints Tested	See Floor Plan Sketch in Attachment D for Locations

Section 3: Hazardous Waste Inspection

A visual inspection for hazardous waste was conducted on October 29, 2012 by Forensic Analytical and is summarized in a report dated January 7, 2013. The report is included in Attachment E. The purpose of the inspection was to identify hazardous materials that may be encountered in the pump station demolition. The items found at each of the pump stations fall within one of three categories: suspect Polychlorinated biphenyl (PCB) containing waste, universal waste, and other hazardous waste materials. These items are summarized in Table 3-1.

Table 3-1. Hazardous Waste Inspection Summary for SBSA Pump Stations

Category	Type	Waste Found at Pump Station (X)			
		Menlo Park PS	Redwood City PS	San Carlos PS	Belmont PS
Suspect PCB-Containing Waste	Electrical Switch Gear/Transformers (Wet Type)	X	X	X	X
	Fluorescent Light Fixture Ballasts	X	X	X	X
Universal Waste	Lead Acid Batteries	X	X	X	X
	Light Bulbs/Tubes	X	X	X	X
	Miscellaneous Chemicals and Cleaning Supplies	X	X	X	X
Other Hazardous Waste	Various Oils	X	X	X	X
	Oily Rags	X	X	X	X
	Diesel Fuel	X	X	X	X
	Generator (Oil, Fuel, Coolant)	X	X	X	X
	Sodium Hypochlorite		X	X	
	Bio Hazard Waste				X

Section 4: Recommendations

Recommendations were made for handling the contaminated and hazardous waste materials found at each of the pump station sites. The recommendations apply to all locations these materials are found on each site and are listed below.

4.1 Contaminated Material Recommendations

Recommendations were made for handling the asbestos and lead found at each of the pump station sites. The recommendations apply to all locations these materials are found on each site and are listed in Table 4-1.

Table 4-1. Contaminated Material Recommendations

Asbestos Materials[1]	Remove prior to demolition by licensed asbestos abatement contractor.
	Consult Certified Asbestos Consultant to assist with project design and monitoring, including clearance inspection and air sampling after asbestos removal.
	If any additional suspect asbestos-containing material is discovered during the renovation, the work should stop, and the material should be tested.

Table 4-1. Contaminated Material Recommendations

Lead Materials[2]	Work performed on surfaces containing any amount of lead must comply with the Cal/OSHA Lead in Construction Safety Standard (8 CCR 1532.1).
	Remove lead paint at spots scheduled for disturbance by the construction to eliminate the Cal/OSHA trigger task and worker protection and monitoring requirements. Otherwise, utilize Cal/OSHA standards for working around lead.
	Remove areas of lead containing paint where the paint is peeling or deteriorated prior to sending components for recycling or disposal and prior to demolition. The paint chips are likely classified as hazardous waste and will contaminate any waste at the site with which they are combined.
	Paint chips and other waste generated from paint removal as well as painted components destined for disposal, should be tested for lead. If the lead content is determined to be hazardous according to the applicable Federal and State regulations, the paint should be removed accordingly.

[1] *12-inch square Beige Vinyl tile floor and Mastic found at Menlo Park PS and San Carlos PS*

[2] *Lead found in some of the paints at all four pump stations*

4.2 Hazardous Waste Material Recommendations

The recommendation for the suspect PCB-containing waste is to sample the materials after energy isolation or to otherwise assume that they contain PCBs.

All regulated and hazardous waste items listed in Table 3-1 above should be properly packaged, labeled, transported and disposed of or recycled in accordance with all applicable federal, state and local regulations.

Attachment A: Pre-Demolition Asbestos Survey & Lead Testing Reports by Forensic Analytical

Menlo Park Pump Station, August 13, 2012

Forensic Analytical

ENVIRONMENTAL HEALTH CONSULTANTS

Pre-Demolition Asbestos Survey & Lead Testing Report

SBSA Menlo Park Pump Station
Marsh Road at Highway 101
Menlo Park, California

August 13, 2012

Prepared for:

Mr. Timothy Banyai
Brown and Caldwell
201 North Civic Center Drive, Suite 115
Walnut Creek, CA 94596
tbanyai@brwncald.com

Prepared by:

Wilson Wong
Forensic Analytical Consulting Services, Inc.
3777 Depot Road, Suite 413
Hayward, CA 94545
510-266-4600 ♦ wwong@forensicanalytical.com

FACS Project #PJ17441

Table of Contents

Executive Summary

Forensic Analytical Consulting Services, Inc. (FACS) performed a pre-demolition asbestos survey and lead testing at the SBSA San Carlos Pump Station on July 26, 2012. The purpose of the survey was to identify, sample, and analyze all suspect asbestos-containing materials that may be disturbed in the planned demolition.

The survey was intended to meet the requirements of the Bay Area Air Quality Management District. The results of this report should be incorporated into any demolition plans for the building.

Asbestos was identified in the following materials:

Material Description	Location(s) of Material
12-inch beige vinyl floor tile and black mastic	**West utility room, office, entry and bathroom**

Lead was detected in four (4) of the nine (9) paints tested, two of the paints were determined to be lead-based paint, while the other two were determined to be lead-containing paint.

Results of laboratory testing are summarized in the attached tables. The summary tables must not be used alone. Important explanations and limitations are contained in the full report text below.

Introduction

Forensic Analytical Consulting Services, Inc. (FACS) was retained by Mr. Timothy Banyai of Brown and Caldwell to perform a pre-demolition asbestos survey of the SBSA Menlo Park Pump Station located at Marsh Road at Highway 101 in Menlo Park, California. Peter Radzinski of FACS performed the investigation on July 26, 2012. Mr. Radzinski is certified by the State of California as a Certified Site Surveillance Technician (Cert. No. 05-3772). Project Management was provided by Mr. Paulo Parra a California Certified Asbestos Consultant (Cert. No 11-4806). Certifications of FACS personnel are presented in Appendix D.

This report contains the findings and recommendations from our inspection and laboratory analysis of samples collected. The purpose of the survey was to identify, sample, and analyze all suspect asbestos- and lead containing materials that may be disturbed in the planned demolition, within the limitations described below.

Site Description and Scope of Work

The Project building was a cinder block structure with rolled-on roof. The building was a pump station, and the interior was divided into east and west utility areas, with a surface level and two sub-levels at the west utility area and one sub-level at the east.

This survey was performed for the planned demolition of the pump station.

Methodology

Our investigation consisted of the following:

- Visual inspection
- Documentation of relevant conditions
- Collection of samples of suspect asbestos-containing materials using the AHERA sampling protocol
- Collection of samples of suspect lead paint
- Submitting samples to a laboratory accredited by AIHA, NVLAP, and ELAP for analysis by PLM & Flame AA
- Presenting analytical results, conclusions, and recommendations in a report, which can be submitted to the Bay Area Air Quality Management District.

The types, numbers, and locations of samples were determined based on information about the planned demolition, visual observations, regulatory requirements, and other project management considerations.

Findings

Survey results are summarized in the attached table (Appendix A).

Asbestos was identified in the following materials:

Material Description	Location(s) of Material	Asbestos Regulatory Classification
12-inch beige vinyl floor tile and mastic	**West utility room, office, entry and bathroom**	**Category I Nonfriable ACM**

Lead was detected in four (4) of the nine (9) paints tested. Paint testing results ranged from <0.008% to 24% lead by weight.

A floor plan showing sample locations is presented in Appendix B. The detailed laboratory report and completed Sampling Data Form (Chain of Custody) are contained in Appendix C.

Conclusions and Discussion

Asbestos

The 12-inch beige vinyl floor tile and mastic in the utility room, office, entry and bathroom contain asbestos. The vinyl floor tile and mastic are Asbestos-Containing Materials (ACM) and also Asbestos-Containing Construction Materials (>0.1% asbestos) in California. The vinyl floor tile and mastic are subject to regulations of USEPA, BAAQMD, Cal/OSHA, and CSLB.

An asbestos-containing material for which sample analysis results by PLM are greater than one percent asbestos is classified as Asbestos-Containing Material (ACM) under regulations promulgated by: : US EPA, BAAQMD, Cal-EPA, OSHA, and Cal/OSHA. US EPA and BAAQMD require that a material with a PLM analytical result less than 10% (including Trace results of less than one percent) be confirmed by the point count method, or else the material must be assumed to be ACM.

An asbestos-containing material for which sample analysis results by PLM are greater than 0.1 percent asbestos is classified as Asbestos-Containing Construction Material (ACCM) by Cal/OSHA and by the California Contractor State Licensing Board (CSLB).

OSHA (Cal/OSHA) regulates all materials that contain asbestos. At a minimum, employee training, wet methods, HEPA vacuums, and prompt cleanup and disposal of debris in leak-proof containers are recommended or required for the disturbance of any material that contains asbestos.

Lead

Lead is primarily regulated in California by Cal/OSHA and the California Department of Public Health. The current Cal/OSHA Lead in Construction Safety Standard (8 CCR 1532.1) regulation applies to all construction work where an employee may be occupationally exposed to lead. Therefore, work performed on surfaces (including manual demolition, scraping, welding, etc.) containing any amount of lead must comply with the standard, including an exposure assessment (personal air monitoring) to determine if the airborne lead exposure levels are within acceptable limits.

Since **lead was detected in some of the paint chip samples** collected (ranging from 0.008% to 24%), 8 CCR 1532.1 applies to any work that will disturb these lead-containing paints. Other components represented by the positive lead samples in the Summary of Lead Testing Laboratory Results shall be considered to be lead-containing until proven otherwise.

For detailed regulatory requirements in specific situations, FACS should be consulted, or the applicable regulations should be examined

Recommendations

1. The vinyl floor tile and mastic should be removed prior to the planned demolition by a licensed asbestos abatement contractor who complies with all applicable regulations.

2. A Certified Asbestos Consultant should be consulted to assist with project design and monitoring, including clearance inspection and air sampling after asbestos removal.

3. If any additional suspect asbestos-containing material is discovered during the renovation, the work should stop, and the material should be tested for asbestos content.

4. Removal of the lead paint at spots scheduled for disturbance by the construction would eliminate the applicability of the Cal/OSHA standard to the paint. If the paint is not removed, and the work will involve a Cal/OSHA trigger task (such as torch cutting), workers must be protected during the initial exposure monitoring, per the Cal/OSHA Lead Standard requirements, as if they were exposed above the Permissible Exposure Limit, until actual exposures are determined. With torch cutting, for example, this includes providing supplied air respiratory protection during the initial exposure assessment.

5. Because some of the paint present is peeling or deteriorated, these areas of paint should be removed from components prior to sending components for recycling or disposal. The paint chips are likely to be classified as hazardous waste for lead, whereas the components with the remaining intact paint may possibly test as non-hazardous. Scraping of loose and flaky paint prior to removal/demolition of the components is intended to prevent loose paint chips from contaminating the larger quantity of components and causing the larger load of waste to be classified as hazardous, and also intended to prevent paint chips from dislodging and contaminating the ground at the site or along the waste/recycling transportation route.

6. Paint chips and other waste generated from the paint removal, as well as painted components destined for disposal, should be tested to determine if it is hazardous waste. For reference, lead waste is considered a hazardous waste if the result of the Toxicity Characterization Leaching Procedure (TCLP) test exceeds 5 mg/liter, under the Resource Conservation and Recovery Act (RCRA), 40 CFR 261, Appendix II. In California, a waste is also considered hazardous if the result of soluble lead content by a Waste Extraction Test (WET) is greater than 5 mg/l, or if the total lead content exceeds 1,000 mg/kg in accordance with Title 22 of the CCR. When TTLC results are below 50 mg/kg, STLC/TCLP limits cannot be exceeded, so the waste would be classified as non-hazardous for lead. Other hazardous metals historically utilized in paint manufacture should also be tested to determine hazardous waste classification.

7. For further assistance with regulatory requirements, FACS should be consulted, and the applicable regulations should be reviewed.

Limitations

The results of this asbestos survey and lead testing do not apply beyond the planned renovation described above. Construction materials in areas not included in the scope of this survey should be assumed to be asbestos-containing materials / lead paint, unless testing is conducted which determines otherwise. If revisions to the renovation project are made that impact additional materials or areas, FACS should be contacted to review the changes and/or to conduct additional asbestos survey work to address potential impacts to untested materials.

The scope of this asbestos survey and lead testing did not include the identification of other hazardous materials, which might exist in the area of the planned renovation. Other hazardous materials may include polychlorinated biphenyls (PCBs) in fluorescent light ballasts and caulking, lead in paint, and mercury in light fixtures and switches.

This investigation is limited to the conditions and practices observed and information made available to FACS. The methods, conclusions, and recommendations provided are based on FACS' judgment and experience and on the standard of practice for professional service. They are subject to the limitations and variability inherent in the methodology employed. As with all environmental investigations, this investigation is limited to the defined scope and does not purport to set forth all hazards, nor to indicate that other hazards do not exist.

Please do not hesitate to contact our office at 510-266-4600 if you have any questions about our report. Thank you for the opportunity to assist Brown and Caldwell in promoting a more healthful environment.

Respectfully,
Forensic Analytical Consulting Services

Wilson Wong
Program Manager
CAC 92-0791, CDPH 4401

Reviewed by:
Forensic Analytical Consulting Services

Stephen E

Steve Jackson
Director of Consulting
CAC 95-1782

Appendix A:

Asbestos Survey & Lead Testing Results Summary Table

PRE-RENOVATION ASBESTOS SURVEY SUMMARY

SBSA Menlo Park Pump Station
Marsh Road at Highway 101, Menlo Park, California
Date(s) of Sampling: 7/26/2012

Sample Number	Material Description	Location(s) of Material	Asbestos Content (Percent)	Asbestos Regulatory Classification	Approximate Quantity
MP-A01	Wallboard and Taping Compound	Utility Room Enclosure	ND	Not applicable	Not applicable
MP-A02	Hard Wall Surfacing Material	Utility Room/Bathroom Enclosure	ND	Not applicable	Not applicable
MP-A03	Roof Field	Roof	ND	Not applicable	Not applicable
MP-A04	Roof Parapet	Parapet	ND	Not applicable	Not applicable
MP-A05	Blue Painted, Black Sealant	Roof	ND	Not applicable	Not applicable
MP-A06	White Sealant	Air Handler on Room	ND	Not applicable	Not applicable
MP-A07 MP-A08	Brown Adhesive	Walls, Utility Room	ND	Not applicable	Not applicable
MP-A09 MP-A10	12"x12" Beige Floor Tile with Black Mastic	West utility area, Office, Entry, Bathroom	Tile: 2% Mastic: 7%	Category 1 Non-Friable	180 SF

ND = None Detected; Trace = less than one percent by visual area estimation; RACM = friable (easily damaged by hand pressure) or likely to become friable during renovation/demolition; Category I Nonfriable = nonfriable packings, gaskets, resilient floor coverings (not including backing), and asphaltic roofing; Category II Nonfriable = Nonfriable materials other than Category I

NOTE: This summary table must not be used alone. Important explanations and limitations are contained in the accompanying survey report text. Percent asbestos content is based upon visual area estimation unless noted otherwise (point count analysis was not performed).

PRE-RENOVATION ASBESTOS SURVEY SUMMARY

SBSA Menlo Park Pump Station
Marsh Road at Highway 101, Menlo Park, California
Date(s) of Sampling: 7/26/2012

Sample Number	Material Description	Location(s) of Material	Asbestos Content (Percent)	Asbestos Regulatory Classification	Approximate Quantity
MP-A11	Black Sealant	West utility area, duct	ND	Not applicable	Not applicable
MP-A142	TSI Elbow	West utility area, generator exhaust	ND	Not applicable	Not applicable
MP-A13	Gasket	West utility area, 2nd level below	ND	Not applicable	Not applicable
MP-A14 MP-A15 MP-A16 MP-A17 MP-A18 MP-A19 MP-A20	Skim Coat	Interior Walls	ND	Not applicable	Not applicable
MP-A21 MP-A22 MP-A23 MP-A24 MP-A25	Stucco	Exterior Walls	ND	Not applicable	Not applicable

ND = None Detected; Trace = less than one percent by visual area estimation; RACM = friable (easily damaged by hand pressure) or likely to become friable during renovation/demolition; Category I Nonfriable = nonfriable packings, gaskets, resilient floor coverings (not including backing), and asphaltic roofing; Category II Nonfriable = Nonfriable materials other than Category I

NOTE: This summary table must not be used alone. Important explanations and limitations are contained in the accompanying survey report text. Percent asbestos content is based upon visual area estimation unless noted otherwise (point count analysis was not performed).

SUMMARY OF LEAD TESTING LABORATORY RESULTS

SBSA San Carlos Pump Station
150 Monte Vista Drive, San Carlos, California
Date(s) of Sampling: 7/26/2012

Description	Sample Number	Analytical Result
Roof, Parapet Cap, Silver Paint	**MP-Pb01**	**24%**
West Utility Room, Duct, Gray Paint	MP-Pb02	<0.006%
West utility area, Stairs, Yellow	MP-Pb03	<0.008%
West Utility Area, Entry Door, Blue	**MP-Pb04**	**0.54%**
West Utility Room, Hand Rail, Silver	MP-Pb05	<0.04%
West Utility Room, Wall, Beige	MP-Pb06	<0.007%
West Utility Room, MPPS1, Blue	**MP-Pb07**	**0.028%**
West Utility Room, Wall, Beige	MP-Pb08	<0.02%
West Utility Room, Pump 3, Blue	**MP-Pb09**	**0.21%**

% means: percent lead in sample, by weight
< means: less than

Appendix B:

Floor Plan – Sample Locations

Forensic Analytica FLOOR PLAN FORM

ENVIRONMENTAL HEALTH CONSULTANTS

Date: 25 July 2012

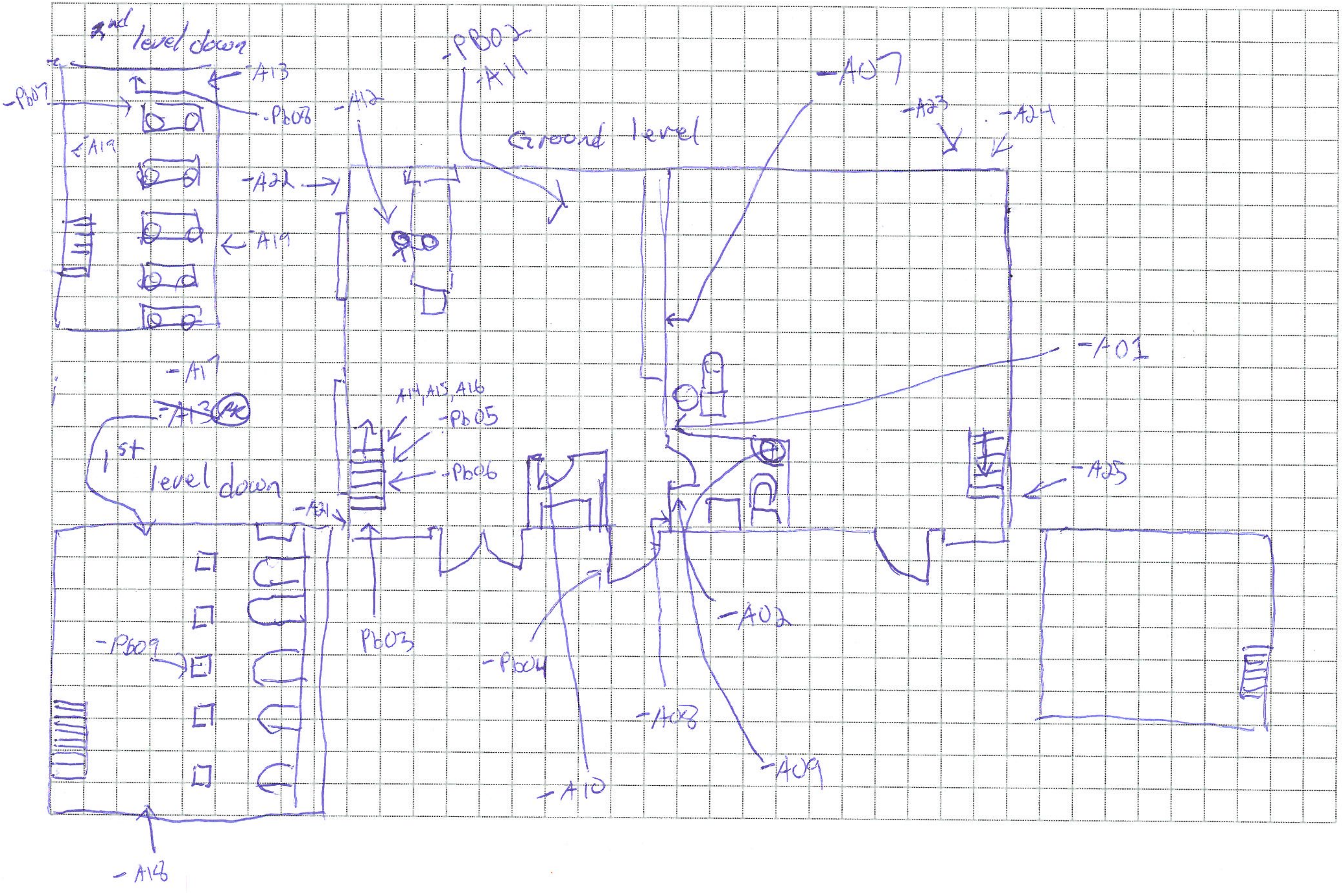
Job #: PJ17441

Site: Various SBSA

Title: sketch

Insp[illegible]rs:

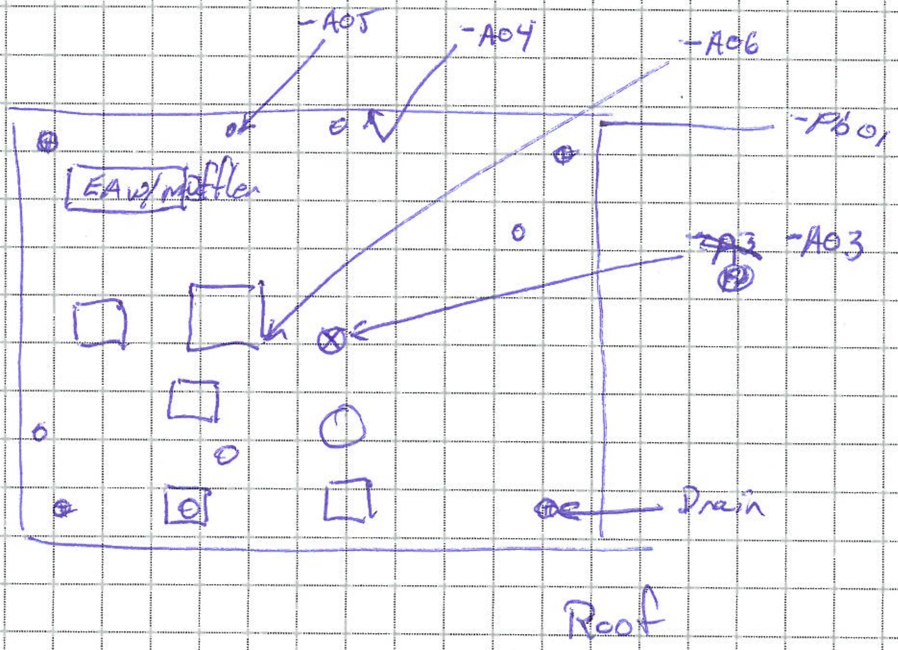
Legend:



Forensic Analytica ENVIRONMENTAL HEALTH CONSULTANT FLOOR PLAN FORM	Date: 25 July 2012	Job #: PJ17441	Site: Various SBSA	Title: sketch	Insp ors: PJR ML

Legend:

N



Appendix C:

Supporting Laboratory Reports and Chain-of-Custody Documents

Final Report

Forensic Analytical Laboratories

Metals Analysis of Bulks

Forensic Analytical Consulting Svcs
Paulo Parra
3777 Depot Road
Suite 413
Hayward, CA 94545

Client ID: HAY01
Report Number: M131399
Date Received: 07/26/12
Date Analyzed: 07/31/12
Date Printed: 07/31/12
First Reported: 07/31/12

Job ID / Site: PJ17441; Various SBSA
Date(s) Collected: 7/25/12

FALI Job ID: HAY01
Total Samples Submitted: 1
Total Samples Analyzed: 1

Sample Number	Lab Number	Analyte	Result	Result Units	Reporting Limit*	Method Reference
MP-PB01	30439859	Pb	240000	mg/kg	20000	EPA 3050B/7420

* The Reporting Limit represents the lowest amount of analyte that the laboratory can confidently detect in the sample, and is not a regulatory level. The Units for the Reporting Limit are the same as the Units for the Final Results.

Daniele Siu

Daniele Siu, Laboratory Supervisor, Hayward Laboratory

Forensic Analytical Laboratories

Final Report

Metals Analysis of Paints

Forensic Analytical Consulting Svcs
Paulo Parra
3777 Depot Road
Suite 413
Hayward, CA 94545

Client ID: HAY01
Report Number: M131269
Date Received: 07/26/12
Date Analyzed: 07/31/12
Date Printed: 07/31/12
First Reported: 07/31/12

Job ID / Site: PJ17441; Various SBSA
Date(s) Collected: 7/25/12

FALI Job ID: HAY01
Total Samples Submitted: 8
Total Samples Analyzed: 8

Sample Number	Lab Number	Analyte	Result	Result Units	Reporting Limit*	Method Reference
MP-PB02	30439860	Pb	< 0.006	wt%	0.006	EPA 3050B/7420
MP-PB03	30439861	Pb	< 0.008	wt%	0.008	EPA 3050B/7420
MP-PB04	30439862	Pb	0.54	wt%	0.03	EPA 3050B/7420
MP-PB05	30439863	Pb	< 0.04	wt%	0.04	EPA 3050B/7420
Comment:	Insufficient sample size for repeatable analysis.					
MP-PB06	30439864	Pb	< 0.007	wt%	0.007	EPA 3050B/7420
MP-PB07	30439865	Pb	0.028	wt%	0.006	EPA 3050B/7420
MP-PB08	30439866	Pb	< 0.02	wt%	0.02	EPA 3050B/7420
Comment:	Insufficient sample size for repeatable analysis.					
MP-PB09	30439867	Pb	0.21	wt%	0.03	EPA 3050B/7420

* The Reporting Limit represents the lowest amount of analyte that the laboratory can confidently detect in the sample, and is not a regulatory level. The Units for the Reporting Limit are the same as the Units for the Final Results.

Daniele Siu

Daniele Siu, Laboratory Supervisor, Hayward Laboratory

Forensic Analytical

PAINT CHIP SAMPLE REQUEST FORM

Page 1 of 1

Client: HAY01 FALS S.F Brown & Caldwell

Sampled by: Pete R.

PM: PP

Date: 7/25/12

Contact: Paulo Parra

Phone: 510-266-4609

Special Instructions: **Email results to** pparra

Site: Various SBSA

Turnaround Time: Rush ☐ 24 Hour ☐ 3-Day ☑

Due Date & Time:

Client No.: C1114

ESD No.: PJ17441

Analysis: [✓ Flame AA (Pb)] / Other:

Sample Number	Sample Location	Component	Color	Substrate	Condition
MP-Pb01	Roof, parapit, northeast corner of cap, seam	parapit cap	silver	metal	G
MP-Pb02	west utility room, e.a. duct in NE corner @ floor level	duct	gray	metal	G
MP-Pb03	west utility room, stairs, step	step	yellow	concrete	F
MP-Pb04	west utility room, entry door	door	blue	metal	G
~~MP-Pb05~~	~~west utility room, intake louvres~~ ML	passive vent	~~black~~	~~metal~~	G
MP-Pb~~06~~ 05 ML	west utility room, stairwell hand rail	hand rail	silver	metal	G
MP-Pb06	west utility room, stairwell wall	stairwell wall	beige	concrete	F
MP-Pb07	west utility room, 2nd floor below ground, paint on MPPS 1	Pump ~~paint on~~ the MPPS 1	blue	metal	F
MP-Pb08	west utility room, 2nd floor below ground, paint on wall	wall	beige	concrete	F
MP-Pb09	west utility room, 1st floor below ground, paint on Pump 3	pump	blue	metal	F

Substrate: wood metal concrete plaster drywall brick

Shipped via: ___ Fed Ex ___ Airborne ___ UPS ___ US Mail ___ Courier XXX Drop Off Other:

Relinquished by: Redzinski

Date & Time:

Received by: 26 July 2012/0630

Date & Time:

Condition Acceptable Yes No

Forensic Analytical Laboratories

Final Report

Bulk Asbestos Analysis

(EPA Method 600/R-93-116, Visual Area Estimation)

Forensic Analytical Consulting Svcs
Paulo Parra
3777 Depot Road
Suite 413
Hayward, CA 94545

Client ID: HAY01
Report Number: B166541
Date Received: 07/26/12
Date Analyzed: 08/02/12
Date Printed: 08/02/12
First Reported: 08/02/12

Job ID/Site: PJ17441; Various SBSA

Date(s) Collected:

FALI Job ID: HAY01
Total Samples Submitted: 25
Total Samples Analyzed: 25

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
MP-A01	11283671						
Layer: White Drywall			**ND**				
Layer: Yellow Woven Material			**ND**				
Layer: White Skimcoat/Joint Compound			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (20 %) Fibrous Glass (10 %) Synthetic (3 %)							
MP-A02	11283672						
Layer: White Drywall			**ND**				
Layer: Yellow Woven Material			**ND**				
Layer: White Skimcoat/Joint Compound			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (20 %) Fibrous Glass (10 %) Synthetic (3 %)							
MP-A03	11283673						
Layer: Stones			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Grey Fibrous Material			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (10 %) Fibrous Glass (35 %)							
Comment: Bulk complex sample.							

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
MP-A04	11283674						
Layer: Stones			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Stones			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Tan Fibrous Material			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (7 %) Fibrous Glass (40 %)							
Comment: Bulk complex sample.							
MP-A05	11283675						
Layer: Black Tar			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
MP-A06	11283676						
Layer: White Non-Fibrous Material			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
MP-A07	11283677						
Layer: Brown Mastic			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace) Wollastonite (2 %)							
MP-A08	11283678						
Layer: Brown Mastic			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace) Wollastonite (2 %)							
MP-A09	11283679						
Layer: Off-White Tile		Chrysotile	**2 %**				
Layer: Black Mastic		Chrysotile	**7 %**				
Total Composite Values of Fibrous Components:		**Asbestos (2%)**					
Cellulose (Trace)							
MP-A10	11283680						
Layer: Off-White Tile		Chrysotile	**2 %**				
Layer: Black Mastic		Chrysotile	**7 %**				
Total Composite Values of Fibrous Components:		**Asbestos (2%)**					
Cellulose (Trace)							

Report Number: B166541

Client Name: Forensic Analytical Consulting Svcs

Date Printed: 08/02/12

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
MP-A11	11283681						
Layer: Grey Non-Fibrous Material			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
MP-A12	11283682						
Layer: Off-White Semi-Fibrous Material			**ND**				
Layer: Grey Semi-Fibrous Material			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (5 %) Fibrous Glass (2 %)							
MP-A13	11283683						
Layer: Tan Fibrous Material			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (99 %)							
MP-A14	11283684						
Layer: Paint			**ND**				
Layer: Off-White Skimcoat			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
MP-A15	11283685						
Layer: Paint			**ND**				
Layer: Off-White Skimcoat			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
MP-A16	11283686						
Layer: Paint			**ND**				
Layer: Off-White Skimcoat			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
MP-A17	11283687						
Layer: Paint			**ND**				
Layer: Off-White Skimcoat			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
MP-A18	11283688						
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
MP-A19	11283689						
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							

Report Number: B166541

Client Name: Forensic Analytical Consulting Svcs

Date Printed: 08/02/12

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
MP-A20	11283690						
Layer: Off-White Skimcoat			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
MP-A21	11283691						
Layer: Yellow Cementitious Material			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
MP-A22	11283692						
Layer: Grey Cementitious Material			**ND**				
Layer: Yellow Cementitious Material			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
MP-A23	11283693						
Layer: Grey Cementitious Material			**ND**				
Layer: Yellow Cementitious Material			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
MP-A24	11283694						
Layer: Grey Cementitious Material			**ND**				
Layer: Yellow Cementitious Material			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
MP-A25	11283695						
Layer: Yellow Cementitious Material			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							

Tad Thrower

Tad Thrower, Laboratory Supervisor, Hayward Laboratory

Note: Limit of Quantification ('LOQ') = 1%. 'Trace' denotes the presence of asbestos below the LOQ. 'ND' = 'None Detected'.

Forensic Analytical
ENVIRONMENTAL HEALTH CONSULTANTS

BULK SAMPLE REQUEST FORM

Page 1 of 3.

Client:	**HAY01 FACS San Francisco** **Brown and Caldwell**	Sampled by:	PM: **Paulo Parra** Date:
Contact:	**Paulo Parra** Phone: **(510) 266-4600**	Special Instructions:	E-mail results to pparra@forensica.com and rvelasquez@forensica.com → Rev Pete R. 7/27/12
Site:	**Various** **SBSA**	Turnaround Time:	1-Day ☐ 2-Day ☐ 3-Day ☐ ~~5-Day ☒~~ Other ☐ Due Date and Time:
Client No.:	**C1114** FACS Job #: **PJ17441**	Analysis:	☐ PLM Standard / ☐ Point Count / ☐ Flame AA (Pb) / ☐ Other: Prior positives per Pete R.

Sample Number	Material Description	Sample Location	Friable	Cond.	Quantity
MP-A01	WB and taping compound	East utility room, ground level, SW corner of exterior wall of bathroom	Y	G	
MP-A02	hard wall surfacing material	West utility room, bathroom, NE corner	N	G	
MP-A03	roof field	roof, ridge center	N	G	
MP-A04	roof parapit	roof, north parapit, center	N	G	
MP-A05	blue painted, black sealant	vent penetration, @ adjacent to N parapit, west of center	N	G	
MP-A06	white sealant.	Air handling system, S. of center, SE corner	N	G	
MP-A07	brown adhesive	east utility room, west wall, center	Y	P	
MP-A08	brown adhesive	west utility room, east wall, south end @ entry	Y	P	
MP-A09	12"x12" beige floor tile w/ black adhesive	west utility room, bathroom floor, behind door			
MP-A10	12"x12" beige Floor tile w/ black adhesive	west utility room, office floor, at entry			

WB - Wallboard JC - Joint Compound FT - Floor Tile FTM - Floor Tile Mastic BBM - Baseboard Mastic
RSF - Resilient Sheet Flooring CT - Ceiling Tile SAAM - Spray-Applied Acoustical Material WT - Wall Texture

Friable Yes / No Good / Fair / Poor

Shipped via: ☐ Fed Ex ☐ Airborne ☐ UPS ☐ US Mail ☐ Courier ☐ Drop Off ☐ Other:

Relinquished by:	*Date & Time:*	*Received by:*	*Date & Time:* 7-26-12 @ 8am Condition Acceptable ☑ Yes ☐ No
Relinquished by:	*Date & Time:*	*Received by:*	*Date & Time:* Condition Acceptable ☐ Yes ☐ No

Forensic Analytical
ENVIRONMENTAL HEALTH CONSULTANTS

BULK SAMPLE REQUEST FORM

Page 2 of 2.

Client:	**HAY01 FACS San Francisco** **Brown and Caldwell**	Sampled by: Radzinski	PM: **Paulo Parra** Date: 25 July 2012
Contact:	**Paulo Parra** Phone: **(510) 266-4600**	Special Instructions:	E-mail results to pparra@forensica.com and rvelasquez@forensica.com
Site:	**Various** **SBSA**	Turnaround Time:	1-Day ☐ 2-Day ☐ 3-Day ☑ 5-Day ☒ Other ☐ Due Date and Time:
Client No.:	**C1114** FACS Job #: **PJ17441**	Analysis:	☑ PLM Standard / ☐ Point Count / ☐ Flame AA (Pb) / ☐ Other:

Sample Number	Material Description	Sample Location	Friable	Cond.	Quantity
MP-A11	black sealant	west utility room, e.a. duct, in NE corner @ floor level	N	G	
MP-A12	TSI - elbow	west utility room, generator exhaust duct elbow insulation	Y	G	
MP-A13	gasket,	~~east~~ west ML utility room second level below ground, at MPS1	N	G	
MP-A14	skim coat	west utility room, stairwell wall, between ground and 1st level	F	G	
MP-A15	skim coat	west utility room, stairwell wall between ground & 1st level below	F	G	
MP-A16	skim coat	west utility room, stairwell wall, between 1st below & 2nd below	F	G	
MP-A17	skim coat	west utility room, north wall, 1st floor below ground	F	G	
MP-A18	skim coat	west utility room, south wall, 1st floor below ground	F	G	
MP-A19	skim coat	west utility room, west wall, 2nd floor below ground	F	G	
MP-A20	skim coat	west utility room, east wall, 2nd floor below ground	F	G	

WB – Wallboard JC - Joint Compound FT - Floor Tile FTM - Floor Tile Mastic BBM - Baseboard Mastic
RSF - Resilient Sheet Flooring CT - Ceiling Tile SAAM - Spray-Applied Acoustical Material WT - Wall Texture

Friable Yes / No
Good / Fair / Poor

Shipped via: ☐ Fed Ex ☐ Airborne ☐ UPS ☐ US Mail ☐ Courier ☐ Drop Off ☐ Other:

Relinquished by: Radzinski	*Date & Time:* 26 July 2012/0630	*Received by:*	*Date & Time:* 7-26-12 @ 8am Condition Acceptable ☑ Yes ☐ No
Relinquished by:	*Date & Time:*	*Received by:*	*Date & Time:* Condition Acceptable ☐ Yes ☐ No

Forensic Analytical
ENVIRONMENTAL HEALTH CONSULTANTS

BULK SAMPLE REQUEST FORM

Page 1 of 1.

Client:	**HAY01 FACS San Francisco** **Brown and Caldwell**	Sampled by: Rulzinski	PM: **Paulo Parra** Date: 25 July 2012
Contact:	**Paulo Parra** Phone: **(510) 266-4600**	Special Instructions:	E-mail results to pparra@forensica.com and rvelasquez@forensica.com
Site:	**Various** **SBSA**	Turnaround Time:	1-Day ☐ 2-Day ☐ 3-Day ~~☑~~ 5-Day ☒ Per Pete K. 7/27/12 Kp Other ☐ Due Date and Time:
Client No.:	**C1114** FACS Job #: **PJ17441**	Analysis:	☑ PLM Standard / ☐ Point Count / ☐ Flame AA (Pb) / ☑ Other: Pb (paint layer only) for MP-A25

Sample Number	Material Description	Sample Location	Friable	Cond.	Quantity
MP-A21	stucco	exterior wall, south ~~north~~west corner	No	F	
MP-A22	stucco	exterior wall, northwest corner	N	F	
MP-A23	stucco	exterior wall, northeast corner	N	F	
MP-A24	stucco	exterior wall, northeast corner	N	F	
MP-A25	stucco	exterior wall, southeast corner	N	F	

WB – Wallboard JC - Joint Compound FT - Floor Tile FTM - Floor Tile Mastic BBM - Baseboard Mastic
RSF - Resilient Sheet Flooring CT - Ceiling Tile SAAM - Spray-Applied Acoustical Material WT - Wall Texture

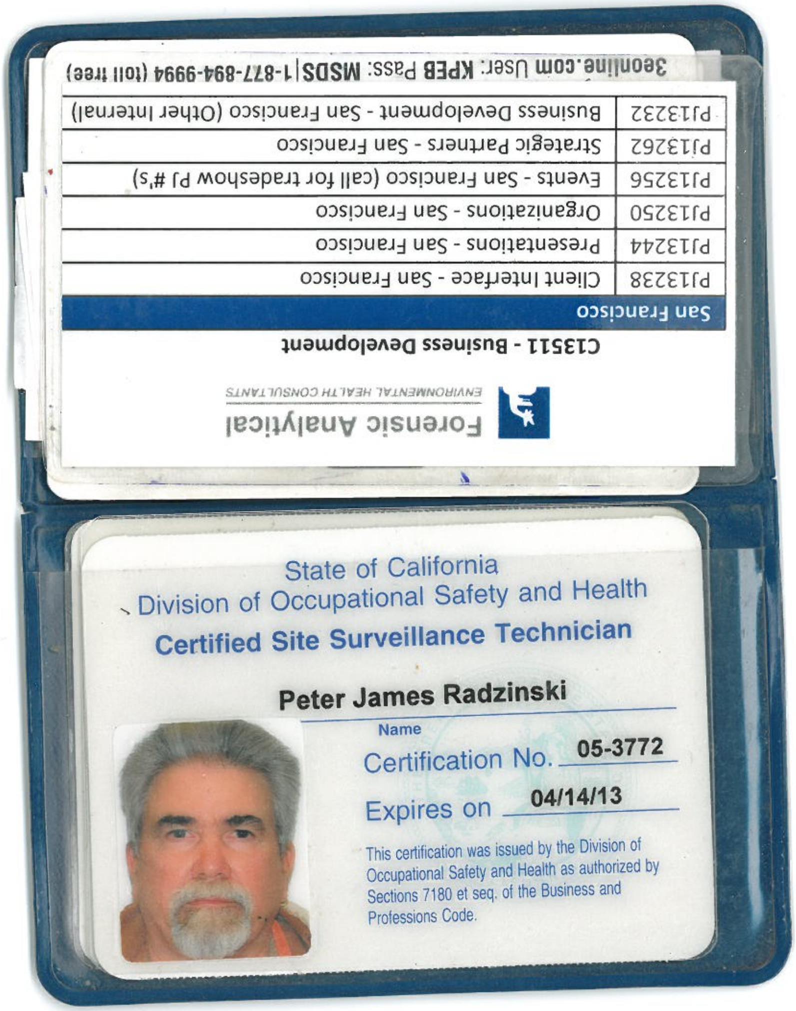
Friable Yes / No Good / Fair / Poor

Shipped via: ☐ Fed Ex ☐ Airborne ☐ UPS ☐ US Mail ☐ Courier ☑ Drop Off ☐ Other:

Relinquished by: Rulzinski	*Date & Time:* 26 July 2012/0630	*Received by:*	*Date & Time:* 7-26-12 @ 8a Condition Acceptable ☑ Yes ☐ No
Relinquished by:	*Date & Time:*	*Received by:*	*Date & Time:* Condition Acceptable ☐ Yes ☐ No

Appendix D:

Certifications of FACS Personnel



Forensic Analytical
ENVIRONMENTAL HEALTH CONSULTANTS

C13511 - Business Development

San Francisco	
PJ13238	Client Interface - San Francisco
PJ13244	Presentations - San Francisco
PJ13250	Organizations - San Francisco
PJ13256	Events - San Francisco (call for tradeshow PJ #'s)
PJ13262	Strategic Partners - San Francisco
PJ13232	Business Development - San Francisco (Other Internal)

3eonline.com User: **KPEB** Pass: **MSDS** | **1-877-894-9994 (toll free)**

State of California
Division of Occupational Safety and Health
Certified Site Surveillance Technician

Peter James Radzinski
Name

Certification No. **05-3772**

Expires on **04/14/13**

This certification was issued by the Division of Occupational Safety and Health as authorized by Sections 7180 et seq. of the Business and Professions Code.

State of California Department of Public Health

Lead-Related Construction Certificate

Certificate Type	Expiration Date
Sampling Technician	08/07/2013

19726

Peter Radzinski

ID #: **5018**

STATE OF CALIFORNIA

Edmund G. Brown, Jr. *Governor*

DEPARTMENT OF INDUSTRIAL RELATIONS
Division of Occupational Safety and Health
Asbestos Unit
2211 Park Towne Circle, Suite 1
Sacramento, CA 95825-0414
(916) 574-2993 Office (916) 483-0572 Fax
http://www.dir.ca.gov/dirdatabases.html actu@dir.ca.gov

109284806C 355

October 28, 2011

Forensic Analytical Consulting Services
Paulo C Parra
3777 Depot Road, #417
Hayward ' CA 94806

Dear Certified Asbestos Consultant or Technician:

Congratulations, you have passed your certification examination!

Enclosed is your certification card. **To maintain your certification, please abide by the rules printed on the back of the certification card**.

Your certification is valid for a period of one year. If you wish to renew your certification, you must apply for renewal at least 60 days <u>before</u> the expiration date shown on your card in accordance with Title 8, California Code of Regulations, Division 1, Chapter 3.2, Article 2.6, Section 341.15(h) (1).

Please keep and do not send copies of your required AHERA refresher renewal certificates to the Division until you apply for renewal of your certification.

Please contact our office at the above address, fax number or email of any changes in your mailing or work address within 15 days of the change.

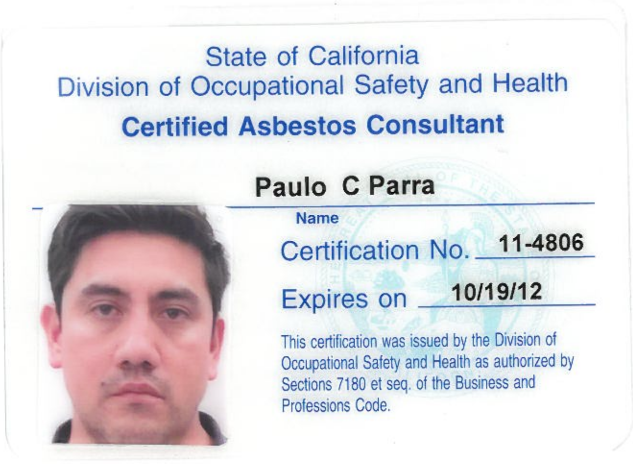
Sincerely,

Jeff Ferrell
Senior Industrial Hygienist

Attachment

cc: File

Passed Exam – Card Attached, Revised 01/07/2011



State of California
Division of Occupational Safety and Health
Certified Asbestos Consultant

Paulo C Parra
Name

Certification No. 11-4806

Expires on 10/19/12

This certification was issued by the Division of Occupational Safety and Health as authorized by Sections 7180 et seq. of the Business and Professions Code.

State of California Department of Public Health

Lead-Related
Construction
Certificate

Certificate Type	Expiration Date
Inspector/Assessor	11/08/2012

18774

Paulo C. Parra

ID #: **20051**

Mr. Paulo C. Parra
Forensic Analytical Consulting Services, Inc.
3777 Depot Road, Suite 413
Hayward, California 94545

Forensic Analytical

ENVIRONMENTAL HEALTH CONSULTANTS

“The solution is in the FACS.”

At Forensic Analytical Consulting Services (FACS) our mission is to leave our scientific fingerprint on every client we serve. We accomplish this by delivering data and expertise that is accurate, cost effective, and contextually useful in solving issues of public and environmental health.

Our expert teams are available to respond nationally to help resolve a broad range of chemical, physical and biological concerns:

California

Los Angeles	*310-668-5600*
Sacramento	*916-726-1303*
San Diego	*858-577-0455*
San Francisco	*510-266-4600*

Nevada

Las Vegas	*702-784-0040*

Oregon

Portland	*503-595-1001*

www.forensicanalytical.com

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Attachment B: Pre-Demolition Asbestos Survey & Lead Testing Reports by Forensic Analytical

Redwood City Pump Station, August 10, 2012

Forensic Analytical
ENVIRONMENTAL HEALTH CONSULTANTS

Pre-Demolition Asbestos Survey & Lead Testing Report

SBSA Redwood City Pump Station
1581 Maple Street
Redwood City, California

August 10, 2012

Prepared for:

Mr. Timothy Banyai
Brown and Caldwell
201 North Civic Center Drive, Suite 115
Walnut Creek, CA 94596
tbanyai@brwncald.com

Prepared by:

Wilson Wong
Forensic Analytical Consulting Services, Inc.
3777 Depot Road, Suite 413
Hayward, CA 94545
510-266-4600 ♦ wwong@forensicanalytical.com

FACS Project #PJ17441

Table of Contents

Executive Summary

Forensic Analytical Consulting Services, Inc. (FACS) performed a pre-demolition asbestos survey and lead testing at the SBSA Redwood City Pump Station on July 25, 2012. The purpose of the survey was to identify, sample, and analyze all suspect asbestos-containing materials that may be disturbed in the planned demolition.

The survey was intended to meet the requirements of the Bay Area Air Quality Management District. The results of this report should be incorporated into any demolition plans for the building.

No asbestos-containing materials were identified in this survey.

Lead was detected in seven (7) of the 11 paints tested, all at concentrations below lead-based paint level (0.5%).

Results of laboratory testing are summarized in the attached table. The summary table must not be used alone. Important explanations and limitations are contained in the full report text below.

Introduction

Forensic Analytical Consulting Services, Inc. (FACS) was retained by Mr. Timothy Banyai of Brown and Caldwell to perform a pre-demolition asbestos survey of the SBSA Belmont Pump Station located at 1581 Maple Street, Redwood City, California. Peter Radzinski of FACS performed the investigation on July 25, 2012. Mr. Radzinski is certified by the State of California as a Certified Site Surveillance Technician (Cert. No. 05-3772). Project Management was provided by Mr. Paulo Parra a California Certified Asbestos Consultant (Cert. No 11-4806). Certifications of FACS personnel are presented in Appendix D.

This report contains the findings and recommendations from our inspection and laboratory analysis of samples collected. The purpose of the survey was to identify, sample, and analyze all suspect asbestos- and lead containing materials that may be disturbed in the planned renovation, within the limitations described below.

Site Description and Scope of Work

The Project building was a single-story concrete structure with a tar-and-gravel roof. The building was a pump station, and the interior was divided into east and west sides, each with two sub-levels.

This survey was performed for the planned demolition of the pump station.

Methodology

Our investigation consisted of the following:

- Visual inspection
- Documentation of relevant conditions
- Collection of samples of suspect asbestos-containing materials using the AHERA sampling protocol
- Collection of samples of suspect lead paint
- Submitting samples to a laboratory accredited by AIHA, NVLAP, and ELAP for analysis by PLM & Flame AA
- Presenting analytical results, conclusions, and recommendations in a report, which can be submitted to the Bay Area Air Quality Management District.

The types, numbers, and locations of samples were determined based on information about the planned demolition, visual observations, regulatory requirements, and other project management considerations.

Findings

Survey results are summarized in the attached table (Appendix A).

No asbestos-containing materials were identified in this survey. Lead was detected in seven (7) of the 11 paints tested. Paint testing results ranged from <0.006% to 0.34% lead by weight.

A floor plan showing sample locations is presented in Appendix B. The detailed laboratory report and completed Sampling Data Form (Chain of Custody) are contained in Appendix C.

Conclusions and Discussion

An asbestos-containing material for which sample analysis results by PLM are greater than one percent asbestos is classified as Asbestos-Containing Material (ACM) under regulations promulgated by: : US EPA, BAAQMD, Cal-EPA, OSHA, and Cal/OSHA. US EPA and BAAQMD require that a material with a PLM analytical result less than 10% (including Trace results of less than one percent) be confirmed by the point count method, or else the material must be assumed to be ACM.

An asbestos-containing material for which sample analysis results by PLM are greater than 0.1 percent asbestos is classified as Asbestos-Containing Construction Material (ACCM) by Cal/OSHA and by the California Contractor State Licensing Board (CSLB).

OSHA (Cal/OSHA) regulates all materials that contain asbestos, even at Trace levels. At a minimum, employee training, wet methods, HEPA vacuums, and prompt cleanup and disposal of debris in leak-proof containers are recommended or required for the disturbance of any material that contains asbestos.

No asbestos-containing material was detected in this survey.

Lead is primarily regulated in California by Cal/OSHA and the California Department of Public Health. The current Cal/OSHA Lead in Construction Safety Standard (8 CCR 1532.1) regulation applies to all construction work where an employee may be occupationally exposed to lead. Therefore, work performed on surfaces (including manual demolition, scraping, welding, etc.) containing any amount of lead must comply with the standard, including an exposure assessment (personal air monitoring) to determine if the airborne lead exposure levels are within acceptable limits.

Since **lead was detected in some of the paint chip samples** collected (ranging from 0.006% to 0.34%), 8 CCR 1532.1 applies to any work that will disturb these lead-containing paints. Other components represented by the positive lead samples in the Summary of Lead Testing Laboratory Results shall be considered to be lead-containing until proven otherwise.

For detailed regulatory requirements in specific situations, FACS should be consulted, or the applicable regulations should be examined

Recommendations

1. No further actions are required for asbestos-related work.

2. If any additional suspect asbestos-containing material is discovered during the renovation, the work should stop, and the material should be tested for asbestos content.

3. Removal of the lead paint at spots scheduled for disturbance by the construction would eliminate the applicability of the Cal/OSHA standard to the paint. If the paint is not removed, and the work will involve a Cal/OSHA trigger task (such as torch cutting), workers must be protected during the initial exposure monitoring, per the Cal/OSHA Lead Standard requirements, as if they were exposed above the Permissible Exposure Limit, until actual exposures are determined. With torch cutting, for

example, this includes providing supplied air respiratory protection during the initial exposure assessment.

4. Because some of the paint present is peeling or deteriorated, these areas of paint should be removed from components prior to sending components for recycling or disposal. The paint chips are likely to be classified as hazardous waste for lead, whereas the components with the remaining intact paint may possibly test as non-hazardous. Scraping of loose and flaky paint prior to removal/demolition of the components is intended to prevent loose paint chips from contaminating the larger quantity of components and causing the larger load of waste to be classified as hazardous, and also intended to prevent paint chips from dislodging and contaminating the ground at the site or along the waste/recycling transportation route.

5. Paint chips and other waste generated from the paint removal, as well as painted components destined for disposal, should be tested to determine if it is hazardous waste. For reference, lead waste is considered a hazardous waste if the result of the Toxicity Characterization Leaching Procedure (TCLP) test exceeds 5 mg/liter, under the Resource Conservation and Recovery Act (RCRA), 40 CFR 261, Appendix II. In California, a waste is also considered hazardous if the result of soluble lead content by a Waste Extraction Test (WET) is greater than 5 mg/l, or if the total lead content exceeds 1,000 mg/kg in accordance with Title 22 of the CCR. When TTLC results are below 50 mg/kg, STLC/TCLP limits cannot be exceeded, so the waste would be classified as non-hazardous for lead. Other hazardous metals historically utilized in paint manufacture should also be tested to determine hazardous waste classification.

6. For further assistance with regulatory requirements, FACS should be consulted, and the applicable regulations should be reviewed.

Limitations

The results of this asbestos survey and lead testing do not apply beyond the planned renovation described above. Construction materials in areas not included in the scope of this survey should be assumed to be asbestos-containing materials / lead paint, unless testing is conducted which determines otherwise. If revisions to the renovation project are made that impact additional materials or areas, FACS should be contacted to review the changes and/or to conduct additional asbestos survey work to address potential impacts to untested materials.

The scope of this asbestos survey and lead testing did not include the identification of other hazardous materials, which might exist in the area of the planned renovation. Other hazardous materials may include polychlorinated biphenyls (PCBs) in fluorescent light ballasts and caulking, lead in paint, and mercury in light fixtures and switches.

This investigation is limited to the conditions and practices observed and information made available to FACS. The methods, conclusions, and recommendations provided are based on FACS' judgment and experience and on the standard of practice for professional service. They are subject to the limitations and variability inherent in the methodology employed. As with all environmental investigations, this investigation is limited to the defined scope and does not purport to set forth all hazards, nor to indicate that other hazards do not exist.

Please do not hesitate to contact our office at 510-266-4600 if you have any questions about our report. Thank you for the opportunity to assist Brown and Caldwell in promoting a more healthful environment.

Respectfully,
Forensic Analytical Consulting Services

Wilson Wong
Program Manager
CAC 92-0791, CDPH 4401

Reviewed by:
Forensic Analytical Consulting Services

Stephen E

Steve Jackson
Director of Consulting
CAC 95-1782

Appendix A:

Asbestos Survey & Lead Testing Results Summary Table

PRE-RENOVATION ASBESTOS SURVEY SUMMARY

SBSA Redwood City Pump Station
1581 Maple Street, Redwood City, California
Date(s) of Sampling: 7/25/2012

Sample Number	Material Description	Location(s) of Material	Asbestos Content (Percent)	Asbestos Regulatory Classification	Approximate Quantity
RC-A01 RC-A02	Roof field	Roof	ND	Not applicable	Not applicable
RC-A03	White/gray sealant	Roof, HVAC unit	ND	Not applicable	Not applicable
RC-A04	Black sealant	Roof, at penetrations	ND	Not applicable	Not applicable
RC-A05	Gasket	Roof, HVAC system, flanges	ND	Not applicable	Not applicable
RC-A06	Brown baseboard adhesive	Interior walls	ND	Not applicable	Not applicable

ND = None Detected; Trace = less than one percent by visual area estimation; RACM = friable (easily damaged by hand pressure) or likely to become friable during renovation/demolition; Category I Nonfriable = nonfriable packings, gaskets, resilient floor coverings (not including backing), and asphaltic roofing; Category II Nonfriable = Nonfriable materials other than Category I

NOTE: This summary table must not be used alone. Important explanations and limitations are contained in the accompanying survey report text. Percent asbestos content is based upon visual area estimation unless noted otherwise (point count analysis was not performed).

SUMMARY OF LEAD TESTING LABORATORY RESULTS
SBSA Redwood City Pump Station
1581 Maple Street, Redwood City, California
Date(s) of Sampling: 7/25/2012

Description	Sample Number	Analytical Result
Ground level, electrical panel room, off-white drywall wall	RC-Pb1	<0.006%
Ground level, HVAC room, gray east HVAC unit	**RC-Pb2**	**0.075%**
Ground level, electrical panel room, stairs to sub-level 1, gray handrail	**RC-Pb3**	**0.027%**
Ground level, electrical panel room, green concrete floor	**RC-Pb4**	**0.08%**
Generator room outside entrance, blue metal door	**RC-Pb5**	**0.009%**
West sub-level, beige west concrete wall	RC-Pb6	<0.006%
East sub-level, 4th pipe system from north, gray metal pipe elbow	**RC-Pb7**	**0.065%**
East sub-level, red concrete floor	RC-Pb8	<0.009%
2nd east sub-level, 2nd piping system from north, gray metal pipe	**RC-Pb9**	**0.34%**
2nd east sub-level, stairs, yellow metal steps	**RC-Pb10**	**0.006%**
Exterior, white north concrete wall	RW-Pb101	<0.006%

% means: percent lead in sample, by weight
< means: less than

Appendix B:

Floor Plan – Sample Locations

Forensic Analytical
ENVIRONMENTAL HEALTH CONSULTANTS

Page ____ of ____.

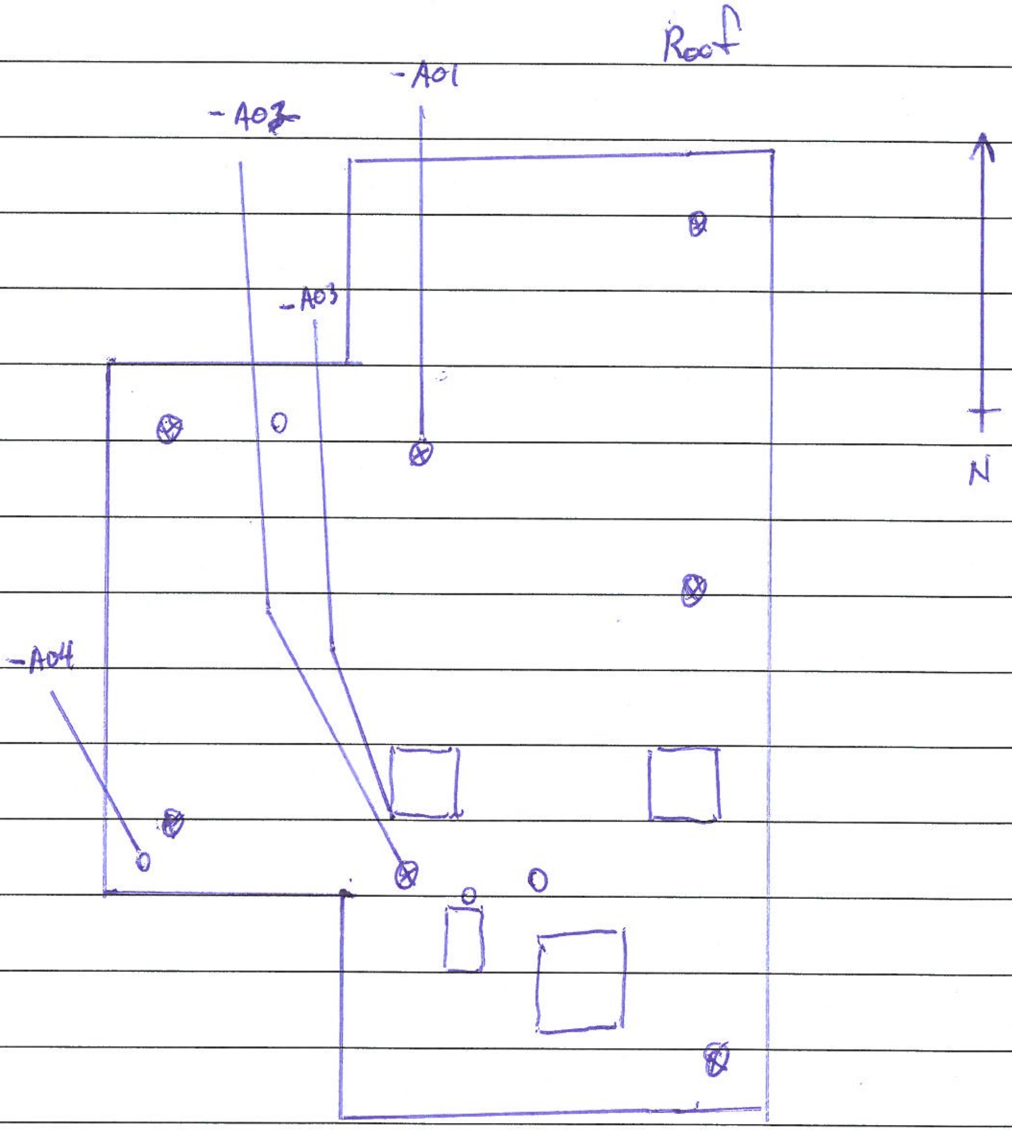
Project Daily Log

Tech: __________.

Client: **Brown and Caldwell** Client No.: **C1114** FACS No.: **PJ17441**

Site Address: **Various**
SBSA

Date:



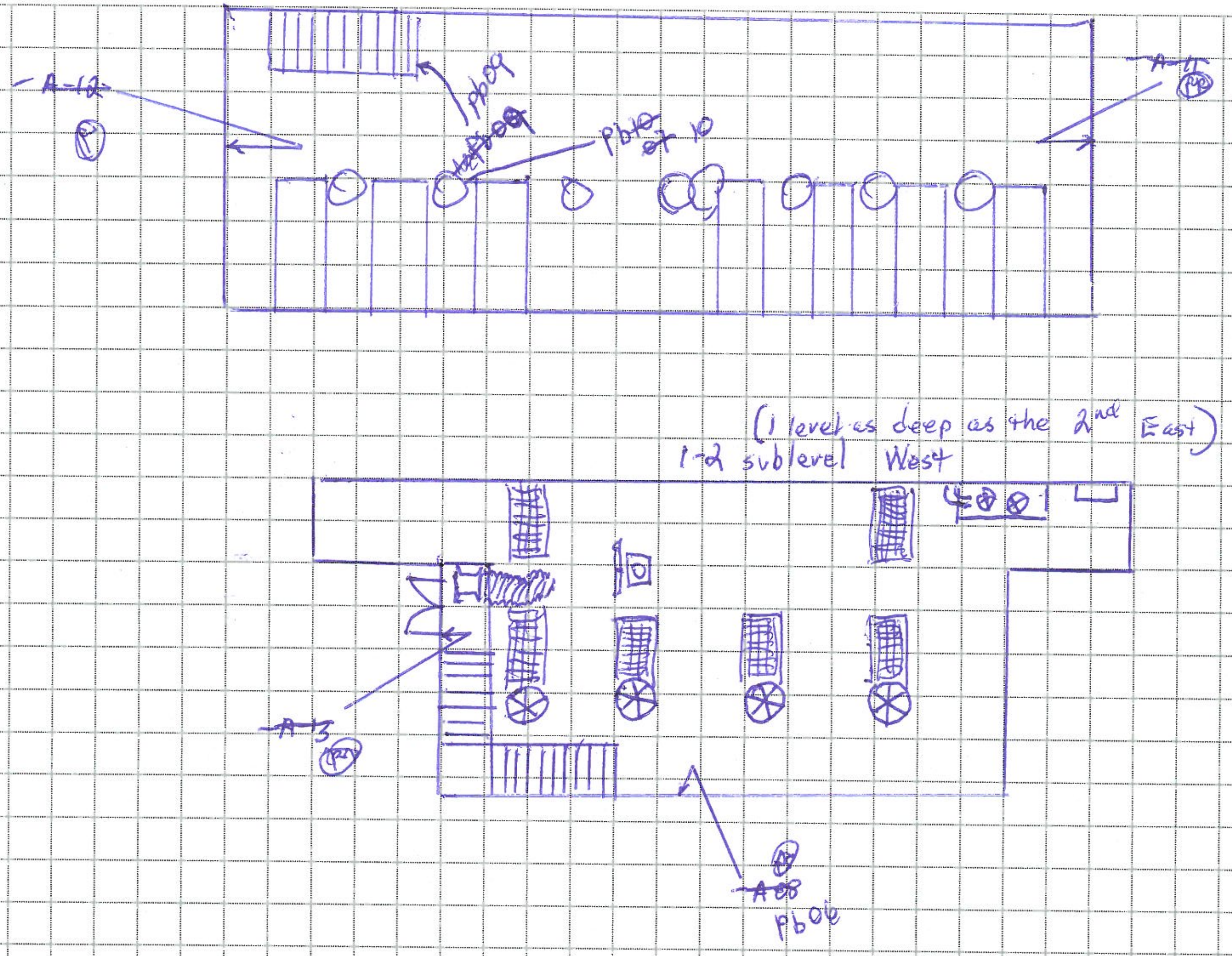
Forensic Analytica FLOOR PLAN FORM
ENVIRONMENTAL HEALTH CONSULTANT

Date:
Job #: PJ17441
Site: Various SBSA
Title:
Insp...ors:

Legend:

←N—

2nd sublevel ~~North~~ East



not to scale

Forensic Analytical ENVIRONMENTAL HEALTH CONSULTANTS **FLOOR PLAN FORM**

Date:

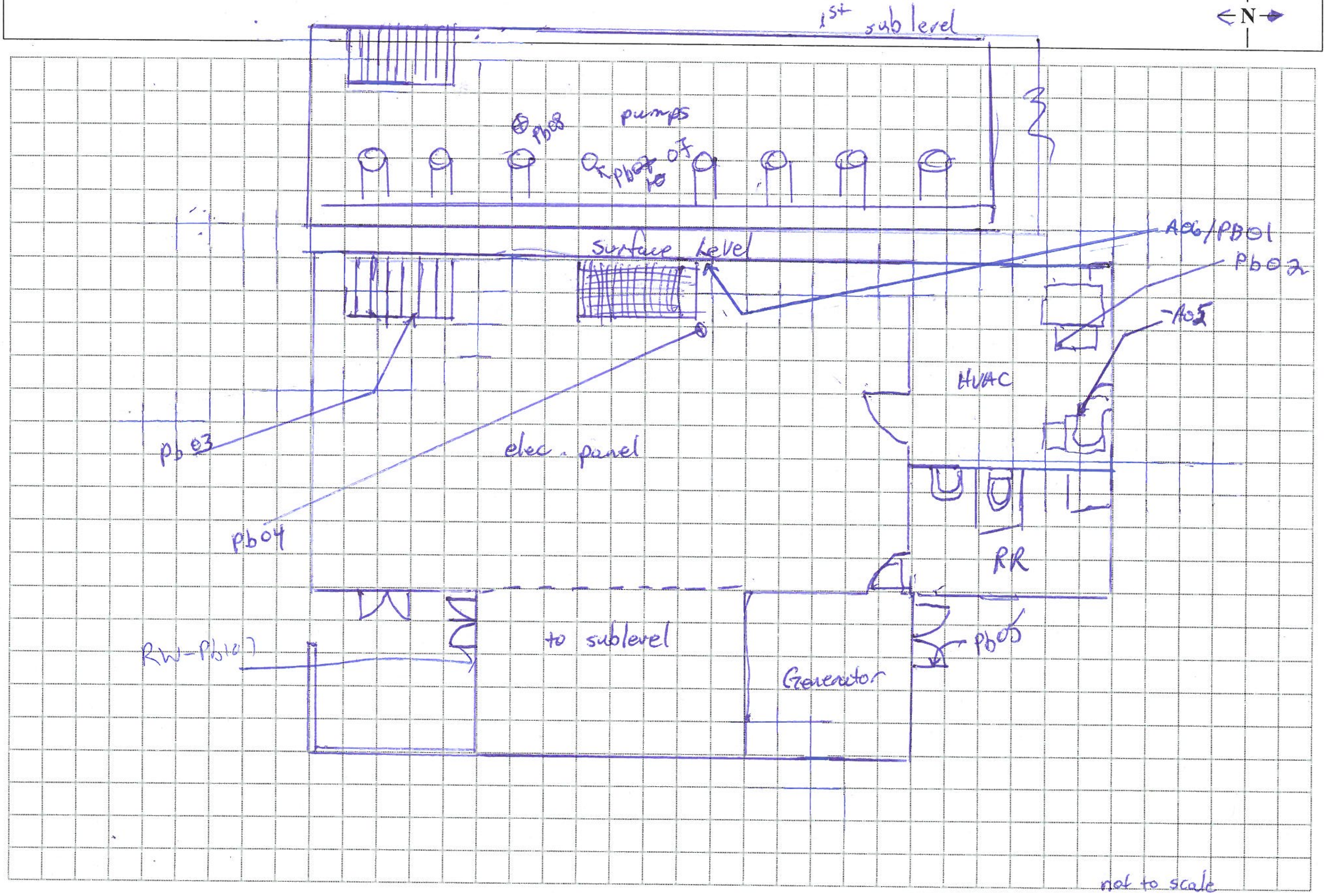
Job #: PJ17441

Site: Various SBSA

Title:

Inspectors:

Legend:



Appendix C:

Supporting Laboratory Reports and Chain-of-Custody Documents

Forensic Analytical Laboratories

Final Report

Bulk Asbestos Analysis

(EPA Method 600/R-93-116, Visual Area Estimation)

Forensic Analytical Consulting Svcs
Paulo Parra
3777 Depot Road
Suite 413
Hayward, CA 94545

Client ID: HAY01
Report Number: B166519
Date Received: 07/26/12
Date Analyzed: 07/31/12
Date Printed: 07/31/12
First Reported: 07/31/12

Job ID/Site: PJ17441; Various SBSA

Date(s) Collected: 07/25/2012

FALI Job ID: HAY01
Total Samples Submitted: 6
Total Samples Analyzed: 6

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
RC-A01	11283479						
Layer: Stones			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				

Total Composite Values of Fibrous Components: **Asbestos (ND)**
Cellulose (Trace) Fibrous Glass (35 %) Synthetic (15 %)
Comment: Bulk complex sample.

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
RC-A02	11283480						
Layer: Stones			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				

Total Composite Values of Fibrous Components: **Asbestos (ND)**
Cellulose (Trace) Fibrous Glass (35 %) Synthetic (15 %)
Comment: Bulk complex sample.

Report Number: B166519

Client Name: Forensic Analytical Consulting Svcs

Date Printed: 07/31/12

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
RC-A03	11283481						
Layer: Black Semi-Fibrous Tar			**ND**				
Layer: Stones			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (15 %)							
RC-A04	11283482						
Layer: Black Tar			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
RC-A05	11283483						
Layer: Dark Grey Foam			**ND**				
Layer: Grey Non-Fibrous Material			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
RC-A06	11283484						
Layer: Brown Mastic			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							

Tad Thrower

Tad Thrower, Laboratory Supervisor, Hayward Laboratory

Note: Limit of Quantification ('LOQ') = 1%. 'Trace' denotes the presence of asbestos below the LOQ. 'ND' = 'None Detected'.

Forensic Analytical
ENVIRONMENTAL HEALTH CONSULTANTS

BULK SAMPLE REQUEST FORM

Page 1 of 1.

Client: **HAY01 FACS San Francisco**
Brown and Caldwell

Sampled by: Radzinski PM: **Paulo Parra** Date: 25 July 2012

Contact: **Paulo Parra** Phone: **(510) 266-4600**

Special Instructions: E-mail results to pparra@forensica.com and rvelasquez@forensica.com

Site: **Various**
SBSA

Turnaround Time: 1-Day ☐ 2-Day ☐ 3-Day ☑ 5-Day ☐ Other ☐ Due Date and Time:

Client No.: **C1114** FACS Job #: **PJ17441**

Analysis: ☑ PLM Standard / ☐ Point Count / ☐ Flame AA (Pb) /
☐ Other:

Sample Number	Material Description	Sample Location	Friable	Cond.	Quantity
RC-A01	roof, field	Roof, North end, field.	N	G	
RC-A02	roof, field	Roof, South end, field.	N	G	
RC-A03	white/grey sealant	HVAC unit, most centered, slightly south of center, SW Corner	N	G	
RC-A04	black sealant	Vent penetration, SW corner.	N	G	
RC-A05	gasket	HVAC room, west unit, flange gasket	N	G	
RC-A06	brown adhesive	East wall, elec. panelroom, behind base board	Y	P	

WB – Wallboard JC – Joint Compound FT - Floor Tile FTM - Floor Tile Mastic BBM - Baseboard Mastic
RSF - Resilient Sheet Flooring CT - Ceiling Tile SAAM - Spray-Applied Acoustical Material WT - Wall Texture

Friable Yes / No

Good / Fair / Poor

Shipped via: ☐ Fed Ex ☐ Airborne ☐ UPS ☐ US Mail ☐ Courier ☐ Drop Off / ☐ Other:

Relinquished by: Radzinski
Date & Time: 26 July 2012/0630
Received by:
Date & Time: 7-26-12 @ 8a
Condition Acceptable ☑ Yes ☐ No

Relinquished by:
Date & Time:
Received by:
Date & Time:
Condition Acceptable ☐ Yes ☐ No

Metals Analysis of Paints

Forensic Analytical Consulting Svcs
Paulo Parra
3777 Depot Road
Suite 413
Hayward, CA 94545

Client ID: HAY01
Report Number: M131268
Date Received: 07/26/12
Date Analyzed: 07/31/12
Date Printed: 07/31/12
First Reported: 07/31/12

Job ID / Site: PJ17441; Various SBSA
Date(s) Collected: 7/25/12

FALI Job ID: HAY01
Total Samples Submitted: 10
Total Samples Analyzed: 10

Sample Number	Lab Number	Analyte	Result	Result Units	Reporting Limit*	Method Reference
RC-PB01	30439849	Pb	< 0.006	wt%	0.006	EPA 3050B/7420
RC-PB02	30439850	Pb	0.075	wt%	0.006	EPA 3050B/7420
RC-PB03	30439851	Pb	0.027	wt%	0.006	EPA 3050B/7420
RC-PB04	30439852	Pb	0.08	wt%	0.02	EPA 3050B/7420
RC-PB05	30439853	Pb	0.009	wt%	0.006	EPA 3050B/7420
RC-PB06	30439854	Pb	< 0.006	wt%	0.006	EPA 3050B/7420
RC-PB07	30439855	Pb	0.065	wt%	0.006	EPA 3050B/7420
RC-PB08	30439856	Pb	< 0.009	wt%	0.009	EPA 3050B/7420
RC-PB09	30439857	Pb	0.34	wt%	0.03	EPA 3050B/7420
RC-PB10	30439858	Pb	0.006	wt%	0.006	EPA 3050B/7420

* The Reporting Limit represents the lowest amount of analyte that the laboratory can confidently detect in the sample, and is not a regulatory level. The Units for the Reporting Limit are the same as the Units for the Final Results.

Daniele Siu

Daniele Siu, Laboratory Supervisor, Hayward Laboratory

Forensic Analytical

PAINT CHIP SAMPLE REQUEST FORM

Page 1 of 1

Client: HAY Gi FACS S.F. Brown + Caldwell		Sampled by: Pete R.	PM: PP Date: 7/25/12
Contact: Paulo Parra	Phone: 510-266-4600	Special Instructions:	**Email results to** pparra
Site: Various SBSA		Turnaround Time:	Rush ☐ 24 Hour ☐ 3-Day ✓ Due Date & Time:
Client No.: C1114	ESD No.: PJ17441	Analysis:	[✓ Flame AA (Pb)] / Other:

Sample Number	Sample Location	Component	Color	Substrate	Condition
RC-Pb01	Ground level, elec. panel room, E. wall center.	wall	off white	drywall	G
RC-Pb02	Ground level, HVAC room, ~~East~~ East HVAC unit.	HVAC unit	grey	metal	F
RC-Pb03	Ground level, stair to sub level 1, hand rail, elec. panel room	hand rail	grey	metal	G
RC-Pb04	Ground level, elec. panel room, floor	floor	green	concrete	F
RC-Pb05	~~West sub level, west wall~~ Generator Room Outdoor entry door	~~wall~~ door	~~beige~~ blue	metal ~~concrete~~	G
RC-Pb06	~~East sub level, piping sys., 4th from N.~~ West sub level, west wall.	~~pipe~~ wall ~~elbow~~	beige ~~grey~~	concrete ~~metal~~	G ~~F~~
RC-Pb07	~~East 2nd East sublevel, floor~~ East sub level, 4th piping sys. from N.	~~floor~~ pipe elbow	~~red~~ grey	~~concrete~~ metal	~~G~~ F
RC-Pb08	East sublevel, floor	floor	red	concrete	G
RC-Pb09	2nd East sublevel, 2nd piping sys. from N	pipe	grey	metal	P
RC-Pb10	2nd East sublevel, stair, leading edge	step	Yellow	metal	F

Substrate: wood metal concrete plaster drywall brick

Shipped via: Fed Ex __ Airborne __ UPS __ US Mail __ Carrier XXX Drop Off Other: ______

Relinquished by: Rabinski

Date & Time:

Received by: 25 July 2012 /0630

Date & Time: 7/26/12 D/O 8AM

Condition Acceptable [✓ Yes] No

Metals Analysis of Paints

Forensic Analytical Consulting Svcs
Paulo Parra
3777 Depot Road
Suite 413
Hayward, CA 94545

Client ID: HAY01
Report Number: M131303
Date Received: 07/26/12
Date Analyzed: 07/30/12
Date Printed: 07/30/12
First Reported: 07/30/12

Job ID / Site: PJ17441; Various SBSA
Date(s) Collected: 7/26/12

FALI Job ID: HAY01
Total Samples Submitted: 1
Total Samples Analyzed: 1

Sample Number	Lab Number	Analyte	Result	Result Units	Reporting Limit*	Method Reference
RW-PB101	30439981	Pb	< 0.006	wt%	0.006	EPA 3050B/7420

* The Reporting Limit represents the lowest amount of analyte that the laboratory can confidently detect in the sample, and is not a regulatory level. The Units for the Reporting Limit are the same as the Units for the Final Results.

Daniele Siu

Daniele Siu, Laboratory Supervisor, Hayward Laboratory

Forensic Analytical
ENVIRONMENTAL HEALTH CONSULTANTS

PAINT CHIP SAMPLE REQUEST FORM

Page 1 of 1

Client:	**HAY01 FACS San Francisco** **Brown and Caldwell**	Sampled by: Pete R.	PM: **Paulo Parra** Date: 7/26/12
Contact:	**Paulo Parra** Phone: **(510) 266-4600**	Special Instructions:	E-mail results to pparra@forensica.com and rvelasquez@forensica.com
Site:	**Various** **SBSA**	Turnaround Time:	☐ 1-Day ☐ 2-Day ☑ 3-Day ☐ 5-Day ☐ Other Due Date and Time:
Client No.:	**C1114** FACS Job #: **PJ17441**	Analysis:	☑ Flame AA (Pb) ☐ Other:

Sample Number	Sample Location	Component	Color	Substrate	Condition
RW-Pb101	exterior, north side, west ~~exterior~~ utility area entrance ML	wall	white	concrete	Fair

Substrate: wood metal concrete plaster drywall brick

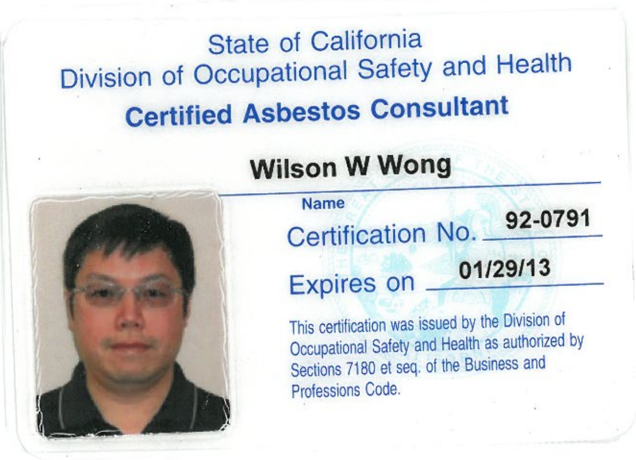
Shipped via: ☐ Fed Ex ☐ Airborne ☐ UPS ☐ US Mail ☐ Courier ☐ Drop Off ☐ Other:

Relinquished by:	*Date & Time:* 26 July 2012/1605	*Received by:*	*Date & Time:* 7-26-12 @ 4:15 pm Condition Acceptable ☑ Yes ☐ No
Relinquished by:	*Date & Time:*	*Received by:*	*Date & Time:* Condition Acceptable ☐ Yes ☐ No

9.

Appendix D:

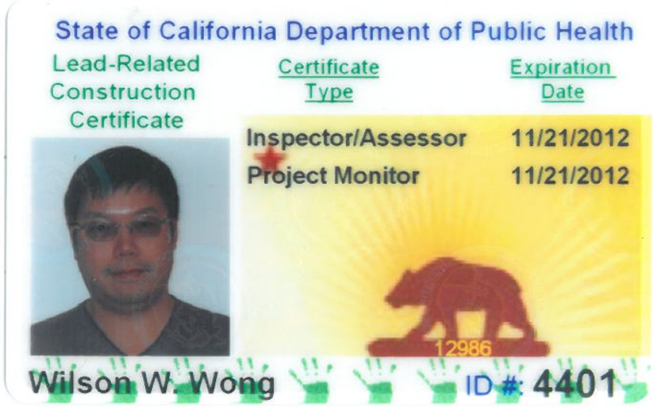
Certifications of FACS Personnel



State of California
Division of Occupational Safety and Health
Certified Asbestos Consultant

Wilson W Wong
Name
Certification No. **92-0791**
Expires on **01/29/13**

This certification was issued by the Division of Occupational Safety and Health as authorized by Sections 7180 et seq. of the Business and Professions Code.



State of California Department of Public Health

Lead-Related
Construction
Certificate

Certificate Type	Expiration Date
Inspector/Assessor	11/21/2012
Project Monitor	11/21/2012

12986

Wilson W. Wong

ID #: 4401

State of California Department of Public Health

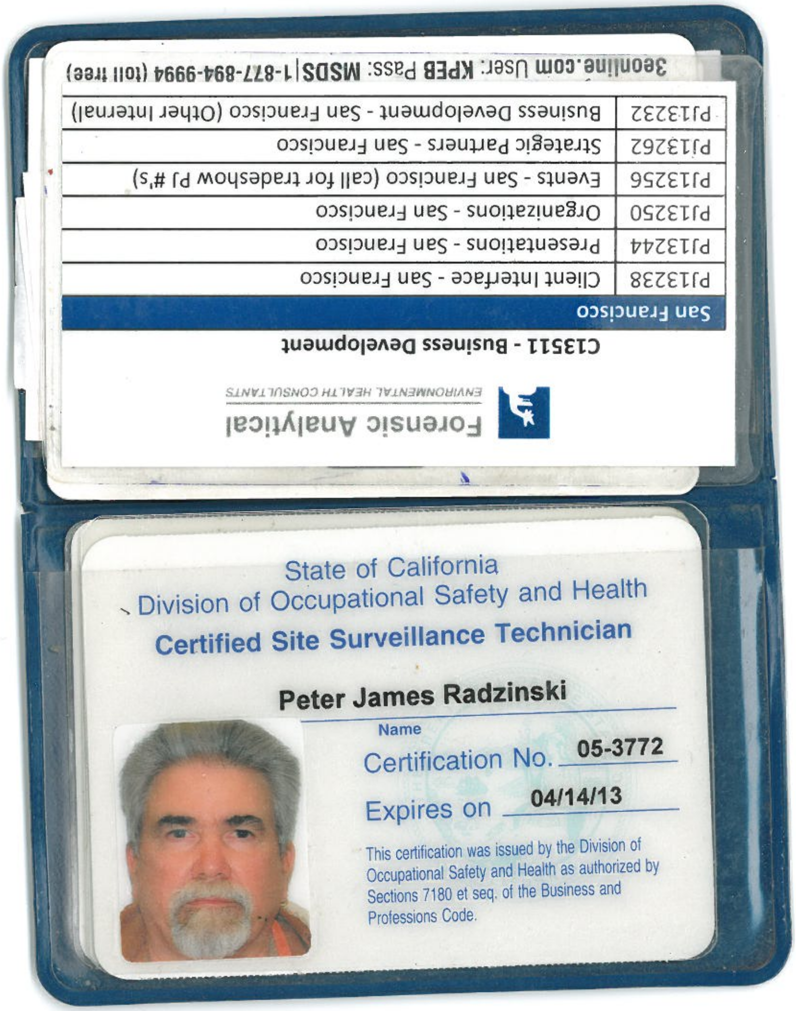
Lead-Related
Construction
Certificate

Certificate Type	Expiration Date
Sampling Technician	08/07/2012

19726

Peter Radzinski

ID #: 5018



Forensic Analytical

ENVIRONMENTAL HEALTH CONSULTANTS

C13511 - Business Development

San Francisco	
PJ13238	Client Interface - San Francisco
PJ13244	Presentations - San Francisco
PJ13250	Organizations - San Francisco
PJ13256	Events - San Francisco (call for tradeshow PJ #'s)
PJ13262	Strategic Partners - San Francisco
PJ13232	Business Development - San Francisco (Other Internal)

3eonline.com User: **KPEB** Pass: **MSDS** | **1-877-894-9994 (toll free)**

State of California
Division of Occupational Safety and Health
Certified Site Surveillance Technician

Peter James Radzinski
Name
Certification No. **05-3772**
Expires on **04/14/13**

This certification was issued by the Division of Occupational Safety and Health as authorized by Sections 7180 et seq. of the Business and Professions Code.

Forensic Analytical

ENVIRONMENTAL HEALTH CONSULTANTS

"The solution is in the FACS."

At Forensic Analytical Consulting Services (FACS) our mission is to leave our scientific fingerprint on every client we serve. We accomplish this by delivering data and expertise that is accurate, cost effective, and contextually useful in solving issues of public and environmental health.

Our expert teams are available to respond nationally to help resolve a broad range of chemical, physical and biological concerns:

California	
Los Angeles	*310-668-5600*
Sacramento	*916-726-1303*
San Diego	*858-577-0455*
San Francisco	*510-266-4600*
Nevada	
Las Vegas	*702-784-0040*
Oregon	
Portland	*503-595-1001*

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Attachment C: Pre-Demolition Asbestos Survey & Lead Testing Reports by Forensic Analytical

San Carlos Pump Station, August 13, 2012

Forensic Analytical

ENVIRONMENTAL HEALTH CONSULTANTS

Pre-Demolition Asbestos Survey & Lead Testing Report

SBSA San Carlos Pump Station
150 Monte Vista Drive
San Carlos, California

August 13, 2012

Prepared for:

Mr. Timothy Banyai
Brown and Caldwell
201 North Civic Center Drive, Suite 115
Walnut Creek, CA 94596
tbanyai@brwncald.com

Prepared by:

Wilson Wong
Forensic Analytical Consulting Services, Inc.
3777 Depot Road, Suite 413
Hayward, CA 94545
510-266-4600 ♦ wwong@forensicanalytical.com

FACS Project #PJ17441

Table of Contents

Executive Summary

Forensic Analytical Consulting Services, Inc. (FACS) performed a pre-demolition asbestos survey and lead testing at the SBSA San Carlos Pump Station on July 26, 2012. The purpose of the survey was to identify, sample, and analyze all suspect asbestos-containing materials that may be disturbed in the planned demolition.

The survey was intended to meet the requirements of the Bay Area Air Quality Management District. The results of this report should be incorporated into any demolition plans for the building.

Asbestos was identified in the following materials:

Material Description	Location(s) of Material
12-inch beige vinyl floor tile and mastic	**Surface level, west utility area, office and bathroom**

Lead was detected in six (6) of the eight (8) paints tested, all at concentrations below lead-based paint level (0.5%).

Results of laboratory testing are summarized in the attached tables. The summary tables must not be used alone. Important explanations and limitations are contained in the full report text below.

Introduction

Forensic Analytical Consulting Services, Inc. (FACS) was retained by Mr. Timothy Banyai of Brown and Caldwell to perform a pre-demolition asbestos survey of the SBSA San Carlos Pump Station located at 150 Monte Vista Drive, San Carlos, California. Peter Radzinski of FACS performed the investigation on July 26, 2012. Mr. Radzinski is certified by the State of California as a Certified Site Surveillance Technician (Cert. No. 05-3772). Project Management was provided by Mr. Paulo Parra a California Certified Asbestos Consultant (Cert. No 11-4806). Certifications of FACS personnel are presented in Appendix D.

This report contains the findings and recommendations from our inspection and laboratory analysis of samples collected. The purpose of the survey was to identify, sample, and analyze all suspect asbestos- and lead containing materials that may be disturbed in the planned demolition, within the limitations described below.

Site Description and Scope of Work

The Project building was a two-story cinder block structure with rolled-on roof. The building was a pump station, and the interior was divided into east and west utility areas, with a surface level and two sub-levels at the west utility area and one sub-level at the east.

This survey was performed for the planned demolition of the pump station.

Methodology

Our investigation consisted of the following:

- Visual inspection
- Documentation of relevant conditions
- Collection of samples of suspect asbestos-containing materials using the AHERA sampling protocol
- Collection of samples of suspect lead paint
- Submitting samples to a laboratory accredited by AIHA, NVLAP, and ELAP for analysis by PLM & Flame AA
- Presenting analytical results, conclusions, and recommendations in a report, which can be submitted to the Bay Area Air Quality Management District.

The types, numbers, and locations of samples were determined based on information about the planned demolition, visual observations, regulatory requirements, and other project management considerations.

Findings

Survey results are summarized in the attached table (Appendix A).

Asbestos was identified in the following materials:

Material Description	Location(s) of Material	Asbestos Regulatory Classification
12-inch beige vinyl floor tile and mastic	**Surface level, west utility area, office and bathroom**	**Category I Nonfriable ACM**

Lead was detected in six (6) of the eight (8) paints tested. Paint testing results ranged from <0.006% to 0.42% lead by weight.

A floor plan showing sample locations is presented in Appendix B. The detailed laboratory report and completed Sampling Data Form (Chain of Custody) are contained in Appendix C.

Conclusions and Discussion

Asbestos

The 12-inch beige vinyl floor tile and mastic in the office and bathroom contain asbestos. The vinyl floor tile and mastic are Asbestos-Containing Materials (ACM) and also Asbestos-Containing Construction Materials (>0.1% asbestos) in California. The vinyl floor tile and mastic are subject to regulations of USEPA, BAAQMD, Cal/OSHA, and CSLB.

An asbestos-containing material for which sample analysis results by PLM are greater than one percent asbestos is classified as Asbestos-Containing Material (ACM) under regulations promulgated by: : US EPA, BAAQMD, Cal-EPA, OSHA, and Cal/OSHA. US EPA and BAAQMD require that a material with a PLM analytical result less than 10% (including Trace results of less than one percent) be confirmed by the point count method, or else the material must be assumed to be ACM.

An asbestos-containing material for which sample analysis results by PLM are greater than 0.1 percent asbestos is classified as Asbestos-Containing Construction Material (ACCM) by Cal/OSHA and by the California Contractor State Licensing Board (CSLB).

OSHA (Cal/OSHA) regulates all materials that contain asbestos. At a minimum, employee training, wet methods, HEPA vacuums, and prompt cleanup and disposal of debris in leak-proof containers are recommended or required for the disturbance of any material that contains asbestos.

Lead

Lead is primarily regulated in California by Cal/OSHA and the California Department of Public Health. The current Cal/OSHA Lead in Construction Safety Standard (8 CCR 1532.1) regulation applies to all construction work where an employee may be occupationally exposed to lead. Therefore, work performed on surfaces (including manual demolition, scraping, welding, etc.) containing any amount of lead must comply with the standard, including an exposure assessment (personal air monitoring) to determine if the airborne lead exposure levels are within acceptable limits.

Since **lead was detected in some of the paint chip samples** collected (ranging from 0.0023% to 0.42%), 8 CCR 1532.1 applies to any work that will disturb these lead-containing paints. Other components represented by the positive lead samples in the Summary of Lead Testing Laboratory Results shall be considered to be lead-containing until proven otherwise.

For detailed regulatory requirements in specific situations, FACS should be consulted, or the applicable regulations should be examined

Recommendations

1. The vinyl floor tile and mastic should be removed prior to the planned demolition by a licensed asbestos abatement contractor who complies with all applicable regulations.

2. A Certified Asbestos Consultant should be consulted to assist with project design and monitoring, including clearance inspection and air sampling after asbestos removal.

3. If any additional suspect asbestos-containing material is discovered during the renovation, the work should stop, and the material should be tested for asbestos content.

4. Removal of the lead paint at spots scheduled for disturbance by the construction would eliminate the applicability of the Cal/OSHA standard to the paint. If the paint is not removed, and the work will involve a Cal/OSHA trigger task (such as torch cutting), workers must be protected during the initial exposure monitoring, per the Cal/OSHA Lead Standard requirements, as if they were exposed above the Permissible Exposure Limit, until actual exposures are determined. With torch cutting, for example, this includes providing supplied air respiratory protection during the initial exposure assessment.

5. Because some of the paint present is peeling or deteriorated, these areas of paint should be removed from components prior to sending components for recycling or disposal. The paint chips are likely to be classified as hazardous waste for lead, whereas the components with the remaining intact paint may possibly test as non-hazardous. Scraping of loose and flaky paint prior to removal/demolition of the components is intended to prevent loose paint chips from contaminating the larger quantity of components and causing the larger load of waste to be classified as hazardous, and also intended to prevent paint chips from dislodging and contaminating the ground at the site or along the waste/recycling transportation route.

6. Paint chips and other waste generated from the paint removal, as well as painted components destined for disposal, should be tested to determine if it is hazardous waste. For reference, lead waste is considered a hazardous waste if the result of the Toxicity Characterization Leaching Procedure (TCLP) test exceeds 5 mg/liter, under the Resource Conservation and Recovery Act (RCRA), 40 CFR 261, Appendix II. In California, a waste is also considered hazardous if the result of soluble lead content by a Waste Extraction Test (WET) is greater than 5 mg/l, or if the total lead content exceeds 1,000 mg/kg in accordance with Title 22 of the CCR. When TTLC results are below 50 mg/kg, STLC/TCLP limits cannot be exceeded, so the waste would be classified as non-hazardous for lead. Other hazardous metals historically utilized in paint manufacture should also be tested to determine hazardous waste classification.

7. For further assistance with regulatory requirements, FACS should be consulted, and the applicable regulations should be reviewed.

Limitations

The results of this asbestos survey and lead testing do not apply beyond the planned renovation described above. Construction materials in areas not included in the scope of this survey should be assumed to be asbestos-containing materials / lead paint, unless testing is conducted which determines otherwise. If revisions to the renovation project are made that impact additional materials or areas, FACS should be contacted to review the changes and/or to conduct additional asbestos survey work to address potential impacts to untested materials.

The scope of this asbestos survey and lead testing did not include the identification of other hazardous materials, which might exist in the area of the planned renovation. Other hazardous materials may include polychlorinated biphenyls (PCBs) in fluorescent light ballasts and caulking, lead in paint, and mercury in light fixtures and switches.

This investigation is limited to the conditions and practices observed and information made available to FACS. The methods, conclusions, and recommendations provided are based on FACS' judgment and experience and on the standard of practice for professional service. They are subject to the limitations and variability inherent in the methodology employed. As with all environmental investigations, this investigation is limited to the defined scope and does not purport to set forth all hazards, nor to indicate that other hazards do not exist.

Please do not hesitate to contact our office at 510-266-4600 if you have any questions about our report. Thank you for the opportunity to assist Brown and Caldwell in promoting a more healthful environment.

Respectfully,
Forensic Analytical Consulting Services

Wilson Wong
Program Manager
CAC 92-0791, CDPH 4401

Reviewed by:
Forensic Analytical Consulting Services

Stephen E

Steve Jackson
Director of Consulting
CAC 95-1782

Appendix A:

Asbestos Survey & Lead Testing Results Summary Table

PRE-RENOVATION ASBESTOS SURVEY SUMMARY

SBSA San Carlos Pump Station
150 Monte Vista Drive, San Carlos, California
Date(s) of Sampling: 7/26/2012

Sample Number	Material Description	Location(s) of Material	Asbestos Content (Percent)	Asbestos Regulatory Classification	Approximate Quantity
SC-A01 SC-A02	Roof field	Roof	ND	Not applicable	Not applicable
SC-A03 SC-A04	White sealant	Roof, on ductwork & parapet cap	ND	Not applicable	Not applicable
SC-A05	Black sealant	Roof, at penetrations	ND	Not applicable	Not applicable
SC-A06	Gray sealant	Roof, at penetrations	ND	Not applicable	Not applicable
SC-A07 SC-A08 SC-A09	Baseboard mastic	Utility areas	ND	Not applicable	Not applicable
SC-A10 SC-A11	**12-inch beige floor tile & mastic**	**Utility areas, office & bathroom**	**FT 2% Mastic 5%**	**Cat. I Nonfriable ACM**	**250 sf**
SC-A12	White adhesive & grout	West utility area, bathroom, in association with ceramic tiles	ND	Not applicable	Not applicable

ND = None Detected; Trace = less than one percent by visual area estimation; RACM = friable (easily damaged by hand pressure) or likely to become friable during renovation/demolition; Category I Nonfriable = nonfriable packings, gaskets, resilient floor coverings (not including backing), and asphaltic roofing; Category II Nonfriable = Nonfriable materials other than Category I

NOTE: This summary table must not be used alone. Important explanations and limitations are contained in the accompanying survey report text. Percent asbestos content is based upon visual area estimation unless noted otherwise (point count analysis was not performed).

PRE-RENOVATION ASBESTOS SURVEY SUMMARY

SBSA San Carlos Pump Station

150 Monte Vista Drive, San Carlos, California
Date(s) of Sampling: 7/26/2012

Sample Number	Material Description	Location(s) of Material	Asbestos Content (Percent)	Asbestos Regulatory Classification	Approximate Quantity
SC-A13 SC-A14 SC-A15	Pipe insulation	West utility area	ND	Not applicable	Not applicable
SC-A16	Elbow insulation	West utility area	ND	Not applicable	Not applicable
SC-A17	Mortar	West utility area, in association with cinder blocks	ND	Not applicable	Not applicable
SC-A18 SC-A19 SC-A20 SC-A21 SC-A22 SC-A23 SC-A24	Skim coat	Utility areas, on walls	ND	Not applicable	Not applicable
SC-A25 SC-A26 SC-A27 SC-A28 SC-A29	Stucco	Exterior wall	ND	Not applicable	Not applicable

ND = None Detected; Trace = less than one percent by visual area estimation; RACM = friable (easily damaged by hand pressure) or likely to become friable during renovation/demolition; Category I Nonfriable = nonfriable packings, gaskets, resilient floor coverings (not including backing), and asphaltic roofing; Category II Nonfriable = Nonfriable materials other than Category I

NOTE: This summary table must not be used alone. Important explanations and limitations are contained in the accompanying survey report text. Percent asbestos content is based upon visual area estimation unless noted otherwise (point count analysis was not performed).

SUMMARY OF LEAD TESTING LABORATORY RESULTS

SBSA San Carlos Pump Station
150 Monte Vista Drive, San Carlos, California
Date(s) of Sampling: 7/26/2012

Description	Sample Number	Analytical Result
Roof, blue paint on HVAC units	**Pb-1**	**0.021%**
West utility area, bathroom, ceramic tile	**Pb-2**	**0.0046%**
West utility area, beige paint on ductwork	**Pb-3**	**0.01%**
West utility area, brown paint on metal shroud for motor gear box	**Pb-4**	**0.42%**
West utility area, paint on concrete stairwell steps	**Pb-5**	**0.016%**
West utility area, paint on concrete stairwell landing	Pb-6	<0.006%
West utility area, blue paint on metal pipes	Pb-7	<0.007%
Beige paint on exterior stucco wall	**Pb-8**	**0.0023%**

% means: percent lead in sample, by weight
< means: less than

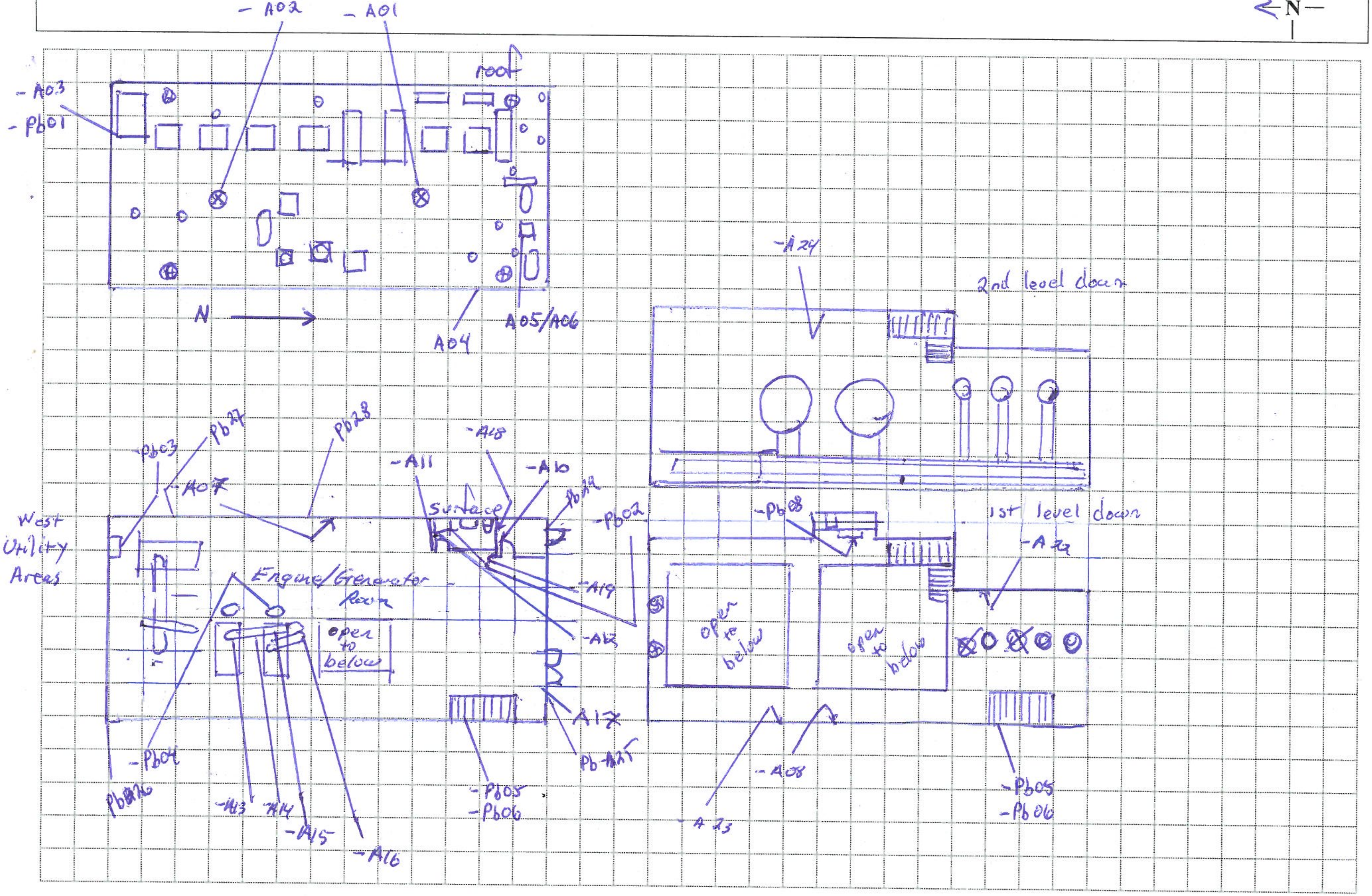
Appendix B:

Floor Plan – Sample Locations

Forensic Analytica ENVIRONMENTAL HEALTH CONSULTAN **FLOOR PLAN FORM**

Date:	Job #: PJ17441	Site: Various SBSA	Title: San Carlos	Inspectors:

Legend:



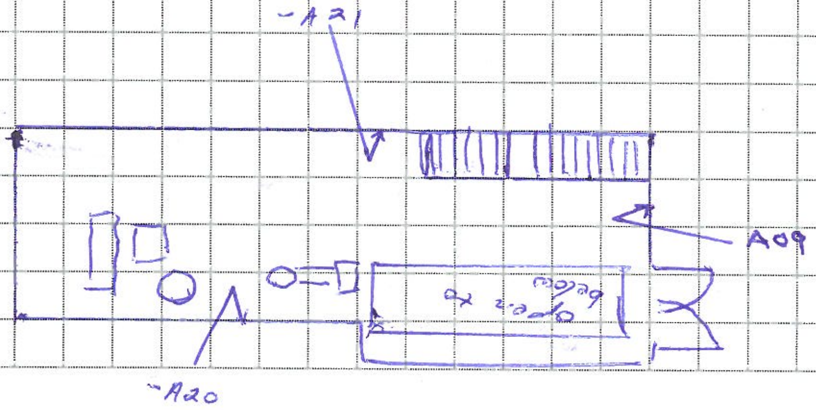
Forensic Analytica ENVIRONMENTAL HEALTH CONSULTANT **FLOOR PLAN FORM**

Date:	**Job #:** PJ17441	**Site:** Various SBSA	**Title:**	**Inspectors:**

Legend:

← N

East utility areas



Appendix C:

Supporting Laboratory Reports and Chain-of-Custody Documents

Bulk Asbestos Analysis

(EPA Method 600/R-93-116, Visual Area Estimation)

Forensic Analytical Consulting Svcs
Paulo Parra
3777 Depot Road
Suite 413
Hayward, CA 94545

Client ID: HAY01
Report Number: B166545
Date Received: 07/26/12
Date Analyzed: 08/02/12
Date Printed: 08/02/12
First Reported: 08/02/12

Job ID/Site: PJ17441; Various SBSA

Date(s) Collected: 07/26/2012

FALI Job ID: HAY01
Total Samples Submitted: 29
Total Samples Analyzed: 29

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
SC-A01	11283725						
Layer: Stones			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Tan Fibrous Material			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (10 %) Fibrous Glass (45 %)							
Comment: Bulk complex sample.							
SC-A02	11283726						
Layer: Stones			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Tan Fibrous Material			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (10 %) Fibrous Glass (45 %)							
Comment: Bulk complex sample.							

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
SC-A03	11283727						
Layer: White Non-Fibrous Material			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components: Cellulose (Trace)		**Asbestos (ND)**					
SC-A04	11283728						
Layer: White Non-Fibrous Material			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components: Cellulose (Trace)		**Asbestos (ND)**					
SC-A05	11283729						
Layer: Black Mastic			**ND**				
Layer: Stones			**ND**				
Total Composite Values of Fibrous Components: Cellulose (15 %)		**Asbestos (ND)**					
SC-A06	11283730						
Layer: Grey Mastic			**ND**				
Total Composite Values of Fibrous Components: Cellulose (15 %)		**Asbestos (ND)**					
SC-A07	11283731						
Layer: Brown Mastic			**ND**				
Total Composite Values of Fibrous Components: Cellulose (Trace) Wollastonite (2 %)		**Asbestos (ND)**					
SC-A08	11283732						
Layer: Light Brown Non-Fibrous Material			**ND**				
Layer: Brown Mastic			**ND**				
Total Composite Values of Fibrous Components: Cellulose (Trace)		**Asbestos (ND)**					
SC-A09	11283733						
Layer: Light Brown Non-Fibrous Material			**ND**				
Layer: Brown Mastic			**ND**				
Total Composite Values of Fibrous Components: Cellulose (Trace)		**Asbestos (ND)**					
SC-A10	11283734						
Layer: Off-White Tile		Chrysotile	**2 %**				
Layer: Black Mastic		Chrysotile	**5 %**				
Total Composite Values of Fibrous Components: Cellulose (Trace)		**Asbestos (2%)**					
SC-A11	11283735						
Layer: Off-White Tile		Chrysotile	**2 %**				
Layer: Black Mastic		Chrysotile	**5 %**				
Total Composite Values of Fibrous Components: Cellulose (Trace)		**Asbestos (2%)**					

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
SC-A12	11283736						
Layer: White Adhesive			**ND**				
Layer: Grey Grout			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
SC-A13	11283737						
Layer: White Semi-Fibrous Material			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (2 %) Synthetic (10 %)							
SC-A14	11283738						
Layer: White Semi-Fibrous Material			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (2 %) Synthetic (10 %)							
SC-A15	11283739						
Layer: White Semi-Fibrous Material			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (2 %) Synthetic (10 %)							
SC-A16	11283740						
Layer: Beige Non-Fibrous Material			**ND**				
Layer: Off-White Woven Material			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (5 %) Fibrous Glass (2 %)							
SC-A17	11283741						
Layer: White Mortar			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
SC-A18	11283742						
Layer: White Skimcoat			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
SC-A19	11283743						
Layer: White Skimcoat			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
SC-A20	11283744						
Layer: White Skimcoat			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
SC-A21	11283745						
Layer: White Skimcoat			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
SC-A22	11283746						
Layer: White Skimcoat			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
SC-A23	11283747						
Layer: White Skimcoat			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
SC-A24	11283748						
Layer: White Skimcoat			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
SC-A25	11283749						
Layer: White Cementitious Material			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
SC-A26	11283750						
Layer: White Cementitious Material			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
SC-A27	11283751						
Layer: White Cementitious Material			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							
SC-A28	11283752						
Layer: White Cementitious Material			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							

Report Number: B166545

Client Name: Forensic Analytical Consulting Svcs

Date Printed: 08/02/12

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
SC-A29	11283753						
Layer: White Cementitious Material			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components:		**Asbestos (ND)**					
Cellulose (Trace)							

Tad Thrower

Tad Thrower, Laboratory Supervisor, Hayward Laboratory

Note: Limit of Quantification ('LOQ') = 1%. 'Trace' denotes the presence of asbestos below the LOQ. 'ND' = 'None Detected'.

Forensic Analytical
ENVIRONMENTAL HEALTH CONSULTANTS

BULK SAMPLE REQUEST FORM

Page 1 of 3

Client: **HAY01 FACS San Francisco**
Brown and Caldwell

Contact: **Paulo Parra** Phone: **(510) 266-4600**

Site: **Various**
SBSA

Client No.: **C1114** FACS Job #: **PJ17441**

Sampled by: Radzinski PM: **Paulo Parra** Date: 26 July 2012

Special Instructions: E-mail results to pparra@forensica.com and rvelasquez@forensica.com
Per Pete K. 7/27/12 (RB)

Turnaround Time: 1-Day ☐ 2-Day ☐ ~~3-Day ☒~~ 5-Day [✓ ☒] Other ☐ Due Date and Time:

Analysis: ☑ PLM Standard / ☐ Point Count / ☐ Flame AA (Pb) /
☐ Other: Stop positive per Pete K.

Sample Number	Material Description	Sample Location	Friable	Cond.	Quantity
SC-A01	roof field	roof center, north half,	N	G	
SC-A02	roof field	roof, center, south half.	N	G	
SC-A03	white sealant	roof, SW quad, blue, HVAC duct seam.	N	G	
SC-A04	white sealant	roof, E. side, under parapit cap	N	G	
SC-A05	black sealant	roof, NE quad, seam @ ~~[illegible]~~ roof penetration	N	G	
SC-A06	grey sealant	roof, NE quad, seam @ roof penetration	N	G	
SC-A07	brown adhesive	~~1st~~ surface level, W. utility area, generator room, E. wall, behind baseboard	Y	F	
SC-A08	brown adhesive	1st level down, west, west wall, behind base board	Y	F	
SC-A09	brown adhesive	surface level, E. utility ~~room~~ area, S. wall @ entry, behind baseboard.	Y	P	
SC-A10	12"x12" FT and black adhesive	surface level W. utility area, office behind door floor	N	G	

WB – Wallboard JC - Joint Compound FT - Floor Tile FTM - Floor Tile Mastic BBM - Baseboard Mastic
RSF - Resilient Sheet Flooring CT - Ceiling Tile SAAM - Spray-Applied Acoustical Material WT - Wall Texture

Friable Yes / No Good / Fair / Poor

Shipped via: ☐ Fed Ex ☐ Airborne ☐ UPS ☐ US Mail ☐ Courier ☐ Drop Off ☑ Other:

Relinquished by: Radzinski.	*Date & Time:* 26 July 2012/1608	*Received by:*	*Date & Time:* 7-26-12 @ 4:15 pm Condition Acceptable ☑ Yes ☐ No
Relinquished by:	*Date & Time:*	*Received by:*	*Date & Time:* Condition Acceptable ☐ Yes ☐ No

RS

Forensic Analytical
ENVIRONMENTAL HEALTH CONSULTANTS

BULK SAMPLE REQUEST FORM

Page 2 of 3.

Client:	HAY01 FACS San Francisco Brown and Caldwell	Sampled by: Radzinski	PM: Paulo Parra Date: 26 July 2012
Contact:	Paulo Parra Phone: (510) 266-4600	Special Instructions:	E-mail results to pparra@forensica.com and rvelasquez@forensica.com
Site:	Various SBSA	Turnaround Time:	☐ 1-Day ☐ 2-Day ☐ 3-Day ☒ 5-Day ☐ Other Due Date and Time:
Client No.:	C1114 FACS Job #: PJ17441	Analysis:	☐ PLM Standard / ☐ Point Count / ☐ Flame AA (Pb) / ☐ Other:

Sample Number	Material Description	Sample Location	Friable	Cond.	Quantity
SC-A11	12" x 12" beige FT and black adhesive.	surface level, W. utility area, bathroom, behind door, floor	N	G	
SC-A12	white adhesive, grey grout	surface level, W. utility area, bathroom, shower enclosure, behind and between 2" x 6" blue tiles	N	G	
SC-A13	TSI - linear run	surface level, W. utility area ~~generator~~ drive motor #2 EA line, N-	Y	G	
SC-A14	TSI - linear run	Surface level, W. utility area, drive motor #2 EA line, C	Y	G	
SC-A15	TSI - linear run	surface level, W. utility area, drive motor #2 E EA line, S-	Y	G	
SC-A16	TSI - elbow	surface level, W. utility area, drive motor #1 EA line	Y	G	
SC-A17	mortar	surface level W. utility area, S. wall, between cinder blocks.	N	G	
SC-A18	skim coat	surface level, W. utility area, office, N. wall	Y	G	
SC-A19	skim coat	surface ~~area~~ level @, W. utility area just outside rest room	Y	G	
SC-A20	skim coat	surface ~~area~~ level @, E. utility area, E. wall, ctr.	Y	G	

WB – Wallboard JC - Joint Compound FT - Floor Tile FTM - Floor Tile Mastic BBM - Baseboard Mastic
RSF - Resilient Sheet Flooring CT - Ceiling Tile SAAM - Spray-Applied Acoustical Material WT - Wall Texture

Friable Yes / No Good / Fair / Poor

Shipped via: ☐ Fed Ex ☐ Airborne ☐ UPS ☐ US Mail ☐ Courier ☐ Drop Off ☑ Other: 02

Relinquished by: Radzinski	Date & Time: 26 July 2012/1600	Received by:	Date & Time: 7-26-12 @ 4:15 pm Condition Acceptable ☒ Yes ☐ No
Relinquished by:	Date & Time:	Received by:	Date & Time: Condition Acceptable ☐ Yes ☐ No

Forensic Analytical
ENVIRONMENTAL HEALTH CONSULTANTS

BULK SAMPLE REQUEST FORM

Page 3 of 5.

Client:	**HAY01 FACS San Francisco** **Brown and Caldwell**	Sampled by: Rebinski	PM: **Paulo Parra** Date: 26 July 2012
Contact:	**Paulo Parra** Phone: **(510) 266-4600**	Special Instructions:	E-mail results to pparra@forensica.com and rvelasquez@forensica.com
Site:	**Various** **SBSA**	Turnaround Time:	1-Day ☑ 2-Day ☐ 3-Day ☒ 5-Day ☒ Other ☐ Due Date and Time:
Client No.:	**C1114** FACS Job #: **PJ17441**	Analysis:	☑ PLM Standard / ☐ Point Count / ☐ Flame AA (Pb) / ☐ Other:

Sample Number	Material Description	Sample Location	Friable	Cond.	Quantity
SC-A21	skim coat	Surface level, East utility area, 1st level down E-wall @ stairs	Y	G	
SC-A22	skim coat	~~1st level down~~ @ W. utility area, 1st level down ~~##~~ E-wall	Y	G	
SC-A23	skim coat	S W. Utility area, 1st level down, W. wall	Y	G	
SC-A24	skim coat	W. utility are, 2nd level down, E-wall	Y	G	
SC-A25	stucco	S side @ entry	N	G	
SC-A26	stucco	NW corner	N	G	
SC-A27	stucco	NE corner	N	G	
SC-A28	stucco	E side	N	G	
SC-A29.	stucco	SE corner	N	G	

WB – Wallboard JC - Joint Compound FT - Floor Tile FTM - Floor Tile Mastic BBM - Baseboard Mastic
RSF - Resilient Sheet Flooring CT - Ceiling Tile SAAM - Spray-Applied Acoustical Material WT - Wall Texture

Friable Yes / No Good / Fair / Poor

Shipped via: ☐ Fed Ex ☐ Airborne ☐ UPS ☐ US Mail ☐ Courier ☐ Drop Off ☐ Other:

Relinquished by:	Date & Time: 26 July 2012/ 1600	Received by:	Date & Time: 7-26-12 @ 4:15 pm Condition Acceptable ☑ Yes ☐ No
Relinquished by:	Date & Time:	Received by:	Date & Time: Condition Acceptable ☐ Yes ☐ No

Forensic Analytical
ENVIRONMENTAL HEALTH CONSULTANTS

PAINT CHIP SAMPLE REQUEST FORM

Page 1 of 1

Client:	HAY01 FACS San Francisco Brown and Caldwell	Sampled by: Radzinski	PM: Paulo Parra Date: 26 July 2012
Contact:	Paulo Parra Phone: (510) 266-4600	Special Instructions:	E-mail results to pparra@forensica.com and rvelasquez@forensica.com
Site:	Various SBSA	Turnaround Time:	1-Day ☐ 2-Day ☐ 3-Day ☑ 5-Day ☐ Other ☐ Due Date and Time:
Client No.:	C1114 FACS Job #: PJ17441	Analysis:	☑ Flame AA (Pb) / ☐ Other:

Sample Number	Sample Location	Component	Color	Substrate	Condition
SC-Pb01	roof, SW Quad, blue HVAC unit duct seam	duct	blue	metal	G
SC-Pb02	surface level, W. utility area, restroom shower enclosure, tile	wall	blue	WB	G
SC-Pb03	surface level, W. utility area, HVAC duct, N. wall	duct	beige	metal	P
SC-Pb04	surface level, W. utility area, #1 drive motor gear box	metal shroud	brown	metal	G
SC-Pb05	W. utility area, 1st level down, ~~[illegible]~~ steps	~~wall~~ Floor	brown ~~beige~~	concrete	G
SC-Pb06	W. utility area, 1st level down, steps, leading edge	Floor	Yellow	concrete	G
SC-Pb07	W. utility area, 1st level down, E. pipe	pipe	blue	metal	G
SC-Pb08	Exterior W. side	wall	beige	stucco	G
~~SC-Pb09~~ RP					
~~SC-Pb10~~					

Substrate: wood metal concrete plaster drywall brick

Shipped via: ☐ Fed Ex ☐ Airborne ☐ UPS ☐ US Mail ☐ Courier ☐ Drop Off ☐ Other:

9/0

Relinquished by: Radzinski	Date & Time: 26 July 2012 / 1605	Received by:	Date & Time: 7-26-12 @ 4:15pm Condition Acceptable ☒ Yes ☐ No
Relinquished by:	Date & Time:	Received by:	Date & Time: Condition Acceptable ☐ Yes ☐ No

Metals Analysis of Paints

Forensic Analytical Consulting Svcs
Paulo Parra
3777 Depot Road
Suite 413
Hayward, CA 94545

Client ID: HAY01
Report Number: M131302
Date Received: 07/26/12
Date Analyzed: 07/31/12
Date Printed: 07/31/12
First Reported: 07/31/12

Job ID / Site: PJ17441; Various SBSA
Date(s) Collected: 7/26/12

FALI Job ID: HAY01
Total Samples Submitted: 6
Total Samples Analyzed: 6

Sample Number	Lab Number	Analyte	Result	Result Units	Reporting Limit*	Method Reference
SC-PB01	30439973	Pb	0.021	wt%	0.006	EPA 3050B/7420
SC-PB03	30439975	Pb	0.010	wt%	0.006	EPA 3050B/7420
SC-PB04	30439976	Pb	0.42	wt%	0.03	EPA 3050B/7420
Comment:	Insufficient sample size for repeatable analysis.					
SC-PB05	30439977	Pb	0.016	wt%	0.006	EPA 3050B/7420
SC-PB06	30439978	Pb	< 0.006	wt%	0.006	EPA 3050B/7420
SC-PB07	30439979	Pb	< 0.007	wt%	0.007	EPA 3050B/7420

* The Reporting Limit represents the lowest amount of analyte that the laboratory can confidently detect in the sample, and is not a regulatory level. The Units for the Reporting Limit are the same as the Units for the Final Results.

Daniele Siu

Daniele Siu, Laboratory Supervisor, Hayward Laboratory

Metals Analysis of Bulks

Forensic Analytical Consulting Svcs
Paulo Parra
3777 Depot Road
Suite 413
Hayward, CA 94545

Client ID: HAY01
Report Number: M131398
Date Received: 07/26/12
Date Analyzed: 07/31/12
Date Printed: 07/31/12
First Reported: 07/31/12

Job ID / Site: PJ17441; Various SBSA
Date(s) Collected: 7/26/12

FALI Job ID: HAY01
Total Samples Submitted: 1
Total Samples Analyzed: 1

Sample Number	Lab Number	Analyte	Result	Result Units	Reporting Limit*	Method Reference
SC-PB08	30439980	Pb	23	mg/kg	6	EPA 3050B/7420

* The Reporting Limit represents the lowest amount of analyte that the laboratory can confidently detect in the sample, and is not a regulatory level. The Units for the Reporting Limit are the same as the Units for the Final Results.

Daniele Siu

Daniele Siu, Laboratory Supervisor, Hayward Laboratory

Metals Analysis of Bulks

Forensic Analytical Consulting Svcs
Paulo Parra
3777 Depot Road
Suite 413
Hayward, CA 94545

Client ID: HAY01
Report Number: M131397
Date Received: 07/26/12
Date Analyzed: 07/31/12
Date Printed: 07/31/12
First Reported: 07/31/12

Job ID / Site: PJ17441; Various SBSA
Date(s) Collected: 7/26/12

FALI Job ID: HAY01
Total Samples Submitted: 1
Total Samples Analyzed: 1

Sample Number	Lab Number	Analyte	Result	Result Units	Reporting Limit*	Method Reference
SC-PB02	30439974	Pb	46	mg/kg	7	EPA 3050B/7420

* The Reporting Limit represents the lowest amount of analyte that the laboratory can confidently detect in the sample, and is not a regulatory level. The Units for the Reporting Limit are the same as the Units for the Final Results.

Daniele Siu

Daniele Siu, Laboratory Supervisor, Hayward Laboratory

Appendix D:

Certifications of FACS Personnel

STATE OF CALIFORNIA
Edmund G. Brown, Jr. *Governor*
DEPARTMENT OF INDUSTRIAL RELATIONS
Division of Occupational Safety and Health
Asbestos Unit
2211 Park Towne Circle, Suite 1
Sacramento, CA 95825-0414
(916) 574-2993 Office (916) 483-0572 Fax
http://www.dir.ca.gov/dirdatabases.html actu@dir.ca.gov

109284806C 355

October 28, 2011

Forensic Analytical Consulting Services
Paulo C Parra
3777 Depot Road, #417
Hayward ' CA 94806

Dear Certified Asbestos Consultant or Technician:

Congratulations, you have passed your certification examination!

Enclosed is your certification card. **To maintain your certification, please abide by the rules printed on the back of the certification card.**

Your certification is valid for a period of one year. If you wish to renew your certification, you must apply for renewal at least 60 days before the expiration date shown on your card in accordance with Title 8, California Code of Regulations, Division 1, Chapter 3.2, Article 2.6, Section 341.15(h) (1).

Please keep and do not send copies of your required AHERA refresher renewal certificates to the Division until you apply for renewal of your certification.

Please contact our office at the above address, fax number or email of any changes in your mailing or work address within 15 days of the change.

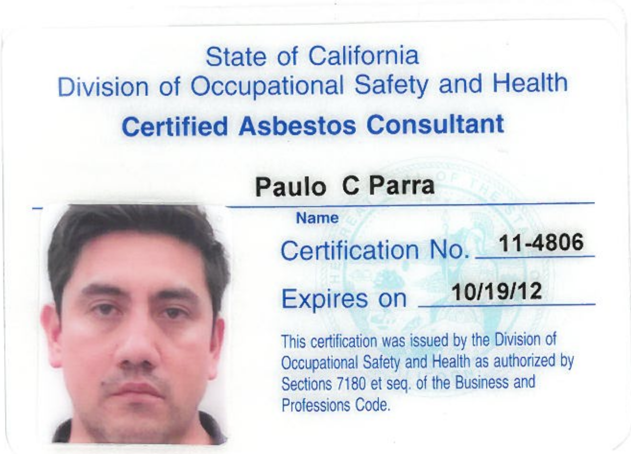
Sincerely,

Jeff Ferrell
Senior Industrial Hygienist

Attachment

cc: File

Passed Exam – Card Attached, Revised 01/07/2011



State of California
Division of Occupational Safety and Health
Certified Asbestos Consultant

Paulo C Parra
Name

Certification No. 11-4806

Expires on 10/19/12

This certification was issued by the Division of Occupational Safety and Health as authorized by Sections 7180 et seq. of the Business and Professions Code.

State of California Department of Public Health

Lead-Related
Construction
Certificate

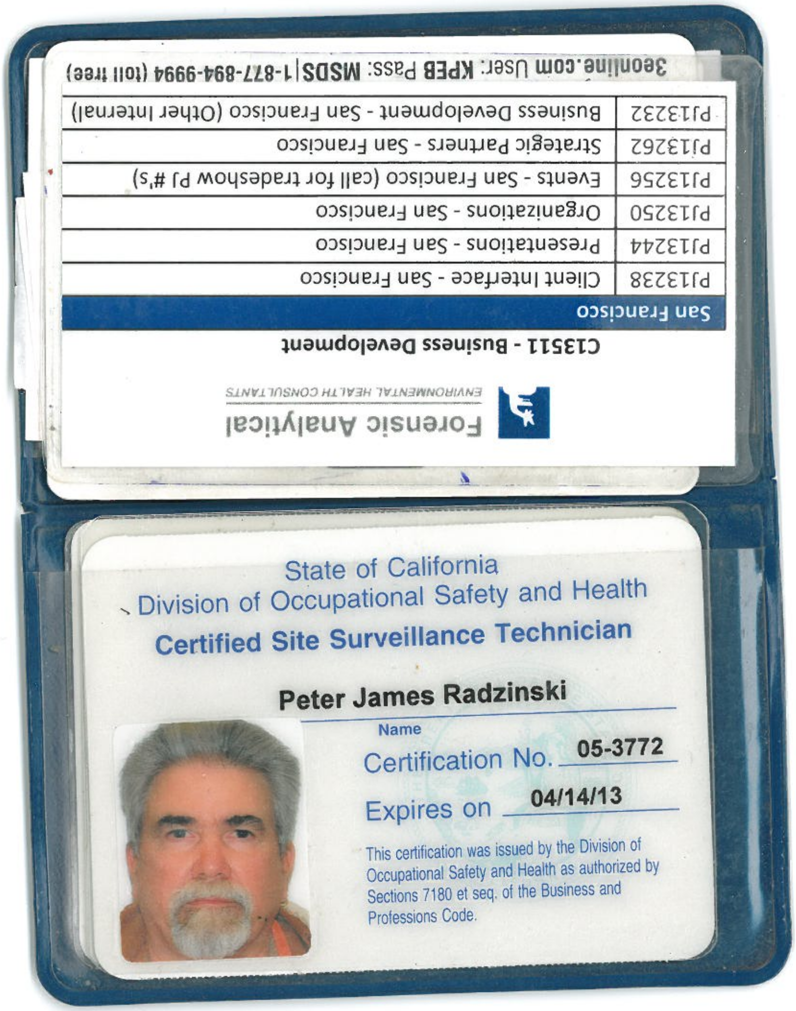
Certificate Type	Expiration Date
Inspector/Assessor	11/08/2012

18774

Paulo C. Parra

ID #: **20051**

Mr. Paulo C. Parra
Forensic Analytical Consulting Services, Inc.
3777 Depot Road, Suite 413
Hayward, California 94545



Forensic Analytical

ENVIRONMENTAL HEALTH CONSULTANTS

C13511 - Business Development

San Francisco	
PJ13238	Client Interface - San Francisco
PJ13244	Presentations - San Francisco
PJ13250	Organizations - San Francisco
PJ13256	Events - San Francisco (call for tradeshow PJ #'s)
PJ13262	Strategic Partners - San Francisco
PJ13232	Business Development - San Francisco (Other Internal)

3eonline.com User: **KPEB** Pass: **MSDS** | **1-877-894-9994 (toll free)**

State of California
Division of Occupational Safety and Health

Certified Site Surveillance Technician

Peter James Radzinski
Name

Certification No. **05-3772**

Expires on **04/14/13**

This certification was issued by the Division of Occupational Safety and Health as authorized by Sections 7180 et seq. of the Business and Professions Code.

State of California Department of Public Health

Lead-Related Construction Certificate

Certificate Type	Expiration Date
Sampling Technician	08/07/2013

19726

Peter Radzinski

ID #: **5018**

Attachment D: Pre-Demolition Asbestos Survey & Lead Testing Reports by Forensic Analytical

Belmont Pump Station, August 10, 2012

Forensic Analytical

ENVIRONMENTAL HEALTH CONSULTANTS

Pre-Demolition Asbestos Survey & Lead Testing Report

SBSA Belmont Pump Station
1385 Shoreway Road
Belmont, California

August 10, 2012

Prepared for:

Mr. Timothy Banyai
Brown and Caldwell
201 North Civic Center Drive, Suite 115
Walnut Creek, CA 94596
tbanyai@brwncald.com

Prepared by:

Wilson Wong
Forensic Analytical Consulting Services, Inc.
3777 Depot Road, Suite 413
Hayward, CA 94545
510-266-4600 ♦ wwong@forensicanalytical.com

FACS Project #PJ17441

Table of Contents

Executive Summary

Forensic Analytical Consulting Services, Inc. (FACS) performed a pre-demolition asbestos survey and lead testing at the SBSA Belmont Pump Station on July 26, 2012. The purpose of the survey was to identify, sample, and analyze all suspect asbestos-containing materials that may be disturbed in the planned demolition.

The survey was intended to meet the requirements of the Bay Area Air Quality Management District. The results of this report should be incorporated into any demolition plans for the building.

No asbestos-containing materials were identified in this survey.

Lead was detected in five (5) of the seven (7) paints tested, all at concentrations below lead-based paint level (0.5%).

Results of laboratory testing are summarized in the attached table. The summary table must not be used alone. Important explanations and limitations are contained in the full report text below.

Introduction

Forensic Analytical Consulting Services, Inc. (FACS) was retained by Mr. Timothy Banyai of Brown and Caldwell to perform a pre-demolition asbestos survey of the SBSA Belmont Pump Station located at 1385 Shoreway Road, Belmont, California. Peter Radzinski of FACS performed the investigation on July 26, 2012. Mr. Radzinski is certified by the State of California as a Certified Site Surveillance Technician (Cert. No. 05-3772). Project Management was provided by Mr. Paulo Parra a California Certified Asbestos Consultant (Cert. No 11-4806). Certifications of FACS personnel are presented in Appendix D.

This report contains the findings and recommendations from our inspection and laboratory analysis of samples collected. The purpose of the survey was to identify, sample, and analyze all suspect asbestos- and lead containing materials that may be disturbed in the planned renovation, within the limitations described below.

Site Description and Scope of Work

The Project building was a single-story cinder block structure with a tar-and-gravel roof. The building was a pump station, and the interior was divided into north and south utility areas, each with two sub-levels.

This survey was performed for the planned demolition of the pump station. However, since the north sub-levels were confined spaces, they were excluded from the scope of this survey.

Methodology

Our investigation consisted of the following:

- Visual inspection
- Documentation of relevant conditions
- Collection of samples of suspect asbestos-containing materials using the AHERA sampling protocol
- Collection of samples of suspect lead paint
- Submitting samples to a laboratory accredited by AIHA, NVLAP, and ELAP for analysis by PLM & Flame AA
- Presenting analytical results, conclusions, and recommendations in a report, which can be submitted to the Bay Area Air Quality Management District.

The types, numbers, and locations of samples were determined based on information about the planned demolition, visual observations, regulatory requirements, and other project management considerations.

Findings

Survey results are summarized in the attached table (Appendix A).

No asbestos-containing materials were identified in this survey. Lead was detected in five (5) of the seven (7) paints tested. Paint testing results ranged from <0.006% to 0.067% lead by weight.

A floor plan showing sample locations is presented in Appendix B. The detailed laboratory report and completed Sampling Data Form (Chain of Custody) are contained in Appendix C.

Conclusions and Discussion

An asbestos-containing material for which sample analysis results by PLM are greater than one percent asbestos is classified as Asbestos-Containing Material (ACM) under regulations promulgated by: : US EPA, BAAQMD, Cal-EPA, OSHA, and Cal/OSHA. US EPA and BAAQMD require that a material with a PLM analytical result less than 10% (including Trace results of less than one percent) be confirmed by the point count method, or else the material must be assumed to be ACM.

An asbestos-containing material for which sample analysis results by PLM are greater than 0.1 percent asbestos is classified as Asbestos-Containing Construction Material (ACCM) by Cal/OSHA and by the California Contractor State Licensing Board (CSLB).

OSHA (Cal/OSHA) regulates all materials that contain asbestos, even at Trace levels. At a minimum, employee training, wet methods, HEPA vacuums, and prompt cleanup and disposal of debris in leak-proof containers are recommended or required for the disturbance of any material that contains asbestos.

No asbestos-containing material was detected in this survey.

Lead is primarily regulated in California by Cal/OSHA and the California Department of Public Health. The current Cal/OSHA Lead in Construction Safety Standard (8 CCR 1532.1) regulation applies to all construction work where an employee may be occupationally exposed to lead. Therefore, work performed on surfaces (including manual demolition, scraping, welding, etc.) containing any amount of lead must comply with the standard, including an exposure assessment (personal air monitoring) to determine if the airborne lead exposure levels are within acceptable limits.

Since **lead was detected in some of the paint chip samples** collected (ranging from 0.0021% to 0.067%), 8 CCR 1532.1 applies to any work that will disturb these lead-containing paints. Other components represented by the positive lead samples in the Summary of Lead Testing Laboratory Results shall be considered to be lead-containing until proven otherwise.

For detailed regulatory requirements in specific situations, FACS should be consulted, or the applicable regulations should be examined

Recommendations

1. No further actions are required for asbestos-related work.

2. If any additional suspect asbestos-containing material is discovered during the renovation, the work should stop, and the material should be tested for asbestos content.

3. Removal of the lead paint at spots scheduled for disturbance by the construction would eliminate the applicability of the Cal/OSHA standard to the paint. If the paint is not removed, and the work will involve a Cal/OSHA trigger task (such as torch cutting), workers must be protected during the initial exposure monitoring, per the Cal/OSHA Lead Standard requirements, as if they were exposed above the Permissible Exposure Limit, until actual exposures are determined. With torch cutting, for

example, this includes providing supplied air respiratory protection during the initial exposure assessment.

4. Because some of the paint present is peeling or deteriorated, these areas of paint should be removed from components prior to sending components for recycling or disposal. The paint chips are likely to be classified as hazardous waste for lead, whereas the components with the remaining intact paint may possibly test as non-hazardous. Scraping of loose and flaky paint prior to removal/demolition of the components is intended to prevent loose paint chips from contaminating the larger quantity of components and causing the larger load of waste to be classified as hazardous, and also intended to prevent paint chips from dislodging and contaminating the ground at the site or along the waste/recycling transportation route.

5. Paint chips and other waste generated from the paint removal, as well as painted components destined for disposal, should be tested to determine if it is hazardous waste. For reference, lead waste is considered a hazardous waste if the result of the Toxicity Characterization Leaching Procedure (TCLP) test exceeds 5 mg/liter, under the Resource Conservation and Recovery Act (RCRA), 40 CFR 261, Appendix II. In California, a waste is also considered hazardous if the result of soluble lead content by a Waste Extraction Test (WET) is greater than 5 mg/l, or if the total lead content exceeds 1,000 mg/kg in accordance with Title 22 of the CCR. When TTLC results are below 50 mg/kg, STLC/TCLP limits cannot be exceeded, so the waste would be classified as non-hazardous for lead. Other hazardous metals historically utilized in paint manufacture should also be tested to determine hazardous waste classification.

6. For further assistance with regulatory requirements, FACS should be consulted, and the applicable regulations should be reviewed.

Limitations

The results of this asbestos survey and lead testing do not apply beyond the planned renovation described above. Construction materials in areas not included in the scope of this survey should be assumed to be asbestos-containing materials / lead paint, unless testing is conducted which determines otherwise. If revisions to the renovation project are made that impact additional materials or areas, FACS should be contacted to review the changes and/or to conduct additional asbestos survey work to address potential impacts to untested materials.

The scope of this asbestos survey and lead testing did not include the identification of other hazardous materials, which might exist in the area of the planned renovation. Other hazardous materials may include polychlorinated biphenyls (PCBs) in fluorescent light ballasts and caulking, lead in paint, and mercury in light fixtures and switches.

This investigation is limited to the conditions and practices observed and information made available to FACS. The methods, conclusions, and recommendations provided are based on FACS' judgment and experience and on the standard of practice for professional service. They are subject to the limitations and variability inherent in the methodology employed. As with all environmental investigations, this investigation is limited to the defined scope and does not purport to set forth all hazards, nor to indicate that other hazards do not exist.

Please do not hesitate to contact our office at 510-266-4600 if you have any questions about our report. Thank you for the opportunity to assist Brown and Caldwell in promoting a more healthful environment.

Respectfully,
Forensic Analytical Consulting Services

Wilson Wong
Program Manager
CAC 92-0791, CDPH 4401

Reviewed by:
Forensic Analytical Consulting Services

Stephen E

Steve Jackson
Director of Consulting
CAC 95-1782

Appendix A:

Asbestos Survey & Lead Testing Results Summary Table

PRE-RENOVATION ASBESTOS SURVEY SUMMARY

SBSA Belmont Pump Station
1385 Shoreway Road, Belmont, California
Date(s) of Sampling: 7/26/2012

Sample Number	Material Description	Location(s) of Material	Asbestos Content (Percent)	Asbestos Regulatory Classification	Approximate Quantity
BL-A01	Brown adhesive	Surface level, at louvers	ND	Not applicable	Not applicable
BL-A02	HVAC seam cloth	On ductwork	ND	Not applicable	Not applicable
BL-A03	Wall coating	Surface level, interior walls	ND	Not applicable	Not applicable
BL-A04	Tanks coating	Surface level, utility area, tank	ND	Not applicable	Not applicable
BL-A05	Roof field	Roof	ND	Not applicable	Not applicable
BL-A06	Roof parapet flashing	Roof, at parapet	ND	Not applicable	Not applicable
BL-A07	Black sealant	Roof	ND	Not applicable	Not applicable
BL-A08	White sealant	Roof	ND	Not applicable	Not applicable

ND = None Detected; Trace = less than one percent by visual area estimation; RACM = friable (easily damaged by hand pressure) or likely to become friable during renovation/demolition; Category I Nonfriable = nonfriable packings, gaskets, resilient floor coverings (not including backing), and asphaltic roofing; Category II Nonfriable = Nonfriable materials other than Category I

NOTE: This summary table must not be used alone. Important explanations and limitations are contained in the accompanying survey report text. Percent asbestos content is based upon visual area estimation unless noted otherwise (point count analysis was not performed).

PRE-RENOVATION ASBESTOS SURVEY SUMMARY

SBSA Belmont Pump Station
1385 Shoreway Road, Belmont, California
Date(s) of Sampling: 7/26/2012

Sample Number	Material Description	Location(s) of Material	Asbestos Content (Percent)	Asbestos Regulatory Classification	Approximate Quantity
BL-A09 BL-A10 BL-A11	Stucco	Exterior wall	ND	Not applicable	Not applicable
BL-A12 BL-A13	Mortar	Exterior, at façade	ND	Not applicable	Not applicable

ND = None Detected; Trace = less than one percent by visual area estimation; RACM = friable (easily damaged by hand pressure) or likely to become friable during renovation/demolition; Category I Nonfriable = nonfriable packings, gaskets, resilient floor coverings (not including backing), and asphaltic roofing; Category II Nonfriable = Nonfriable materials other than Category I

NOTE: This summary table must not be used alone. Important explanations and limitations are contained in the accompanying survey report text.
Percent asbestos content is based upon visual area estimation unless noted otherwise (point count analysis was not performed).

SUMMARY OF LEAD TESTING LABORATORY RESULTS

SBSA Belmont Pump Station
1385 Shoreway Road, Belmont, California
Date(s) of Sampling: 7/26/2012

Description	Sample Number	Analytical Result
Roof, white painted penetration by muffler	**Pb-1**	**0.067**
Roof, white painted parapet	Pb-2	<0.006%
South utility area, gray painted diesel fuel tank	Pb-3	<0.006%
South utility area, 1st level down, gray painted floor	**Pb-4**	**0.012%**
South utility area, 1st level down, gray painted pump	**Pb-5**	**0.04%**
South utility area, 1st level down, white painted wall	**Pb-6**	**0.04%**
Tan tile on east exterior wall	**Pb-7**	**0.0021%**

% means: percent lead in sample, by weight
< means: less than

Appendix B:

Floor Plan – Sample Locations

Forensic Analytical
ENVIRONMENTAL HEALTH CONSULTANTS

FLOOR PLAN FORM

Date:

Job #: PJ17441

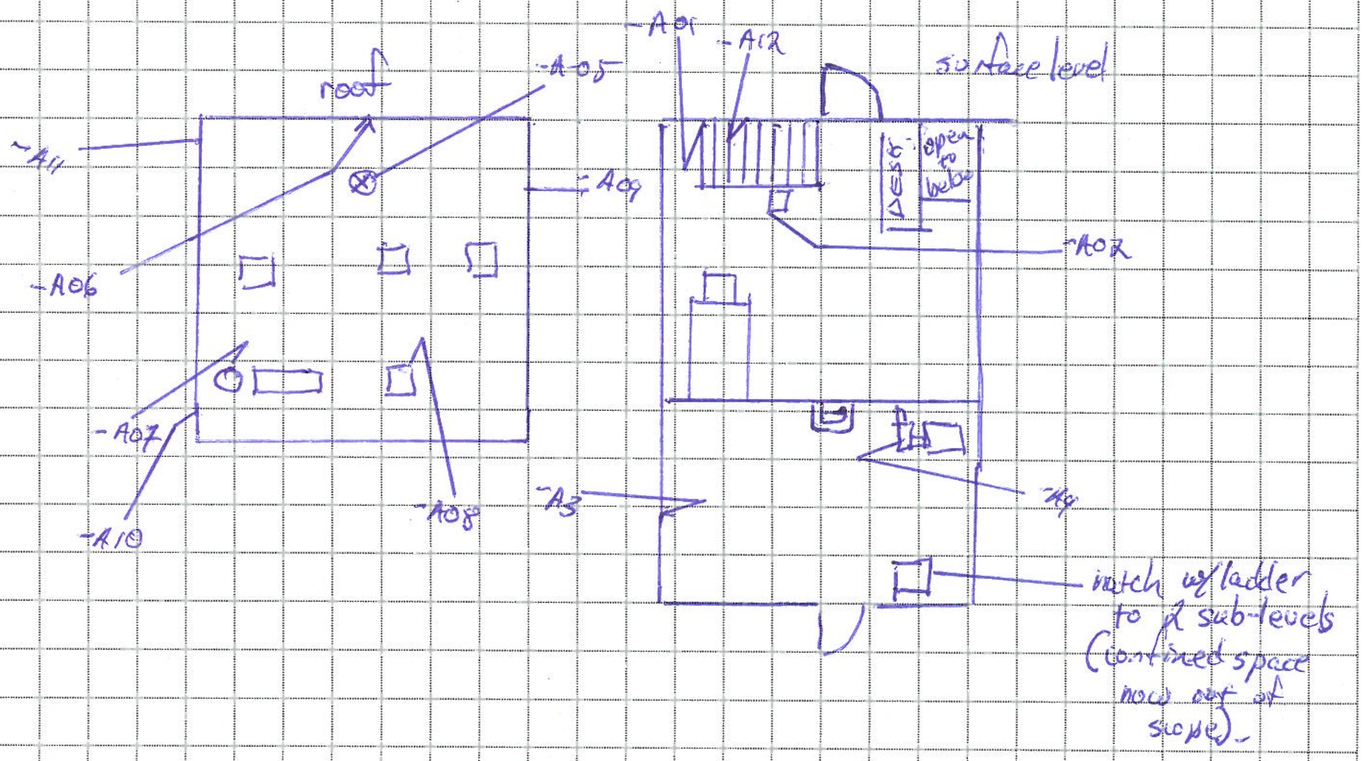
Site: Various SBSA

Title:

Inspectors:

Legend:

— N —



Not to scale, bldg. is square

Appendix C:

Supporting Laboratory Reports and Chain-of-Custody Documents

Forensic Analytical Laboratories

Final Report

Bulk Asbestos Analysis

(EPA Method 600/R-93-116, Visual Area Estimation)

Forensic Analytical Consulting Svcs
Paulo Parra
3777 Depot Road
Suite 413
Hayward, CA 94545

Client ID: HAY01
Report Number: B166543
Date Received: 07/26/12
Date Analyzed: 08/02/12
Date Printed: 08/02/12
First Reported: 08/02/12

Job ID/Site: PJ17441; Various SBSA

Date(s) Collected: 07/26/2012

FALI Job ID: HAY01
Total Samples Submitted: 13
Total Samples Analyzed: 13

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
BL-A01	11283706						
Layer: Light Brown Non-Fibrous Material			**ND**				
Layer: Brown Mastic			**ND**				
Total Composite Values of Fibrous Components: Cellulose (Trace)		**Asbestos (ND)**					
BL-A02	11283707						
Layer: Off-White Semi-Fibrous Material			**ND**				
Total Composite Values of Fibrous Components: Cellulose (Trace) Fibrous Glass (60 %)		**Asbestos (ND)**					
BL-A03	11283708						
Layer: White Coating			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components: Cellulose (Trace)		**Asbestos (ND)**					
BL-A04	11283709						
Layer: White Coating			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components: Cellulose (Trace)		**Asbestos (ND)**					
BL-A05	11283710						
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Brown Fibrous Material			**ND**				
Total Composite Values of Fibrous Components: Cellulose (10 %) Fibrous Glass (45 %) Comment: Bulk complex sample.		**Asbestos (ND)**					

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
BL-A06	11283711						
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Layer: Black Tar			**ND**				
Layer: Black Felt			**ND**				
Total Composite Values of Fibrous Components: Cellulose (5 %) Fibrous Glass (50 %) Comment: Bulk complex sample.		**Asbestos (ND)**					
BL-A07	11283712						
Layer: Black Mastic			**ND**				
Total Composite Values of Fibrous Components: Cellulose (Trace)		**Asbestos (ND)**					
BL-A08	11283713						
Layer: White Non-Fibrous Material			**ND**				
Total Composite Values of Fibrous Components: Cellulose (Trace)		**Asbestos (ND)**					
BL-A09	11283714						
Layer: White Cementitious Material			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components: Cellulose (Trace)		**Asbestos (ND)**					
BL-A10	11283715						
Layer: White Cementitious Material			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components: Cellulose (Trace)		**Asbestos (ND)**					
BL-A11	11283716						
Layer: White Cementitious Material			**ND**				
Layer: Paint			**ND**				
Total Composite Values of Fibrous Components: Cellulose (Trace)		**Asbestos (ND)**					
BL-A12	11283717						
Layer: Tan Mortar			**ND**				
Total Composite Values of Fibrous Components: Cellulose (Trace)		**Asbestos (ND)**					

Report Number: B166543

Client Name: Forensic Analytical Consulting Svcs

Date Printed: 08/02/12

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
BL-A13	11283718						
Layer: Tan Mortar			**ND**				
Total Composite Values of Fibrous Components: Cellulose (Trace)		**Asbestos (ND)**					

Tad Thrower

Tad Thrower, Laboratory Supervisor, Hayward Laboratory

Note: Limit of Quantification ('LOQ') = 1%. 'Trace' denotes the presence of asbestos below the LOQ. 'ND' = 'None Detected'.

Forensic Analytical
ENVIRONMENTAL HEALTH CONSULTANTS

BULK SAMPLE REQUEST FORM

Page 1 of 2.

Client:	**HAY01 FACS San Francisco** **Brown and Caldwell**	Sampled by: Rebczinski	PM: **Paulo Parra** Date: 26 July 2012
Contact:	**Paulo Parra** Phone: **(510) 266-4600**	Special Instructions:	E-mail results to pparra@forensica.com and rvelasquez@forensica.com per Pete K. 7/27/12
Site:	**Various** **SBSA**	Turnaround Time:	1-Day ☐ 2-Day ☐ 3-Day ☒ 5-Day ☒ Other ☐ Due Date and Time:
Client No.:	**C1114** FACS Job #: **PJ17441**	Analysis:	☑ PLM Standard / ☐ Point Count / ☐ Flame AA (Pb) / ☐ Other: Prior positive per Pete K.

Sample Number	Material Description	Sample Location	Friable	Cond.	Quantity
BL-A01	brown adhesive	Surface level, south utility area, s. wall @ louvres	Y	G	
BL-A02	glassed HVAC seam cloth	Surface level, adjacent to stairs HVAC duct south utility area	N	G	
BL-A03	wall coating	Surface level, N. utility area E wall, glassed wall coating.	N	F	
BL-A04	coating.	Surface level, N. utility area SW quad, tank protective coating	N	G	
BL-A05	roof field	roof, center of South half	N	G	
BL-A06	roof parapit flashing	roof, south parapit, center.	N	G	
BL-A07	black sealant	roof, EA penetration @ muffler, NE Quad	N	G	
BL-A08	white sealant	roof, HVAC penetration, NW quad	N	G	
BL-A09	stucco	Exterior, west side, S. end.	N	G	
BL-A10	stucco	Exterior, E side, N. end.	N	G	

WB Wallboard JC - Joint Compound FT - Floor Tile FTM - Floor Tile Mastic BBM - Baseboard Mastic
RSF - Resilient Sheet Flooring CT - Ceiling Tile SAAM - Spray-Applied Acoustical Material WT - Wall Texture

Friable Yes / No Good / Fair / Poor

Shipped via: ☐ Fed Ex ☐ Airborne ☐ UPS ☐ US Mail ☐ Courier ☒ Drop Off ☐ Other:

Relinquished by: Rebczinski	Date & Time: 26 July 2012 / 1606	Received by:	Date & Time: 7-26-12 @ 4:15 pm Condition Acceptable ☑ Yes ☐ No
Relinquished by:	Date & Time: /	Received by:	Date & Time: Condition Acceptable ☐ Yes ☐ No

Forensic Analytical
ENVIRONMENTAL HEALTH CONSULTANTS

BULK SAMPLE REQUEST FORM

Page 2 of 2.

Client: **HAY01 FACS San Francisco**
Brown and Caldwell

Contact: **Paulo Parra** Phone: **(510) 266-4600**

Site: **Various**
SBSA

Client No.: **C1114** FACS Job #: **PJ17441**

Sampled by: Rabinski PM: **Paulo Parra** Date: 26 July 2012

Special Instructions: E-mail results to pparra@forensica.com and rvelasquez@forensica.com

Turnaround Time: 1-Day ☐ 2-Day ☐ 3-Day ☑ ~~5-Day ☒~~ Other ☐ Due Date and Time:

Analysis: ☑ PLM Standard / ☐ ~~Point Count~~ / ☐ Flame AA (Pb) /
☐ Other:

Sample Number	Material Description	Sample Location	Friable	Cond.	Quantity
BL-A11	stucco	Exterior, E. side, S. end.	N	G	
BL-A12	mortar	surface level, S. utility space, S. wall @ stairs, between cinderblocks	N	G	
BL-A13	mortar	Exterior, ~~side~~ E. side, center, between facade bricks	N	G	

WB – Wallboard JC - Joint Compound FT - Floor Tile FTM - Floor Tile Mastic BBM - Baseboard Mastic
RSF - Resilient Sheet Flooring CT - Ceiling Tile SAAM - Spray-Applied Acoustical Material WT - Wall Texture

Friable Yes / No Good / Fair / Poor

Shipped via: ☐ Fed Ex ☐ Airborne ☐ UPS ☐ US Mail ☐ Courier ☐ Drop Off ☐ Other:

Relinquished by: Rabinski	*Date & Time:* 26 July 2012 / 1606	*Received by:*	*Date & Time:* 7-26-12 @ 4:15pm Condition Acceptable ☑ Yes ☐ No
Relinquished by:	*Date & Time:*	*Received by:*	*Date & Time:* Condition Acceptable ☐ Yes ☐ No

Metals Analysis of Paints

Forensic Analytical Consulting Svcs
Paulo Parra
3777 Depot Road
Suite 413
Hayward, CA 94545

Client ID: HAY01
Report Number: M131313
Date Received: 07/26/12
Date Analyzed: 08/02/12
Date Printed: 08/02/12
First Reported: 08/02/12

Job ID / Site: PJ17441; Various SBSA
Date(s) Collected: 7/26/12

FALI Job ID: HAY01
Total Samples Submitted: 6
Total Samples Analyzed: 6

Sample Number	Lab Number	Analyte	Result	Result Units	Reporting Limit*	Method Reference
BL-PB01	30440051	Pb	0.067	wt%	0.006	EPA 3050B/7420
BL-PB02	30440052	Pb	< 0.006	wt%	0.006	EPA 3050B/7420
BL-PB04	30440053	Pb	0.012	wt%	0.006	EPA 3050B/7420
BL-PB05	30440054	Pb	0.04	wt%	0.01	EPA 3050B/7420
BL-PB06	30440055	Pb	0.04	wt%	0.01	EPA 3050B/7420
BL-PB03	30440056	Pb	< 0.006	wt%	0.006	EPA 3050B/7420

* The Reporting Limit represents the lowest amount of analyte that the laboratory can confidently detect in the sample, and is not a regulatory level. The Units for the Reporting Limit are the same as the Units for the Final Results.

Daniele Siu

Daniele Siu, Laboratory Supervisor, Hayward Laboratory

Forensic Analytical
ENVIRONMENTAL HEALTH CONSULTANTS

BULK SAMPLE REQUEST FORM

Page 1 of 1.

Client:	**HAY01 FACS San Francisco** **Brown and Caldwell**	Sampled by: Radzinski.	PM: **Paulo Parra** Date: 26 July 2012
Contact:	**Paulo Parra** Phone: **(510) 266-4600**	Special Instructions:	E-mail results to pparra@forensica.com and rvelasquez@forensica.com OK ↓
Site:	**Various** **SBSA**	Turnaround Time:	1-Day ☐ 2-Day ☐ ~~3-Day~~ ☒ ~~5-Day~~ ☒ Other ☑ Due Date and Time:
Client No.:	**C1114** FACS Job #: **PJ17441**	Analysis:	☐ PLM Standard / ☐ Point Count / ☑ Flame AA (Pb) / ☐ Other:

Sample Number	Material Description	Sample Location	Friable	Cond.	Quantity
BL-Pb01	white paint	roof/EA penetration, by muffler, NE quad	Y	P	
BL-Pb02	white paint	roof, parapit, roof side.	Y	F	
BL-Pb04	grey paint	south utility ~~level~~ area, 1st level down, floor	N	F	
BL-Pb05	grey paint	South utility area, 1st level down, W. pump housing	N	G	
BL-Pb06	white paint	South utility area, 1st level down, N. wall	N	G	
~~BL-P~~ BL-Pb03	grey paint	South utility area, ~~gen~~ diesel fuel tank	N	G	

WB – Wallboard JC - Joint Compound FT - Floor Tile FTM - Floor Tile Mastic BBM - Baseboard Mastic
RSF - Resilient Sheet Flooring CT - Ceiling Tile SAAM - Spray-Applied Acoustical Material WT - Wall Texture

Friable Yes / No Good / Fair / Poor

Shipped via: ☐ Fed Ex ☐ Airborne ☐ UPS ☐ US Mail ☐ Courier ☐ Drop Off ☐ Other:

Relinquished by: Radzinski.	*Date & Time:* 26 July 2012 / 1607	*Received by:*	*Date & Time:* 7-26-12 @ 4:15 pm Condition Acceptable ☑ Yes ☐ No
Relinquished by:	*Date & Time:*	*Received by:*	*Date & Time:* Condition Acceptable ☐ Yes ☐ No

Metals Analysis of Bulks

Forensic Analytical Consulting Svcs
Paulo Parra
3777 Depot Road
Suite 413
Hayward, CA 94545

Client ID: HAY01
Report Number: M131330
Date Received: 07/27/12
Date Analyzed: 07/30/12
Date Printed: 07/30/12
First Reported: 07/30/12

Job ID / Site: PJ17441; Various SBSA
Date(s) Collected: 7/26/12

FALI Job ID: HAY01
Total Samples Submitted: 1
Total Samples Analyzed: 1

Sample Number	Lab Number	Analyte	Result	Result Units	Reporting Limit*	Method Reference
BL-PB07	30440105	Pb	21	mg/kg	6	EPA 3050B/7420

* The Reporting Limit represents the lowest amount of analyte that the laboratory can confidently detect in the sample, and is not a regulatory level. The Units for the Reporting Limit are the same as the Units for the Final Results.

Daniele Siu

Daniele Siu, Laboratory Supervisor, Hayward Laboratory

Forensic Analytical
ENVIRONMENTAL HEALTH CONSULTANTS

PAINT CHIP SAMPLE REQUEST FORM

Page 1 of 1.

Client: **HAY01 FACS San Francisco**
Brown and Caldwell

Sampled by: Radzinski

PM: **Paulo Parra**

Date: 26 July 2012

Contact: **Paulo Parra**

Phone: **(510) 266-4600**

Special Instructions: E-mail results to pparra@forensica.com and rvelasquez@forensica.com

Site: **Various**
SBSA

Turnaround Time: 1-Day ☐ 2-Day ☐ 3-Day ☐ 5-Day ☑ Other ☐

Due Date and Time:

Client No.: **C1114**

FACS Job #: **PJ17441**

Analysis: ☑ Flame AA (Pb) /
☐ Other:

Sample Number	Sample Location	Component	Color	Substrate	Condition
BL-Pb07	Exterior, East wall, S. end	wall	tan	concrete	G

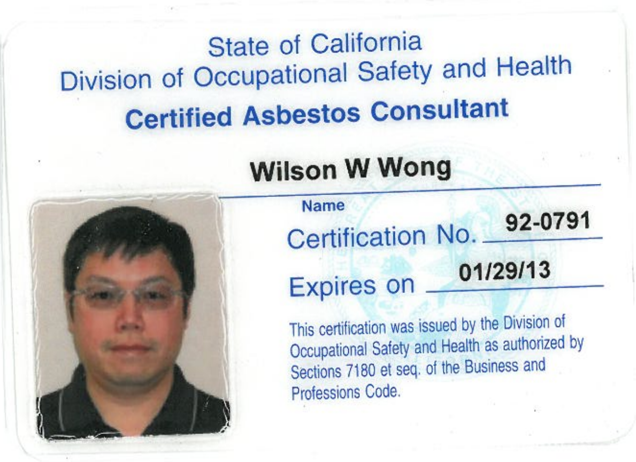
Substrate: wood metal concrete plaster drywall brick

Shipped via: ☐ Fed Ex ☐ Airborne ☐ UPS ☐ US Mail ☐ Courier ☐ Drop Off ☐ Other:

Relinquished by:	Date & Time:	Received by:	Date & Time:
Radzinski	27 July 2012/1330	D/O	7/27/12 1:30PM Condition Acceptable ☒ Yes ☐ No
			Condition Acceptable ☐ Yes ☐ No

Appendix D:

Certifications of FACS Personnel



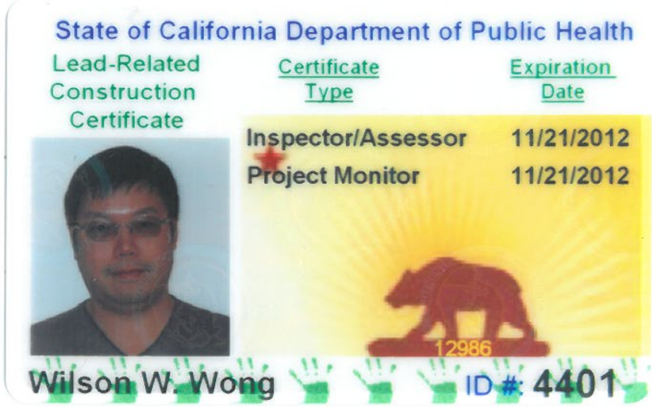
State of California
Division of Occupational Safety and Health
Certified Asbestos Consultant

Wilson W Wong
Name

Certification No. **92-0791**

Expires on **01/29/13**

This certification was issued by the Division of Occupational Safety and Health as authorized by Sections 7180 et seq. of the Business and Professions Code.



State of California Department of Public Health

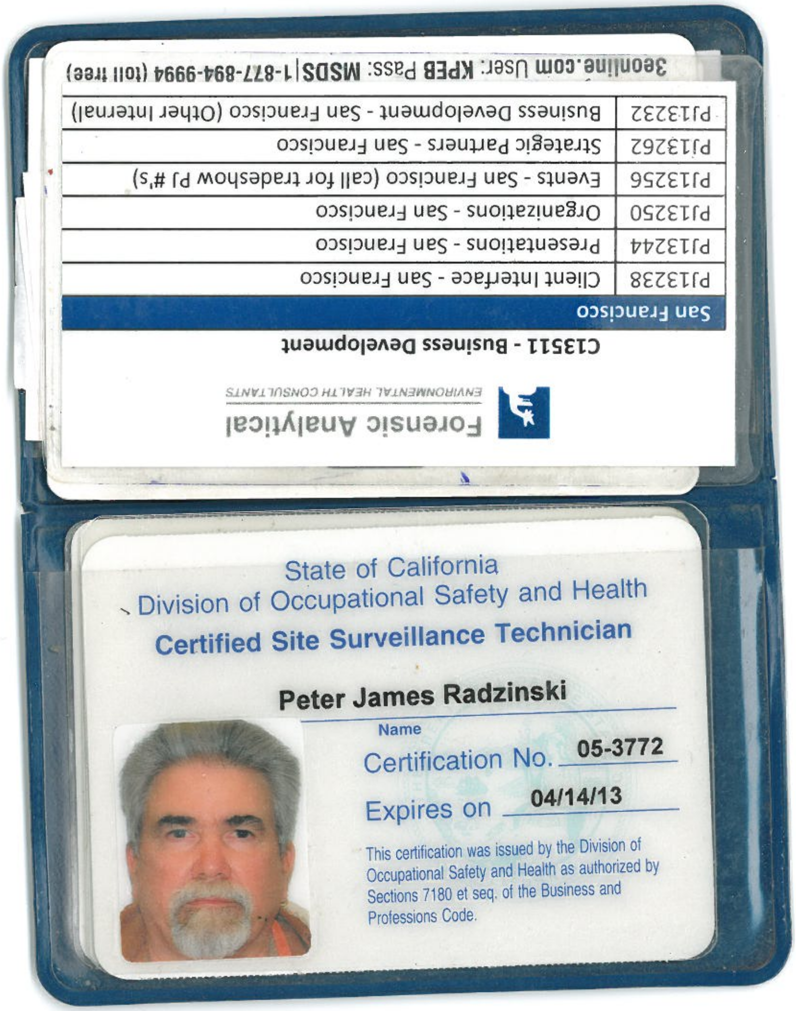
Lead-Related
Construction
Certificate

Certificate Type	Expiration Date
Inspector/Assessor	11/21/2012
Project Monitor	11/21/2012

12986

Wilson W. Wong

ID #: **4401**



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C13511 - Business Development

San Francisco	
PJ13238	Client Interface - San Francisco
PJ13244	Presentations - San Francisco
PJ13250	Organizations - San Francisco
PJ13256	Events - San Francisco (call for tradeshow PJ #'s)
PJ13262	Strategic Partners - San Francisco
PJ13232	Business Development - San Francisco (Other Internal)

3eonline.com User: **KPEB** Pass: **MSDS** | **1-877-894-9994 (toll free)**

State of California
Division of Occupational Safety and Health
Certified Site Surveillance Technician

Peter James Radzinski
Name

Certification No. **05-3772**

Expires on **04/14/13**

This certification was issued by the Division of Occupational Safety and Health as authorized by Sections 7180 et seq. of the Business and Professions Code.

State of California Department of Public Health

Lead-Related
Construction
Certificate

Certificate Type	Expiration Date
Sampling Technician	08/07/2012

19726

Peter Radzinski

ID #: 5018

Forensic Analytical

ENVIRONMENTAL HEALTH CONSULTANTS

“The solution is in the FACS.”

At Forensic Analytical Consulting Services (FACS) our mission is to leave our scientific fingerprint on every client we serve. We accomplish this by delivering data and expertise that is accurate, cost effective, and contextually useful in solving issues of public and environmental health.

Our expert teams are available to respond nationally to help resolve a broad range of chemical, physical and biological concerns:

California

Los Angeles	*310-668-5600*
Sacramento	*916-726-1303*
San Diego	*858-577-0455*
San Francisco	*510-266-4600*

Nevada

Las Vegas	*702-784-0040*

Oregon

Portland	*503-595-1001*

www.forensicanalytical.com

Attachment E: SBSA Four Pump Stations Hazardous Waste Inspection Report

January 7, 2013

Forensic Analytical

ENVIRONMENTAL HEALTH CONSULTANTS

January 7, 2013

To: Mr. Timothy Banyai
Brown and Caldwell
201 North Civic Center, Suite 515
Walnut Creek, CA 94596
TBanyai@brwncald.com

From: Mr. Paulo Parra
Forensic Analytical Consulting Services, Inc.
3777 Depot Road, Suite 413
Hayward, CA 94545
pparra@forensicanalytical.com
Phone: 510-266-4618

Subject: **SBSA Four Pump Stations - Hazardous Waste Inspection**

Dear Mr. Banyai,

Forensic Analytical Consulting Services (FACS) conducted an inspection for potentially hazardous waste associated with the South Bayside System Authority (SBSA) Menlo Park, Redwood City, San Carlos and Belmont pumps stations. The inspection was conducted at the request of Brown and Caldwell in support of planned renovation activities at these pump stations. The following is a summary of the items classified as suspect PCB-containing, Universal Waste and Other Hazardous Materials/Waste. Our visual inspection was conducted on October 29, 2012.

SBSA Menlo Park Pump Station **Potentially Hazardous Waste**
Suspect PCB-Containing Waste
• Electrical Switch Gear/Transformers (Wet Type)
• Fluorescent Light Fixture Ballasts
Universal Waste
• Lead Acid Batteries
• Light Bulbs/Tubes
• Miscellaneous Chemicals and Cleaning Supplies
Other Hazardous Materials/Waste
• Various Oils
• Oily Rags
• Diesel Fuel
• Generator (Oil, Fuel, Coolant)

SBSA Redwood City Pump Station **Potentially Hazardous Waste**
Suspect PCB-Containing Waste
• Electrical Switch Gear/Transformers (Wet Type)
• Fluorescent Light Fixture Ballasts
Universal Waste
• Lead Acid Batteries
• Light Bulbs/Tubes

• Miscellaneous Chemicals and Cleaning Supplies
Other Hazardous Materials/Waste
• Various Oils
• Oily Rags
• Diesel Fuel
• Generator (Oil, Fuel, Coolant)
• Sodium Hypochlorite

SBSA San Carlos Pump Station **Potentially Hazardous Waste**
Suspect PCB-Containing Waste
• Electrical Switch Gear/Transformers (Wet Type)
• Fluorescent Light Fixture Ballasts
Universal Waste
• Lead Acid Batteries
• Light Bulbs/Tubes
• Miscellaneous Chemicals and Cleaning Supplies
Other Hazardous Materials/Waste
• Various Oils
• Oily Rags
• Diesel Fuel
• Generator (Oil, Fuel, Coolant)
• Sodium Hypochlorite

SBSA Belmont Pump Station **Potentially Hazardous Waste**
Suspect PCB-Containing Waste
• Electrical Switch Gear/Transformers (Wet Type)
• Fluorescent Light Fixture Ballasts
Universal Waste
• Lead Acid Batteries
• Light Bulbs/Tubes
• Miscellaneous Chemicals and Cleaning Supplies
Other Hazardous Materials/Waste
• Various Oils
• Oily Rags
• Diesel Fuel
• Generator (Oil, Fuel, Coolant)
• Bio Hazard Waste

Suspect PCB-Containing materials should be sampled after energy isolation or assumed to contain PCBs. All regulated and hazardous waste should be properly packaged, labeled, transported and disposed of or recycled in accordance with all applicable federal, state and local regulations.

Please do not hesitate to contact our office at 510-266-4600 if you have any additional questions or concerns. Thank you for the opportunity to assist Brown and Caldwell in promoting a more healthful environment.

Best Regards,
Forensic Analytical Consulting Services, Inc.

Paulo Parra
Project Manager

Appendix C: South Bayside System Authority Pre design of Planned Pump Stations, Redwood City, San Carlos, and Menlo Park, Geotechnical Data Report

Jacobs Associates, October 22, 2013

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South Bayside System Authority
Pre-design of Planned Pump Stations
Redwood City, San Carlos and Menlo Park, California

Geotechnical Data Report

October 22, 2013

Prepared for:

Brown and Caldwell

Prepared by:

JACOBS ASSOCIATES
Engineers/Consultants

1350 Treat Boulevard, Suite 100
Walnut Creek, CA 94597

Distribution

To: Charlie Joyce

Brown and Caldwell
201 N. Civic Drive, Suite 115
Walnut Creek, CA 94596

From: Robert Kahl, GE, CE
Jacobs Associates

RAK

REGISTERED PROFESSIONAL ENGINEER
ROBERT A. KAHL
RAK
NO. 38310
EXP. 3/31/15
CIVIL
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
ROBERT A. KAHL
RAK
NO. 2254
EXP. 3/31/15
GEOTECHNICAL
STATE OF CALIFORNIA

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Appendix A – Legends

Appendix B – Boring Logs

Appendix C – Laboratory Test Results

Appendix D – Reference Boring Logs

1 Introduction

This geotechnical data report is for pre-design of the following planned South Bayside System Authority (SBSA) Pump Stations and for a gravity sewer between the Belmont Pump Station and the San Carlos Pump Station (herein referred to as the Belmont Gravity Sewer):

- PS1 (Menlo Park P.S.)
- PS2 (Redwood City P.S.)
- PS3 (San Carlos P.S.)

Site maps of the project are provided in Figures 1 through 4.

2 Geotechnical Field Investigation and Laboratory Testing

2.1 Project Test Borings

Six project test borings were drilled for the project. Boring B-1 was drilled at the PS3 to a depth of 50 feet on June 25, 2012 (see Figure 1). Boring B-2 was drilled at the PS2 to a depth of 50 feet on June 25, 2012 (see Figure 2). Borings B-3, B-4, and B-5 were drilled to depths ranging from 25 feet to 45 feet along Shoreway Road for the Belmont Gravity Sewer on July 16 and 17, 2013 (see Figure 3). Boring 6 was drilled at the PS1 to a depth of 50 feet on July 16, 2013 (see Figure 4).

The boring log legends and boring logs are provided in Appendices A and B. The borings were drilled with a truck-mounted CME 75 drill rig using 8-inch-diameter continuous flight hollow-stem augers. Soil and groundwater conditions were logged and representative soil samples were obtained from the borings. Relatively undisturbed soil samples were obtained by driving a 2.5-inch-inside-diameter, 3.0-inch-outside-diameter, Modified California Sampler (MCS) containing brass liners, into the bottom of the borings at the depths indicated on the logs. Disturbed soil samples were obtained by driving a 1.4-inch-inside-diameter, 2.0-inch-outside-diameter Standard Penetration Test (SPT) sampler (ASTM D1586) into the bottom of the borings at the depths indicated on the logs. A 140-pound hammer falling 30 inches per blow was used to drive all samplers. The number of blows required to drive the samplers the last 12 inches of an 18-inch drive are recorded on the boring logs as penetration resistance. The penetration resistance values (blows/ft) recorded for SPT sampler drives on the boring logs are actual American Society for Testing and Materials (ASTM) D1586 N-values. The penetration resistance values recorded on the boring logs for MCS sampler drives are field blow counts for the MCS sampler that have not been reduced to equivalent SPT N-values. Soil samples retrieved from the borings were examined for classification, logged, and sealed to preserve their natural moisture content for laboratory testing. Classification systems used to log the soils are provided in Appendix A. Descriptions of soils provided on the boring logs are based on observations during drilling and sampling and on the results of laboratory tests.

A partial summary of selected data from the test borings is provided in Table 1.

Table 1. Partial Summary of Selected Test Boring Data

Pump Station	Test Boring[1]	Drilling Date (m.d.y)	Total Depth (ft)	Groundwater Depth[2] (ft)	Pavement (inches)[3]	
					Asphalt Concrete	Aggregate Base
PS3 (San Carlos P.S)	B-1	06.25.12	50	9 (9)	3	12
PS2 (Redwood P.S)	B-2	06.25.12	50	14.5 (14.5)	3	12
Belmont Gravity Sewer	B-3	07.17.13	25	19 (11)	3	10
	B-4	07.17.13	35	18 (8)	3	N/E
	B-5	07.16.13	45	27 (7)	N/E	N/E
PS1 (Menlo Park P.S.)	B-6	07.16.13	50	12 (5)	3	5

[1] See logs in Appendix B. Mapped location of test borings provided in Figures 1 through 4.

[2] Represents depth below ground surface that groundwater was first encountered during drilling. Numbers in parentheses represent measured depth to groundwater at end of drilling. Neither depth necessarily reflects the static equilibrium groundwater level. The depth of static equilibrium groundwater level is unknown.

[3] Boring B-4 was drilled in asphaltic concrete driveway and did not encounter base rock. Boring B-5 was drilled in landscaped area.

2.2 Laboratory Tests Results

Moisture content, unit weight, Atterberg limits, grain size analysis, hydrometer w/sieve analysis, unconfined compression, direct shear tests, consolidation, and corrosion tests were performed on soil samples retrieved from the test borings to evaluate their physical characteristics and engineering properties. The results of the tests are included on the boring logs in Appendix B and on laboratory test result figures in Appendix C.

2.3 Previous Geotechnical Investigations

Boring logs from former geotechnical engineering investigations by others on or adjacent to the pump station sites and on or adjacent to the Belmont Gravity Sewer alignment are included in this data report for reference (see Appendix D). The locations of the reference boring are shown on Figures 1 through 4.

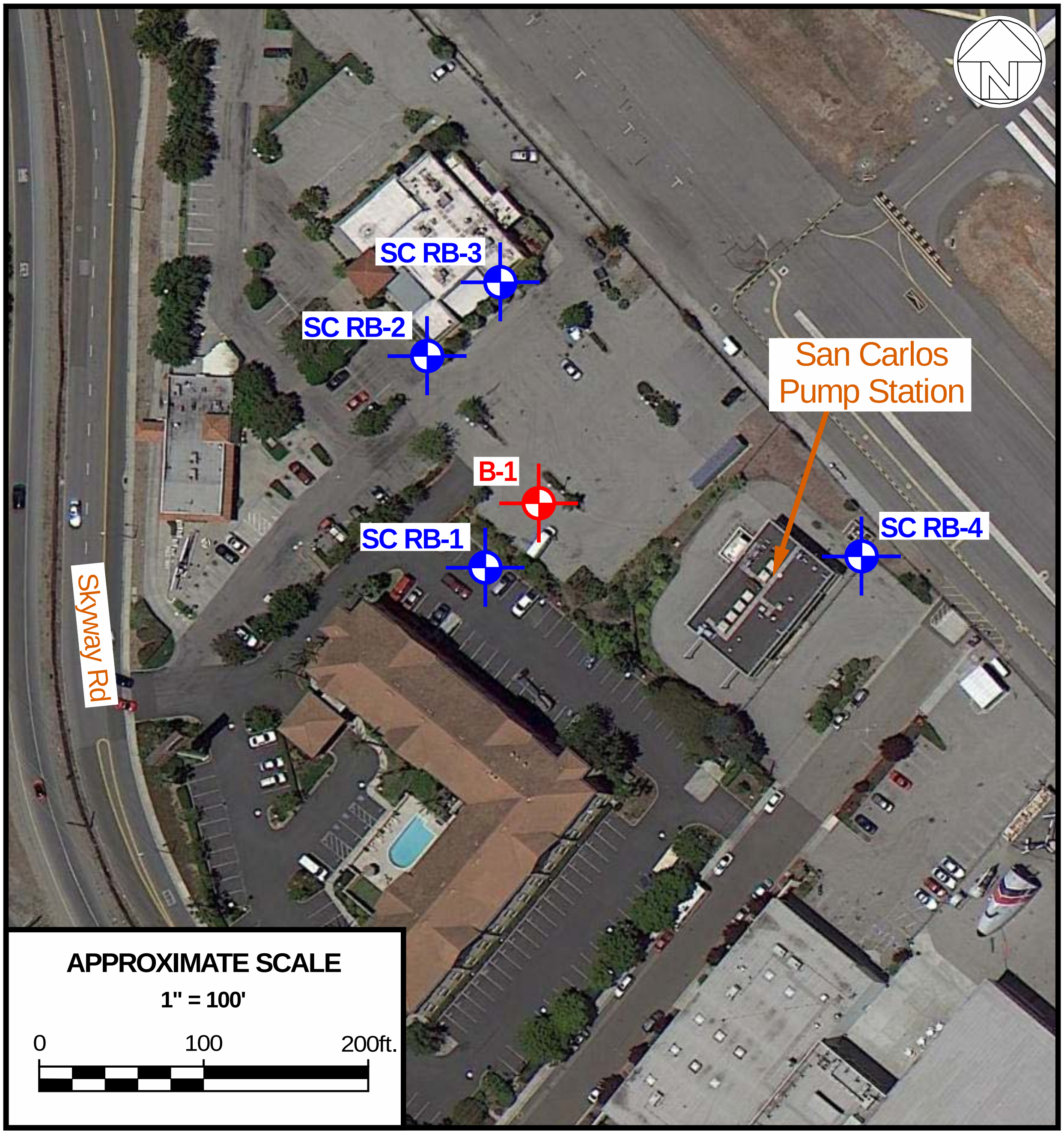
3 Limitations

This data report has been prepared for the exclusive use of Brown and Caldwell and SBSA for the Pre-design of SBSA Pump Stations in City of Menlo Park, Redwood City and City of San Carlos, and the Belmont Gravity Sewer between Belmont and San Carlos Pump Stations. The geotechnical data obtained for this report was gathered based on the project scope and information provided to us by Brown and Caldwell at the time of our field work. Subsurface conditions may vary between exploration locations and with time; as a result, conditions that differ from those summarized in the report and that are unanticipated can and do occur. Jacobs Associates is not responsible for the interpretation of the data contained in this report by anyone; as such interpretations are dependent on each person’s subjectivity.

The geotechnical data was gathered and this report was completed within the limitations of Jacobs Associates' approved scope of work, schedule, and budget. Studies for the absence or existence of soil and groundwater contamination in the project areas are not part of our scope of services for this project, but should be addressed by others as part of project design.

The services rendered by Jacobs Associates have been performed in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions in the same area. Jacobs Associates is not responsible for the use of this report in connection with anything other than the project and the locations described herein.

Figures



LEGEND:

B-1 - Approximate location and reference number for project geotechnical borings.

SC RB-1 - Approximate location and reference number for San Carlos Pump Station reference borings (see Appendix D).

JACOBS ASSOCIATES
Engineers/Consultants

File No. 4520.0

October 2013

Brown and Caldwell
South Bayside System Authority
Pump Station Predesign
San Carlos, California

PS3 (San Carlos PS) and Boring Location Map

Figure

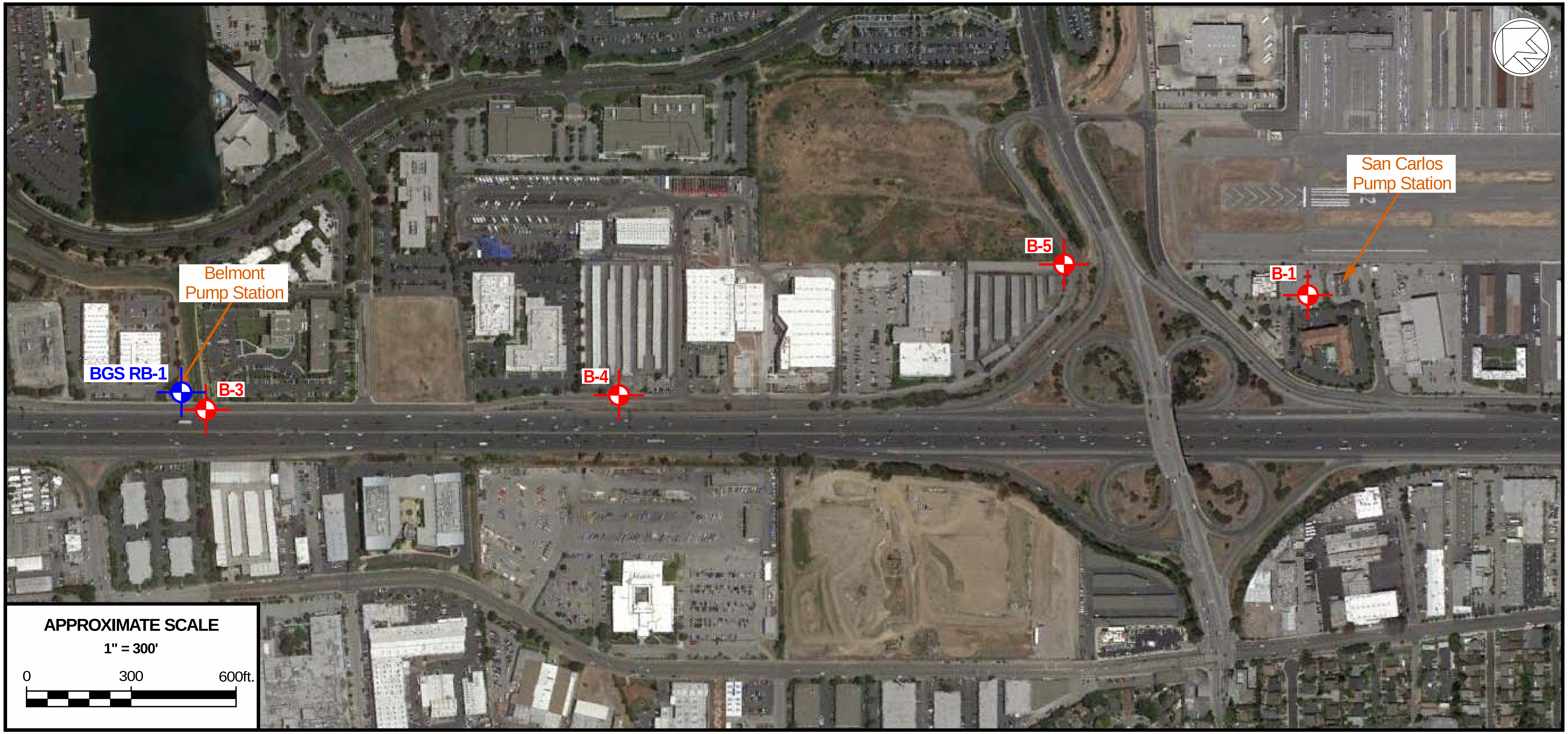
1

LEGEND:

B-2 - Approximate location and reference number for project geotechnical borings (See Appendix B).

RC RB-1 - Approximate location and reference number for Redwood City Pump Station reference borings (see Appendix D).

JACOBS ASSOCIATES Engineers/Consultants		**Brown and Caldwell** SBSA Pump Station Predesign Pump Station Predesign Redwood City, California **PS2 (Redwood City P.S.) and Boring Location Map**	**Figure** **2**
File No. 4520.0	October 2013		



LEGEND:

B-3 - Approximate location and reference number for project geotechnical borings (See Appendix B).

BGS RB-1 - Approximate location and reference number for Belmont Graivty Sewer reference boring (see Appendix D).

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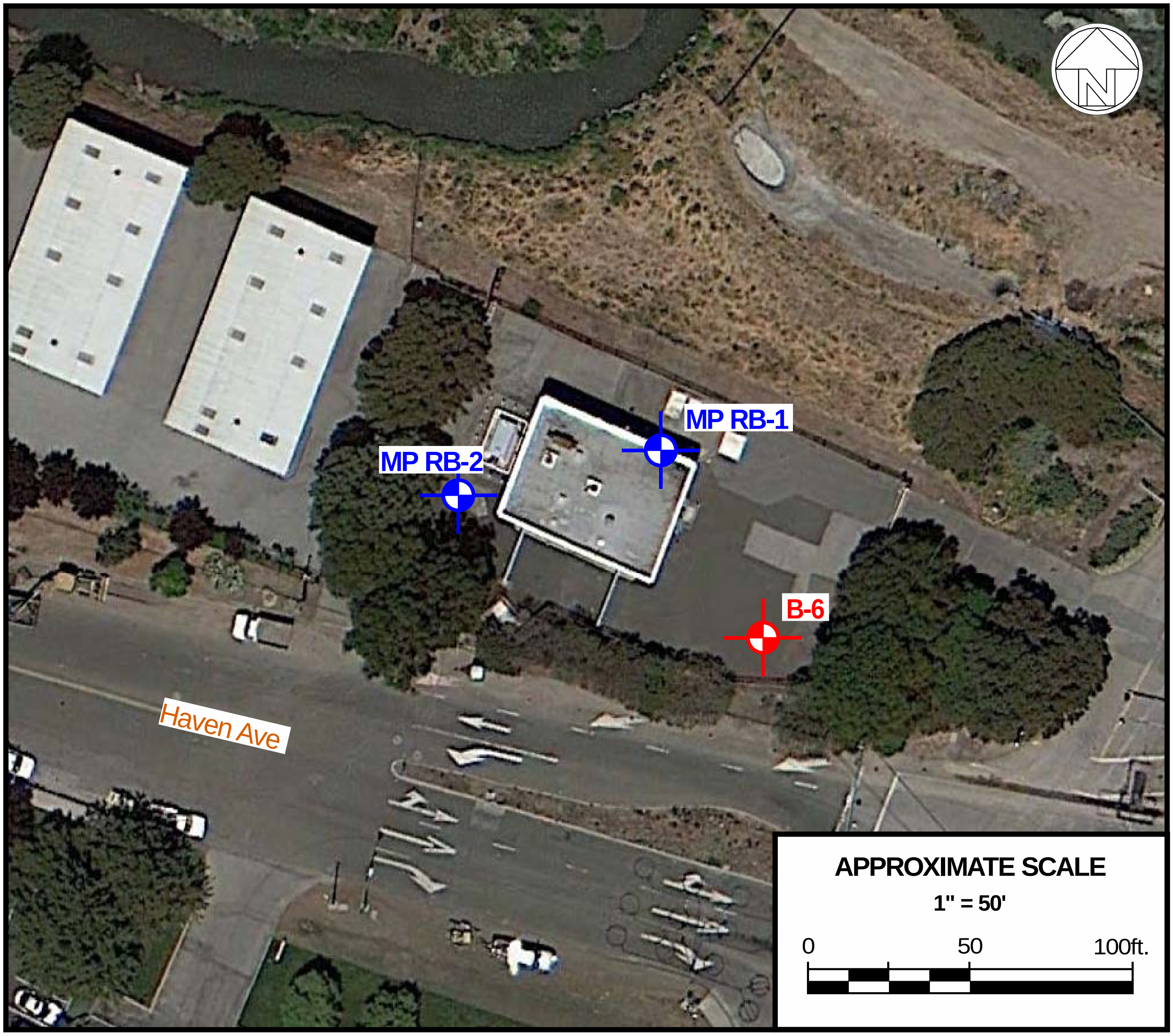
San Carlos, California

Belmont Gravity Sewer and Boring Location Map

Figure
3



LEGEND:

B-6 - Approximate location and reference number for project geotechnical borings (see Appendix B).

MP RB-1 - Approximate location and reference number for Menlo Park Pump Station reference borings (see Appendix D).

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PS1 (Menlo Park PS) and Boring Location Map

Figure
4

Appendix A

KEY TO BORING LOGS

▯ Shelby tube sample

☒ Grab sample

◩ 1.4" I.D./2" O.D. Standard Penetration Test (ASTM D1586) sampler (SPT)

■ 2.5" I.D./3" O.D. Modified California sampler (MCS) with brass liners

◧ 2" I.D./2.5" O.D. Split Spoon sampler (SSS)

NSR No sample recovery

PP Pocket Penetrometer (tsf = tons per square foot)

▼ Groundwater level observed in boring at end of drilling unless noted otherwise. Not to be interpreted as the equilibrium groundwater level.

▽ Groundwater seepage encountered during drilling.

Planned pipeline I.D. (projected to boring)

RELATIVE DENSITY		CONSISTENCY		
SANDS AND GRAVELS	SPT, N	SILTS AND CLAYS	SPT, N	UNCONFINED COMPRESSIVE STRENGTH, tsf
VERY LOOSE	0-4	VERY SOFT	0-2	0-0.25
LOOSE	4-10	SOFT	2-4	0.25-0.50
MEDIUM DENSE	10-30	MEDIUM STIFF	4-8	0.50-1.00
DENSE	30-50	STIFF	8-15	1.00-2.00
VERY DENSE	50+	VERY STIFF	15-30	2.00-4.00
		HARD	30+	>4.00

Reference: Terzaghi, K. and Peck, R., SOIL MECHANICS IN ENGINEERING PRACTICE, 2nd ed., John Wiley and Sons, New York, 1967. Page 341 Table 45.1 and page 347 Table 45.2.

MOISTURE CONDITION

DESCRIPTION	CRITERIA
DRY	Absence of moisture, dusty, dry to the touch
MOIST	Damp but no visible water
WET	Visible free water, usually soil is below water table

Reference: ASTM D2488, Table 3 - Criteria for Describing Moisture Condition

CONSTITUENT DESCRIPTIONS

DESCRIPTION	CRITERIA
TRACE	less than 5%
FEW	5% to 10%
LITTLE	15% to 25%
SOME	30% to 45%
MOSTLY	50% to 100%

Reference: ASTM D2488, Note 15

NOTES:

1. Lines separating strata in the logs represent approximate boundaries only and are dashed where strata change depth is less certain and queried where strata change depth is not known. Actual strata change may be gradual. No warranty is provided as to the continuity of strata between borings. Logs represent the subsurface section observed at the boring location on the date of drilling only.
2. Penetration resistance (blows/ft.) are the last 12" of an 18" drive or the middle 12" of a 24" drive using a 140-pound hammer falling 30 inches per blow (Mobile B-24 rig) unless noted otherwise. The penetration resistance values noted on the logs are actual blows per foot of penetration for the respective sampler type (i.e., MCS sampler penetration resistance has not been reduced to an equivalent SPT "N" value).
3. Where noted on the boring logs, slough is defined as material from the bore hole walls which collapses or flows into and partially fills the bore hole on removal of the hollow stem auger plug or solid stem augers. The presence of slough within the bore hole can render drive sampling impossible (samplers fill entirely with slough) and invalidate the blow count.
4. Where noted on the boring logs, groundwater seepage is defined as the depths at which groundwater was first observed in project exploratory borings during drilling.

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San Mateo County, California
Boring Log Legend

Figure
A-1
(1 of 2)

UNIFIED SOIL CLASSIFICATION SYSTEM

CRITERIA FOR ASSIGNING GROUP SYMBOLS AND GROUP NAMES [A]				GROUP SYMBOL	GROUP NAME [B]
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve	**GRAVELS** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels** < 5% fines [C]	Cu $\geq$ 4 and 1 $\leq$ Cc $\leq$ 3 [E]	**GW**	Well-graded gravel [F]
			Cu < 4 and/or 1 > Cc > 3 [E]	**GP**	Poorly graded gravel [F]
		Gravels with Fines > 12% fines [C]	Fines classify as ML or MH	**GM**	Silty gravel [F,G,H]
			Fines classify as CL or CH	**GC**	Clayey gravel [F,G,H]
	SANDS 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands** < 5% fines [D]	Cu $\geq$ 6 and 1 $\leq$ Cc $\leq$ 3 [E]	**SW**	Well-graded sand [I]
			Cu < 6 and/or 1 > Cc > 3 [E]	**SP**	Poorly graded sand [I]
		Sands with Fines > 12% fines [D]	Fines classify as ML or MH	**SM**	Silty sand [G,H,I]
			Fines classify as CL or CH	**SC**	Clayey sand [G,H,I]
FINE-GRAINED SOILS 50% or more passes the No. 200 sieve	**SILTS AND CLAYS** Liquid limit $\leq$ 50	**Inorganic**	PI > 7 plots on or above "A" line [J]	**CL**	Lean clay [K,L,M]
			PI < 4 plots below "A" line [J]	**ML**	Silt [K,L,M]
		Organic	$\frac{\text{Liquid limit-oven dried}}{\text{Liquid limit-not dried}} < 0.75$	**OL**	Organic Clay [K,L,M,N]
					Organic Silt [K,L,M,O]
	SILTS AND CLAYS Liquid limit > 50	**Inorganic**	PI plots on or above "A" line	**CH**	Fat clay [K,L,M]
			PI plots below "A" line	**MH**	Elastic silt [K,L,M]
		Organic	$\frac{\text{Liquid limit-oven dried}}{\text{Liquid limit-not dried}} < 0.75$	**OH**	Organic Clay [K,L,M,P]
					Organic Silt [K,L,M,Q]
HIGHLY ORGANIC SOILS		**Primarily organic matter, dark color and organic odor**		**PT**	Peat

NOTES:

A Based on the material passing the 3-in. (75mm) sieve.

B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

C Gravels with 5% to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay

D Sands with 5% to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

E $Cu = \frac{D_{60}}{D_{10}} \qquad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

F If soil contains $\geq$15% sand, add "with sand" to group name.

G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

H If fines are organic, add "with organic fines" to group name.

I If soil contains $\geq$15% gravel, add "with gravel" to group name.

J If Atterberg limits plot in hatched area, soil is a CL-ML (silty clay).

K If soil contains 15% to 29% plus No. 200, add "with sand" or "with gravel", whichever is predominant.

L If soil contains $\geq$30% plus No.200, predominantly sand, add "sandy" to group name.

M If soil contains $\geq$30% plus No.200, predominantly gravel, add "gravelly" to group name.

N PI $\geq$ 4 and plots on or above "A" line.

O PI < 4 or plots below "A" line.

P PI plots on or above "A" line.

Q PI plots below "A" line.

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San Mateo County, California
Boring Log Legend

Figure
A-1
(2 of 2)

Appendix B

LOG OF BORING B-1①

LOCATION: Proposed PS3 (see Figure 1).

GROUND SURFACE: Approx. El. 106'④

DEPTH feet	SAMPLE NO.	TYPE	PENETRATION RESISTANCE blows/ft.	GROUNDWATER ③	DESCRIPTION ②	MOISTURE %	DRY DENSITY lbs./ft.³	LIQUID LIMIT	PLASTICITY INDEX	GRAIN SIZE Gravel (>#4 sieve) %	Sand (#4 to #200 sieve) %	Fines (<#200 sieve) %	UNCONFINED COMPRESSIVE STRENGTH kips/ft.²	DIRECT SHEAR Cohesion p.s.f.	Internal Friction Angle
					Hotel Parking Lot: 3 inches asphalt concrete 12 inches aggregate base										
	1	■	22		**FILL - CLAYEY SAND (SC) to SANDY LEAN CLAY (CL)** - multicolored (olive brown, yellow brown, grey) - fine to coarse grained sand - trace to few gravel - medium dense/stiff - moist	16	116			10	43	47			
5	2	◪	11												
	3	■	16		**PEAT (OH)** - black - organic - dry to moist - woody	166	22						CORROSION TEST Sample B1-3 See Figure C-6		
10	4	◪	2	▼	**ORGANIC CLAY (OH) - YOUNG BAY MUD** - very dark green gray - peaty - high plasticity - soft - wet	90		116	65						
	5	■	4			89	50						0.97		
15	6	◪	5												
	7	■	21		**LEAN CLAY (CL) and LEAN TO FAT CLAY (CL/CH)** - interlayered - dark grey (16.5 to 17.5 feet) - olive brown to light olive brown - medium to high plasticity - trace fine sand - stiff to medium stiff - wet	23	103								
20	8	◪	8					30	13						
	9	■	15		**LEAN TO FAT CLAY (CL/CH)** - olive brown to light olive brown with black streaks - medium to high plasticity - stiff - wet	28	97						3.67		
25	10	◪	8												
					BORING CONTINUED AT 27 FEET ON FIGURE B-1 (2 OF 2)										

NOTES

① Drilled 6/25/2012 using a CME 75, 8" diameter hollow stem augers, and a 30" drop by 140 lb. automatic sampling hammer.
② See report text and plates in Appendices A and C for definitions, lab test results, and additional soil descriptions.
③ Free groundwater level encountered at 9 feet during and after drilling. Static equilibrium groundwater depth is unknown.
④ Surface elevation estimated from topographic map of PS3 (San Carlos P.S.) site by Brown and Caldwell (email dated 10/21/2013).

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San Mateo County, California

Log of Boring B-1

Figure

B-1

(1 of 2)

LOG OF BORING B-1 (continued)①

DEPTH feet	SAMPLE NO.	TYPE	PENETRATION RESISTANCE blows/ft.	GROUNDWATER ③	DESCRIPTION ②	% MOISTURE %	DRY DENSITY lbs./ft.^{3}	LIQUID LIMIT	PLASTICITY INDEX	GRAIN SIZE Gravel (>#4 sieve) %	GRAIN SIZE Sand (#4 to #200 sieve) %	GRAIN SIZE Fines (<#200 sieve) %	UNCONFINED COMPRESSIVE STRENGTH kips/ft.^{2}	DIRECT SHEAR Cohesion p.s.f.	DIRECT SHEAR Internal Friction Angle
					BORING CONTINUED FROM 27 FEET FROM FIGURE B-1 (1 OF 2)										
	11	■	14		**FAT CLAY (CH)** - light yellow brown to yellow - few fine-grained sand - stiff - wet	24	105			0	11	89		530	14°
	12	◤	10					53	30						
30															
	13	■	11			27	98								
	14	◤	12		- trace fine gravel-sized concretions										
35															
	15	■	23		**LEAN CLAY (CL)** - dark greenish gray - few sand and fine gravel - medium plasticity - stiff to very stiff - wet	19	115						3.64		
	16	◤	14					43	22						
40															
	17	■	25		**FAT CLAY (CH)** - olive and greenish gray - few sand and fine gravel - medium plasticity - stiff to very stiff - wet	24	105						3.67		
	18	◤	12												
45															
	19	■	19			32	94						2.99		
	20	◤	13												
50					**BOTTOM OF BORING AT 50 FEET**										

FINES
35% Silt
54% Clay

CONSOLIDATION TEST
SAMPLE B1-13
C_C = 0.29
P_C = 4.80 ksf
See Figure C-5 (1 of 4)

NOTES

① See notes on Figure B-1 (1 of 2) for descriptions and details.

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San Mateo County, California

Log of Boring B-1 (continued)

Figure
B-1
(2 of 2)

LOG OF BORING B-2①

LOCATION: PS2 (see Figure 2).

GROUND SURFACE: Approx. El. 107'④

DEPTH feet	SAMPLE NO.	TYPE	PENETRATION RESISTANCE blows/ft.	GROUNDWATER ③	DESCRIPTION ②	% MOISTURE %	DRY DENSITY lbs./ft.³	LIQUID LIMIT	PLASTICITY INDEX	GRAIN SIZE			UNCONFINED COMPRESSIVE STRENGTH kips/ft.²	DIRECT SHEAR	
										Gravel (>#4 sieve) %	Sand (#4 to #200 sieve) %	Fines (<#200 sieve) %		Cohesion p.s.f.	Internal Friction Angle
					Pavement Section: 3 inches asphalt concrete 12 inches aggregate base										
	1	■	8		**FILL - LEAN TO FAT CLAY (CL/CH)/CLAYEY SAND (CS)** - multicolored (olive grey, dark olive grey) - fine to coarse grained sand - few fine to coarse gravel - medium stiff/loose - moist	18				5	45	50			
5															
	2	■	12		**FAT CLAY (CH)** - green black clay - high plasticity - trace sand - medium siff - moist	38	85						1.85		
10															
	3	■	19		**FAT CLAY (CH)** - olive brown mottled yellow brown - high plasticity - stiff - moist to wet	27	100					CORROSION TEST Sample B2-3 See Figure C-6	3.86		
	4	◪	14	▼	**SANDY LEAN CLAY (CL)** - greenish grey mottled yellow brown - medium plasticity - some sand and few fine gravel - stiff -wet	27		41	21	9	31	60			
15															
	5	■	22												
	6	◪	17		**SILTY SAND (SM)** - grey with multicolors - cohesionless - fine to coarse sand and fine gravel - rounded to subrounded - medium dense -wet	19				22	65	13 →	FINES 7% Silt 6% Clay		
20															
	7	■	11		- possible sand slough between 22 and 23.5 feet					0	91	11 →	FINES 5% Silt 6% Clay		
	8	◪	8		**SANDY FAT CLAY (CH)** - olive brown to light olive brown with black streaks - medium to high plasticity - little fine to coarse sand and trace fine gravel - stiff - wet	21		51	27	3	30	67			
25															
					BORING CONTINUED AT 27 FEET ON FIGURE B-2 (2 OF 2)										

NOTES

① Drilled 6/25/2012 using a CME 75, 8" diameter hollow stem augers, and a 30" drop by 140 lb. automatic sampling hammer.
② See report text and plates in Appendices A and C for definitions, lab test results, and additional soil descriptions.
③ Free groundwater level encountered at 14.5 feet during and after drilling. Static equilibrium groundwater depth is unknown
④ Surface elevation estimated from topographic map of PS2 (Redwood city P.S.) site provided by Brown and Caldwell (2013).

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Log of Boring B-2

Figure
B-2
(1 of 2)

LOG OF BORING B-2 (continued)①

DEPTH feet	SAMPLE NO.	TYPE	PENETRATION RESISTANCE blows/ft.	GROUNDWATER ③	DESCRIPTION ②	MOISTURE %	DRY DENSITY lbs./ft.³	LIQUID LIMIT	PLASTICITY INDEX	GRAIN SIZE Gravel (>#4 sieve) %	GRAIN SIZE Sand (#4 to #200 sieve) %	GRAIN SIZE Fines (<#200 sieve) %	UNCONFINED COMPRESSIVE STRENGTH kips/ft.²	DIRECT SHEAR Cohesion p.s.f.	DIRECT SHEAR Internal Friction Angle
					BORING CONTINUED FROM 27 FEET FROM FIGURE B-2 (1 OF 2)										
					CLAYEY SAND TO SANDY FAT CLAY (SC/CH) - grey mottled olive brown - fine to coarse sand - high plasticity clay - stiff - wet - possible 6 inches of slough between 27 and 27.5 feet consisting WELL-GRADED SAND (SW).										
	9	■	13			20	110			1	48	51		310	32°
	10	◩	13										FINES 24% Silt 27% Clay		
30															
									Gradation of possible slough	1	87	12			
					CLAYEY SAND (SC) TO SANDY CLAY (CH) - grey mottled olive brown - high plasticity clay - fine sand - wet - possible 12 inches of slough between 32 and 33 feet consisting of WELL-GRADED SAND WITH SILT (SW-SM (see gradation)										
	11	■	13			17	112						CONSOLIDATION TEST SAMPLE B2-11 C_C = 0.06 P_C = 3.16 ksf See Figure C-5 (2 of 4)		
	12	◩	41			22				0	19	81	FINES 51% Silt 30% Clay		
35															
					LEAN CLAY (CL) - dark greenish gray - medium plasticity - wet - few sand and fine gravel - stiff to very stiff										
	13	■	18			31	94						1.32		
	14	◩	15			22		36	18						
40															
					FAT CLAY (CH) - olive and greenish gray - few sand and fine gravel - medium plasticity - stiff to very stiff - wet										
	15	■	25			20	113						4.54		
	16	◩	12												
45															
	17	■	19			21	107								
	18	◩	13			34									
50					**BOTTOM OF BORING AT 50 FEET**										

NOTES

① See notes on Figure B-2 (1 of 2) for descriptions and details.

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San Mateo County, California

Log of Boring B-2 (continued)

Figure
B-2
(2 of 2)

LOG OF BORING B-3 ①

LOCATION: Proposed Belmont Gravity Sewer. (see Figure 3).

GROUND SURFACE: Approx. El. 108' ④

DEPTH feet	SAMPLE NO.	TYPE	PENETRATION RESISTANCE blows/ft.	GROUNDWATER ③	DESCRIPTION ②	% MOISTURE %	DRY DENSITY lbs./ft.³	LIQUID LIMIT	PLASTICITY INDEX	GRAIN SIZE Gravel (>#4 sieve) %	GRAIN SIZE Sand (#4 to #200 sieve) %	GRAIN SIZE Fines (<#200 sieve) %	UNCONFINED COMPRESSIVE STRENGTH kips/ft.²	DIRECT SHEAR Cohesion p.s.f.	DIRECT SHEAR Internal Friction Angle
					Shoreway Rd: 3 inches asphalt concrete 10 inches aggregate base										
	1		16		**SANDY LEAN CLAY (CL) - FILL** - yellowish/reddish brown - fine to coarse sand, few fine to coarse gravel - stiff - moist	16	109								
5															
	2		5		**FAT CLAY WITH SAND (CH)** - dark grayish blue - little fine sand grades to trace fine sand with depth - soft - moist										
10															
	3		10		**FAT CLAY (CH) WITH SAND** - black with olive brown mottling - trace coarse sand - medium stiff to stiff - moist	28	95			0	19	81	1.29		
	4		9												
15															
	5		28		**SANDY LEAN CLAY (CL)** - grayish brown - fine sand, fine to coarse sand with depth - trace fine gravel - little silt - stiff - moist to wet	16	105			0	47	53		260	35°
	6		13												
20															
	7		25		**LEAN CLAY (CL)** - olive brown to olive gray - few fine sand and silt to trace fine sand and silt - stiff to very stiff - moist	22	105	33	16				1.97		
	8		26												
25					**BOTTOM OF BORING AT 25 FEET**										

FINES
47% Silt
34% Clay

FINES
31% Silt
22% Clay

NOTES
① Drilled 07/17/13 using a CME 75, 8" diameter hollow stem augers, and a 30" drop by 140 lb. automatic sampling hammer.
② See report text and figures in Appendices A and C for definitions, lab test results, and additional soil descriptions.
③ Groundwater seepage measured at 19' during drilling and 11' at end of drilling. Static equilibrium groundwater depth is unknown.
④ Surface elevation estimated from map of Shoreway Road by Freyer & Laureta, dated 9/10/13.

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San Mateo County, California
Log of Boring B-3

Figure
B-3

LOG OF BORING B-4 ①

LOCATION: Proposed Belmont Gravity Sewer (see Figure 2).

GROUND SURFACE: Approx. El. 104' ④

DESCRIPTION ②

Parking Lot at 145 Shoreway Rd: 3 inches asphalt concrete

SANDY LEAN CLAY WITH GRAVEL (CL) - FILL
- brown
- fine to coarse sand, fine to coarse gravel
- dry to moist

FAT CLAY (CH) - BAY MUD
- grayish blue to dark grayish blue
- few fine sand to trace fine sand with depth
- very soft
- moist
- black CH from 4' to 5'
- strong sulfurous odor at 8'
- trace organics at 8'

FAT CLAY (CH)
- bluish gray with black mottling
- trace to few sand, trace fine gravel
- medium stiff
- moist

LEAN/FAT CLAY (CL/CH) WITH SAND
- olive gray with grayish blue mottling
- few fine to coarse sand, trace fine gravel
- stiff
- moist

LEAN/FAT CLAY WITH SAND (CL/CH)
- olive gray/olive brown with light gray mottling
- fine sand and silt, few fine gravel
- stiff
- moist

FAT CLAY (CH)
- mottled olive brown/light brown/greenish gray
- few fine sand and silt
- stiff
- moist
- light brownish gray cemented sand at 23'

BORING CONTINUED AT 27 FEET ON FIGURE B-4 (2 OF 2)

SAMPLE NO.	TYPE	PENETRATION RESISTANCE blows/ft.	GROUNDWATER ③	MOISTURE %	DRY DENSITY lbs./ft.^{3}	LIQUID LIMIT	PLASTICITY INDEX	GRAIN SIZE Gravel (>#4 sieve) %	GRAIN SIZE Sand (#4 to #200 sieve) %	GRAIN SIZE Fines (<#200 sieve) %	UNCONFINED COMPRESSIVE STRENGTH kips/ft.^{2}	DIRECT SHEAR Cohesion p.s.f.	DIRECT SHEAR Internal Friction Angle
1	■	2		92	45								
2	■	1	▼	107	41	148	113						
3	■	11		22	107						0.21		
4	◣	13						0	28	72			
5	■	15	▽	17	116						2.21		
6	◣	9											
7	■	24		27	89	71	45						
8	◣	14											

FINES
39% Silt
33% Clay

CORROSION TEST
Sample B4-6
See Figure C-6

DEPTH feet: 5, 10, 15, 20, 25

NOTES

① Drilled 07/17/13 using a CME 75, 8" diameter hollow stem augers, and a 30" drop by 140 lb. automatic sampling hammer.
② See report text and figures in Appendices A and C for definitions, lab test results, and additional soil descriptions.
③ Groundwater seepage measured at 18' during drilling and 8' at end of drilling. Static equilibrium groundwater depth is unknown.
④ Surface elevation estimated from map of Shoreway Road by Freyer & Laureta, dated 9/10/13.

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San Carlos, California

Log of Boring B-4

Figure
B-4
(1 of 2)

LOG OF BORING B-4 (Continued)①

DEPTH feet	SAMPLE NO.	TYPE	PENETRATION RESISTANCE blows/ft.	GROUNDWATER	DESCRIPTION	% MOISTURE %	DRY DENSITY lbs./ft.³	LIQUID LIMIT	PLASTICITY INDEX	GRAIN SIZE Gravel (>#4 sieve) %	GRAIN SIZE Sand (#4 to #200 sieve) %	GRAIN SIZE Fines (<#200 sieve) %	UNCONFINED COMPRESSIVE STRENGTH kips/ft.²	DIRECT SHEAR Cohesion p.s.f.	DIRECT SHEAR Internal Friction Angle
					BORING CONTINUED FROM 27 FEET ON FIGURE B-4 (1 OF 2)										
	9	■	11		**LEAN/FAT CLAY (CL/CH)** - bluish/greenish gray with reddish brown mottling - few fine sand and silt - stiff - moist	26	93								
	10	◣	9												
30															
	11	■	22		**FAT CLAY (CH)** - dark bluish/greenish gray - trace fine sand and silt - very stiff - moist	34	88								
	12	◣	18												
35					**BOTTOM OF BORING AT 35 FEET**										
40															
45															
50															

NOTES

① See notes on Figure B-4 (1 of 2).

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Log of Boring B-4

Figure
B-4
(2 of 2)

LOG OF BORING B-5 ①

LOCATION: Proposed Belmont Gravity Sewer (see Figure 3).

GROUND SURFACE: Approx. El. 104' ④

DEPTH feet	SAMPLE NO.	TYPE	PENETRATION RESISTANCE blows/ft.	GROUNDWATER ③	DESCRIPTION ②	% MOISTURE %	DRY DENSITY lbs./ft.³	LIQUID LIMIT	PLASTICITY INDEX	GRAIN SIZE			UNCONFINED COMPRESSIVE STRENGTH kips/ft.²	DIRECT SHEAR	
										Gravel (>#4 sieve) %	Sand (#4 to #200 sieve) %	Fines (<#200 sieve) %		Cohesion p.s.f.	Internal Friction Angle
	1	■	14		**SANDY LEAN CLAY WITH GRAVEL (CL) - FILL** - grayish brown and light brown - fine to coarse sand, fine to coarse gravel - stiff - dry to moist	24									
5															
	2	■	4	▼	**FAT CLAY (CH) - BAY MUD** - dark grayish blue - trace fine sand - soft - moist	90	47						0.68		
10															
	3	■	2		- strong sulfurous odor - very soft	87	50	122	90						
15															
	4	■	13		**LEAN/FAT CLAY WITH SAND (CL/CH)** - light olive brown with bluish gray mottling - fine to coarse sand - stiff - moist	21	103			0	27	73	FINES 39% Silt 34% Clay		
	5	◣	10												
20															
	6	■	24		**LEAN/FAT CLAY (CL/CH)** - light olive brown with bluish gray and dark brown mottling - few fine sand - stiff - moist	25	99								
	7	◣	14												
25															

BORING CONTINUED AT 27 FEET ON FIGURE B-5 (2 OF 2)

NOTES
① Drilled 07/16/13 using a CME 75, 8" diameter hollow stem augers, and a 30" drop by 140 lb. automatic sampling hammer.
② See report text and figures in Appendices A and C for definitions, lab test results, and additional soil descriptions.
③ Groundwater seepage measured at 27' during drilling and 7' at end of drilling. Static equilibrium groundwater depth is unknown.
④ Surface elevation estimated from map of Shoreway Road by Freyer & Laureta, dated 9/10/13.

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Log of Boring B-5

Figure
B-5
(1 of 2)

LOG OF BORING B-5 (Continued)①

DEPTH feet	SAMPLE NO.	TYPE	PENETRATION RESISTANCE blows/ft.	GROUNDWATER	DESCRIPTION	MOISTURE %	DRY DENSITY lbs./ft.³	LIQUID LIMIT	PLASTICITY INDEX	GRAIN SIZE Gravel (>#4 sieve) %	GRAIN SIZE Sand (#4 to #200 sieve) %	GRAIN SIZE Fines (<#200 sieve) %	UNCONFINED COMPRESSIVE STRENGTH kips/ft.²	DIRECT SHEAR Cohesion p.s.f.	DIRECT SHEAR Internal Friction Angle
				▽	**BORING CONTINUED FROM 27 FEET ON FIGURE B-5 (1 OF 2)**										
	8	■	12		**SILTY SAND (SM)** - reddish brown - fine sand - wet CONSOLIDATION TEST SAMPLE B5-8A $C_C = 0.29$ $P_C = 4.01$ ksf	27	97						1.94		
	9	◩	11		**LEAN/FAT CLAY (CL/CH)** - olive gray to light olive brown with dark brown/dark blue mottling - few sand to trace sand - stiff - moist/wet										
30															
	10	■	15		**SILTY SAND (SM)** - reddish/grayish brown - fine sand - loose/medium dense - wet	21				0	84	16			
	11	◩	9												
35					**SILTY LEAN/FAT CLAY (CL/CH)** - olive brown - few fine sand, little silt - stiff - moist										
	12	■	19		**SANDY LEAN/FAT CLAY (CL/CH)** - brownish/bluish gray - fine sand, little to some silt - stiff - moist	20	105			1	46	53	FINES 33% Silt 20% Clay	96	37°
	13	◩	16												
40															
	14	■	20		**FAT CLAY (CH)** - dark bluish gray and olive gray - few sand to trace sand, few silt - very stiff - moist	31	91						2.13		
	15	◩	18												
45					**BOTTOM OF BORING AT 45 FEET**										
50															

NOTES

① See notes on Figure B-5 (1 of 2).

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Log of Boring B-5

Figure
B-5
(2 of 2)

LOG OF BORING B-6 ①

LOCATION: PS1 (see Figure 4).

GROUND SURFACE: Approx. El. 107' ④

DEPTH feet	SAMPLE NO.	TYPE	PENETRATION RESISTANCE blows/ft.	GROUNDWATER ③	DESCRIPTION ②	MOISTURE %	DRY DENSITY lbs./ft.³	LIQUID LIMIT	PLASTICITY INDEX	GRAIN SIZE Gravel (>#4 sieve) %	GRAIN SIZE Sand (#4 to #200 sieve) %	GRAIN SIZE Fines (<#200 sieve) %	UNCONFINED COMPRESSIVE STRENGTH kips/ft.²	DIRECT SHEAR Cohesion p.s.f.	DIRECT SHEAR Internal Friction Angle
					Pump Station Lot: 3 inches asphalt concrete 5 inches aggregate base										
	1	■	27	▼	**CLAYEY SAND WITH GRAVEL (SC) - FILL** - dark brown with orange mottling - fine to coarse angular gravel, few to little sand - few organics - medium dense - moist	20	98			31	36	33			
5															
	2	■	10		**FAT CLAY (CH)** - dark olive brown with dark bluish gray mottling - few coarse sand - trace organics - medium stiff - moist	30	90					CORROSION TEST Sample B6-2 See Figure C-6			
10				▽											
	3	■	14		**CLAYEY SAND (SC)** - light olive brown - fine sand, little to some silt - loose - wet	24	102						0.53		
	4	◣	5			24		25	10	2	58	40	FINES 23% Silt 17% Clay		
15															
	5	■	15		**SANDY LEAN/FAT CLAY (CL/CH)** - orangish brown - fine sand, little to some silt - stiff - moist	27	92							321	25°
	6	◣	17												
20					Borehole sloughing below 20'										
	7	■	6		**WELL-GRADED SAND WITH SILT (SW-SM)** - dark gray, varicolored - fine to coarse sand, trace fine gravel - loose/medium dense –> could be slough blow counts - wet	21				1	89	10			
	8	◣	51		**SANDY FAT CLAY (CH)** - light brown with light gray mottling - fine sand, little to some silt - hard - moist										
25															

BORING CONTINUED AT 27 FEET ON FIGURE B-6 (2 OF 2)

NOTES
① Drilled 07/16/13 using a CME 75, 8" diameter hollow stem augers, and a 30" drop by 140 lb. automatic sampling hammer.
② See report text and figures in Appendices A and C for definitions, lab test results, and additional soil descriptions.
③ Groundwater seepage measured at 15' during drilling and 5' at end of drilling. Static equilibrium groundwater depth is unknown.
④ Surface elevation estimated from topographic map of PS1 (Menlo Park P.S.) provided by Brown and Caldwell (email dated 10/21/2013).

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Log of Boring B-6

Figure
B-6
(1 of 2)

LOG OF BORING B-6 (Continued)①

DEPTH feet	SAMPLE NO.	TYPE	PENETRATION RESISTANCE blows/ft.	GROUNDWATER	DESCRIPTION	MOISTURE %	DRY DENSITY lbs./ft.³	LIQUID LIMIT	PLASTICITY INDEX	GRAIN SIZE Gravel (>#4 sieve) %	GRAIN SIZE Sand (#4 to #200 sieve) %	GRAIN SIZE Fines (<#200 sieve) %	UNCONFINED COMPRESSIVE STRENGTH kips/ft.²	DIRECT SHEAR Cohesion p.s.f.	DIRECT SHEAR Internal Friction Angle
					BORING CONTINUED FROM 27 FEET ON FIGURE B-6 (1 OF 2)										
	NSR	■	-		**FAT CLAY (CH)** - light olive brown with bluish gray mottling - few sand and silt - stiff - moist										
	10	◣	12												
30															
										CONSOLIDATION TEST SAMPLE B6-11A C_C = 0.24 P_C = 3.90 ksf					
	11	■	11		- few fine sand, little silt	24	102	54	32						
	12	◣	17												
35															
					SANDY FAT CLAY (CH) - olive brown - fine sand, little to some silt - medium stiff to stiff - moist - grades to CH with depth										
	13	■	9			31	90							645	22°
	14	◣	11					54	32						
40															
					FAT CLAY (CH) - bluish gray to bluish/greenish gray - few fine sand, few to little silt - stiff - moist										
	15	■	14			24	99						1.11		
	16	◣	10												
45															
					SANDY FAT CLAY (CH) - bluish/greenish gray with light gray mottling - fine to coarse sand, few fine gravel, little silt - very stiff - moist/dry										
	17	■	30			22	97								
	18	◣	15												
50					**BOTTOM OF BORING AT 50 FEET**										

NOTES

① See notes on Figure B-6 (1 of 2).

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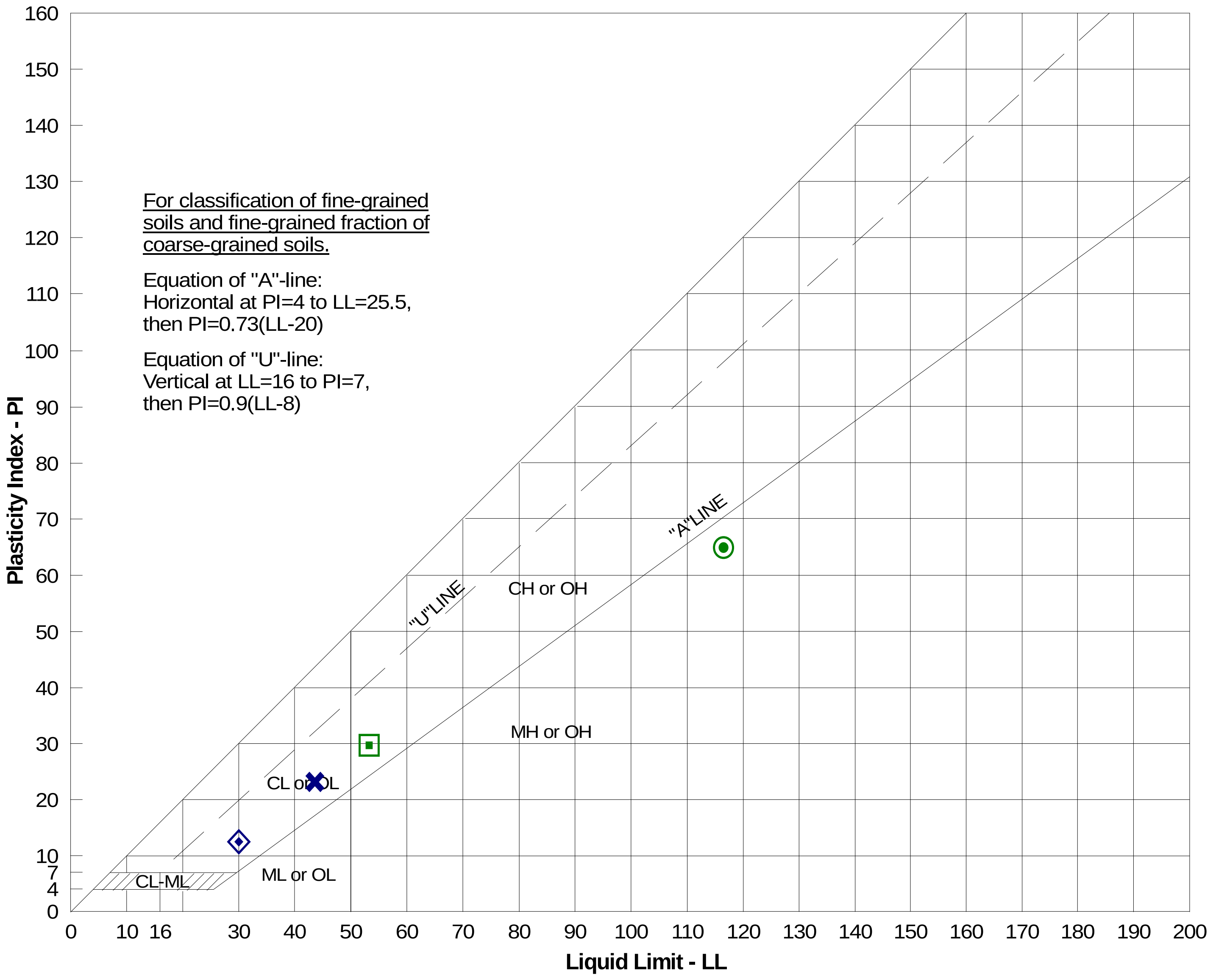
Log of Boring B-6

Figure
B-6
(2 of 2)

Appendix C



SITE LOCATION	TEST SYMBOL	BORING SAMPLE NO.	DEPTH (ft)	LIQUID LIMIT (Wet Prep)	LIQUID LIMIT (Oven Dried)	RATIO*	PLASTICITY INDEX - PI	GROUP SYMBOL**
PS3 (San Carlos PS)	◉	B-1-4	9-10	116	77	0.66	65	OH
	◈	B-1-8	19½-20	30	-	-	13	CL
	▣	B-1-12	28½-30	53	-	-	30	CH
	✖	B-1-16	38½-40	43	-	-	22	CL

* OH or OL Determination = $\frac{\text{Liquid Limit Test performed on oven-dried sample}}{\text{Liquid Limit Test performed on wet prepared sample}}$ = Ratio less than 75%

** Classification of fines < 0.425mm

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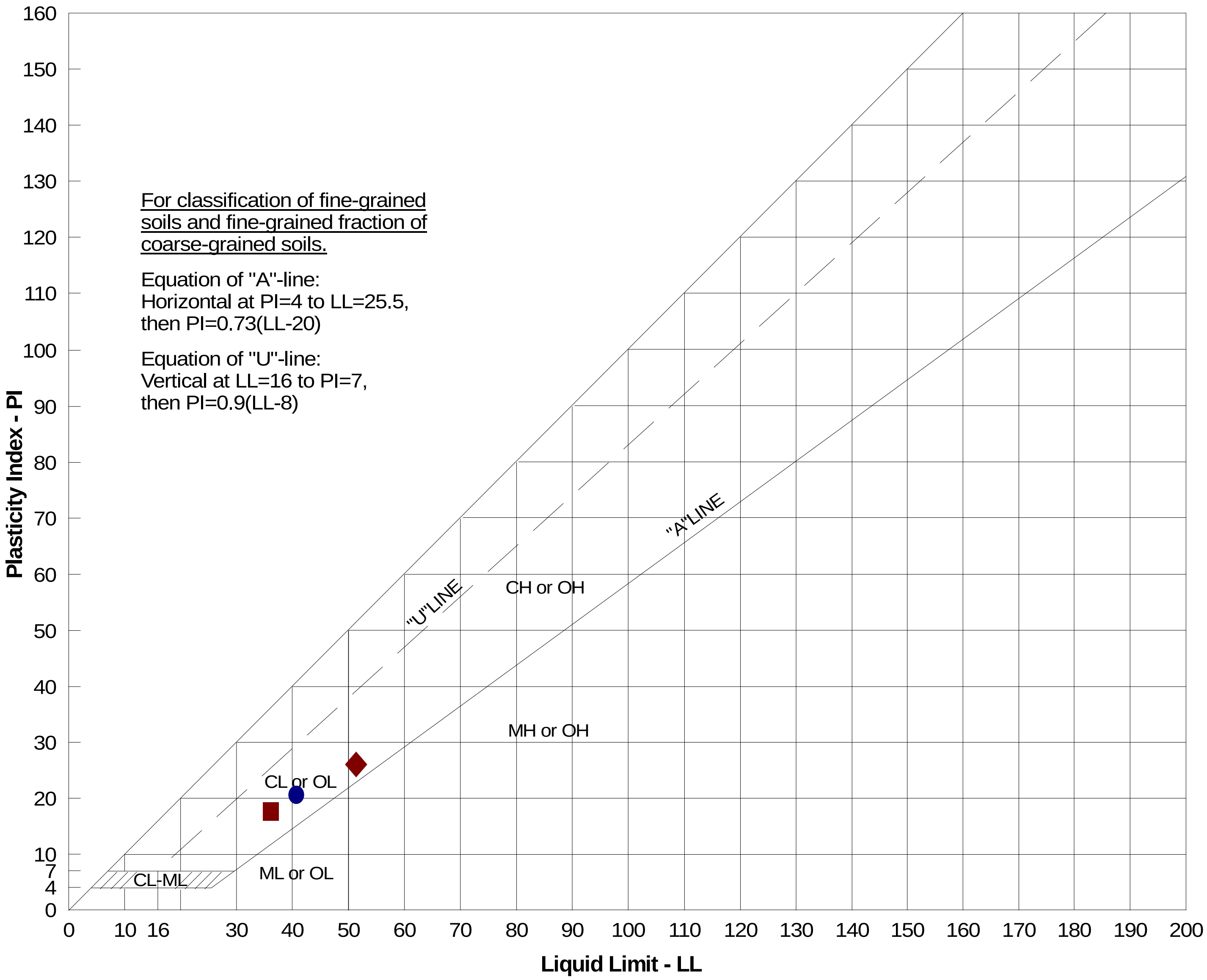
Plasticity Index

Figure
C-1
(1 of 3)



SITE LOCATION	TEST SYMBOL	SAMPLE NO.	DEPTH (ft)	LIQUID LIMIT - LL	PLASTICITY INDEX - PI	GROUP SYMBOL*
PS2 (Redwood City PS)	●	B-2-4	13½-15	41	21	CL
	◆	B-2-8	23½-24	51	27	CH
	■	B-2-14	38½-40	36	18	CL

* Classification of fines < 0.425mm

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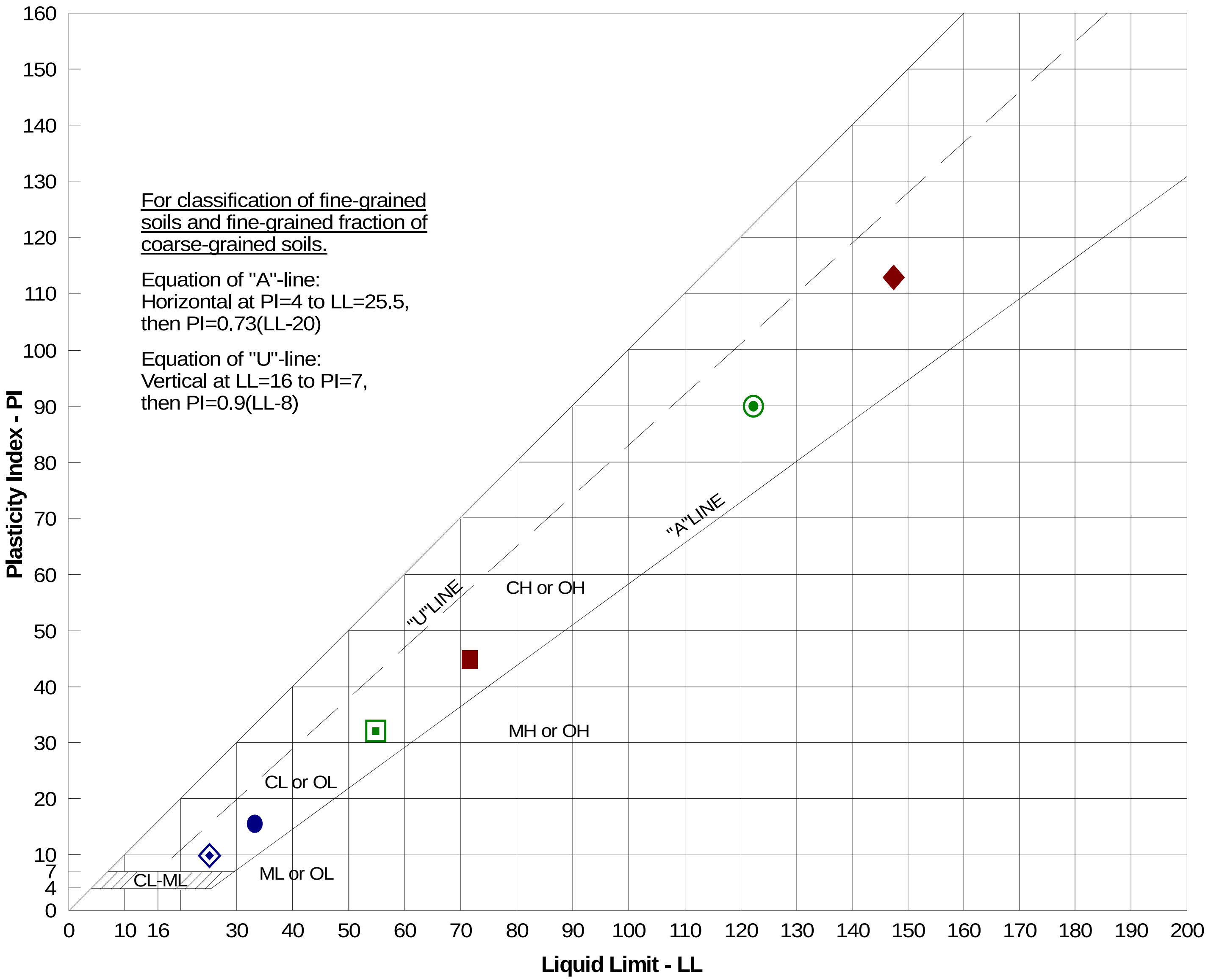
Plasticity Index

Figure
C-1
(2 of 3)



For classification of fine-grained soils and fine-grained fraction of coarse-grained soils.

Equation of "A"-line:
Horizontal at PI=4 to LL=25.5,
then PI=0.73(LL-20)

Equation of "U"-line:
Vertical at LL=16 to PI=7,
then PI=0.9(LL-8)

SITE LOCATION	TEST SYMBOL	SAMPLE NO.	DEPTH (ft)	LIQUID LIMIT - LL	PLASTICITY INDEX - PI	GROUP SYMBOL*
Belmont Gravity Sewer	●	B3-7B	22½-23	33	16	CL
	◆	B4-2B	7½-8	148	113	CH
	■	B4-8	23½-25	71	45	CH
	◉	B5-3A	13-13½	122	90	CH
PS1 (Menlo Park PS)	◈	B6-4	13½-15	25	10	CL
	▣	B6-11A	33-33½	54	32	CH

* Classification of fines < 0.425mm

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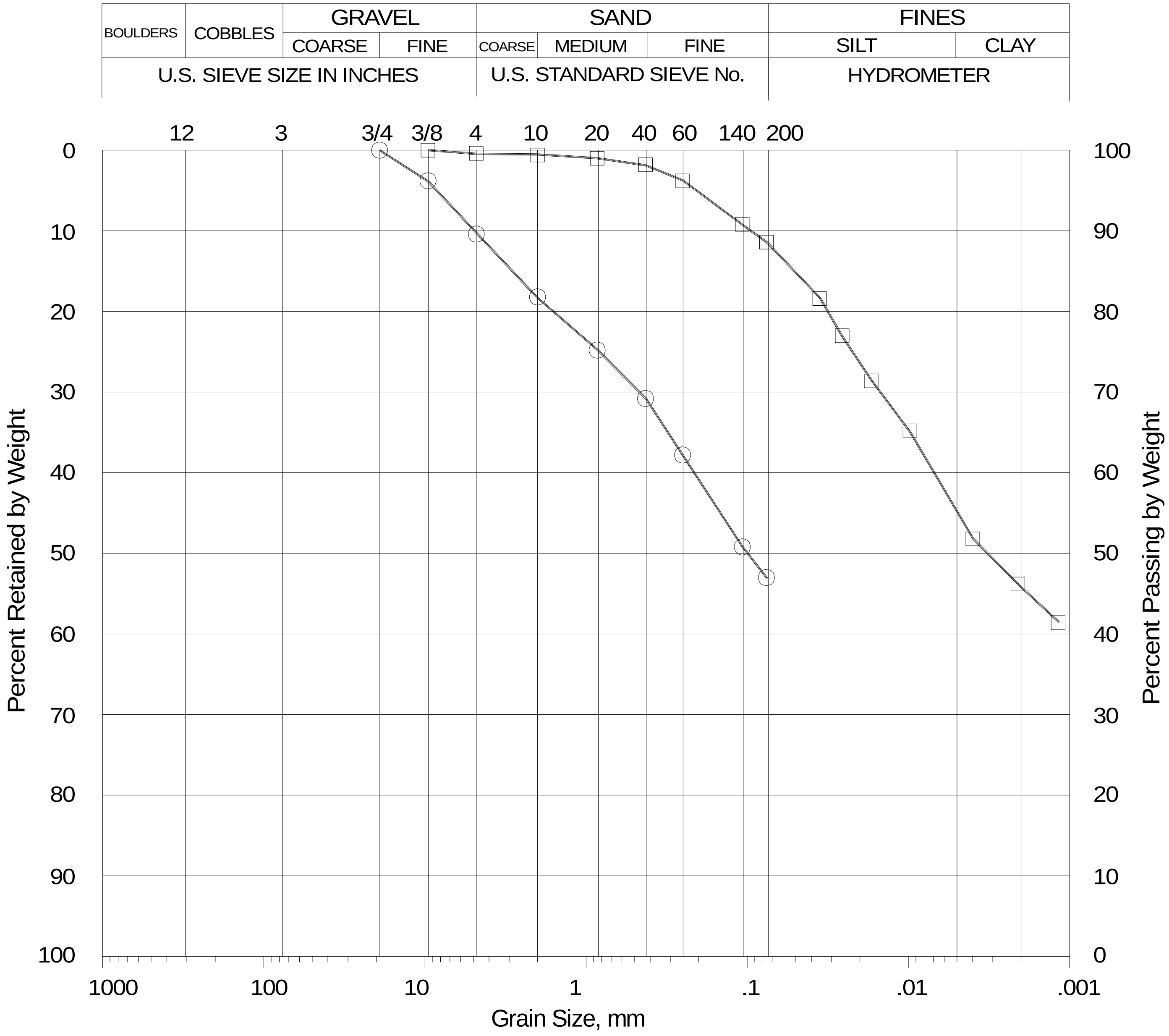
Plasticity Index

Figure
C-1
(3 of 3)



SITE LOCATION	TEST SYMBOL	SAMPLE NO.	DEPTH (ft)	GROUP SYMBOL	USCS DESCRIPTION (based on grain size)
PS 3 (San Carlos PS)	○	B-1-1&2	2½-5	CL	sandy lean clay
	□	B-1-11	27½-28	CH	fat clay

NOTE: The largest particle (grain) size that could have been sampled from our borings by our sample barrels is a function of the inside diameter of the sample barrels used (see Figure A-1). Therefore, there may be larger particles (e.g., coarse gravel, cobbles or boulders) in the soils sampled than reflected on the boring logs and grain size distribution curves provided in this report.

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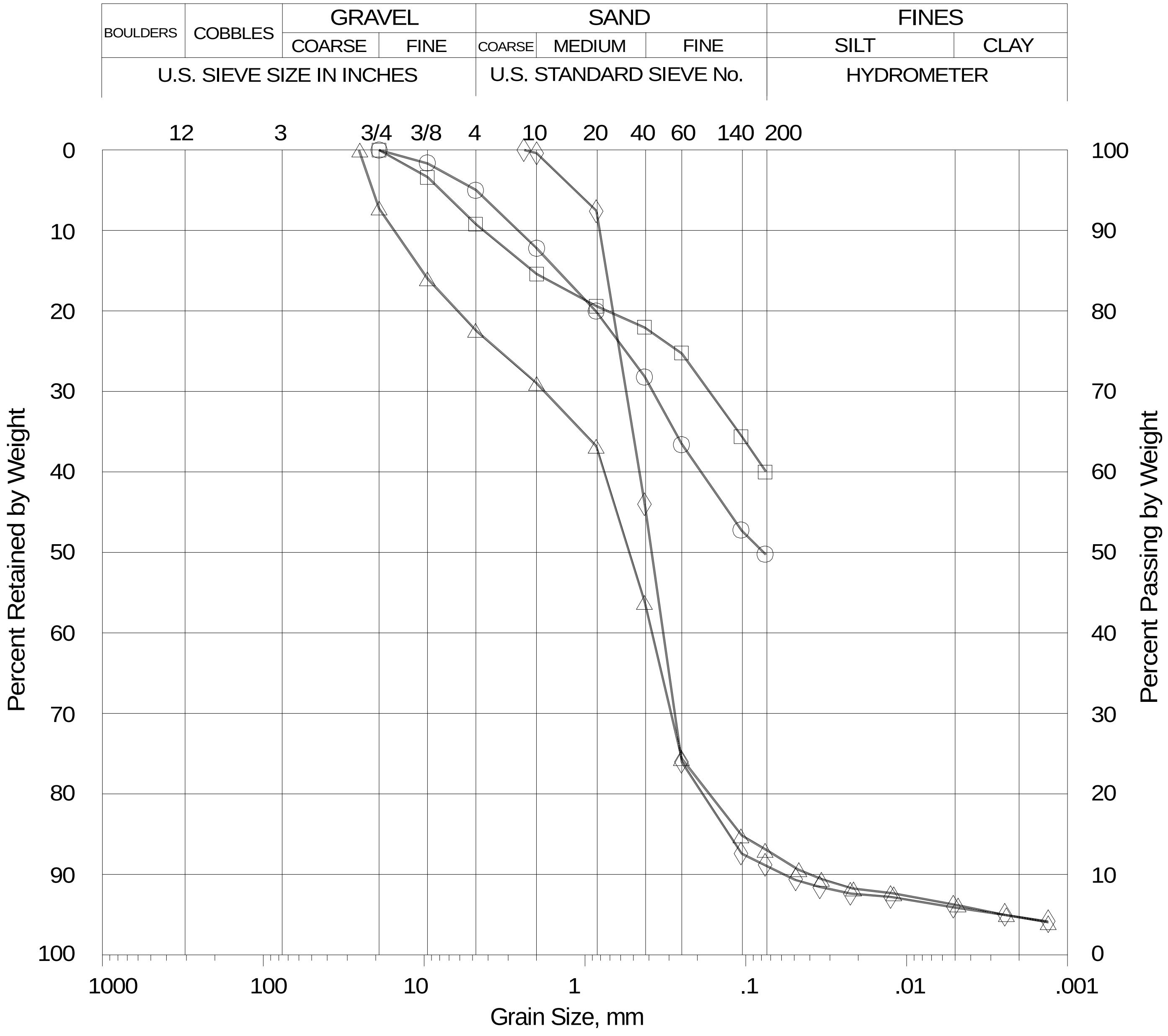
Grain Size

Figure

C-2

(1 of 6)



SITE LOCATION	TEST SYMBOL	SAMPLE NO.	DEPTH (ft)	GROUP SYMBOL	USCS DESCRIPTION (based on grain size)
PS2 (Redwood City PS)	○	B-2-1	2-3½	CL	sandy lean clay
	□	B-2-4	13½-15	CL	sandy lean clay
	△	B-2-5&6	18-20	SM	silty sand with gravel
	◊	B-2-7	22-23½	SW-SM	well-graded sand with silt

NOTE: The largest particle (grain) size that could have been sampled from our borings by our sample barrels is a function of the inside diameter of the sample barrels used (see Figure A-1). Therefore, there may be larger particles (e.g., coarse gravel, cobbles or boulders) in the soils sampled than reflected on the boring logs and grain size distribution curves provided in this report.

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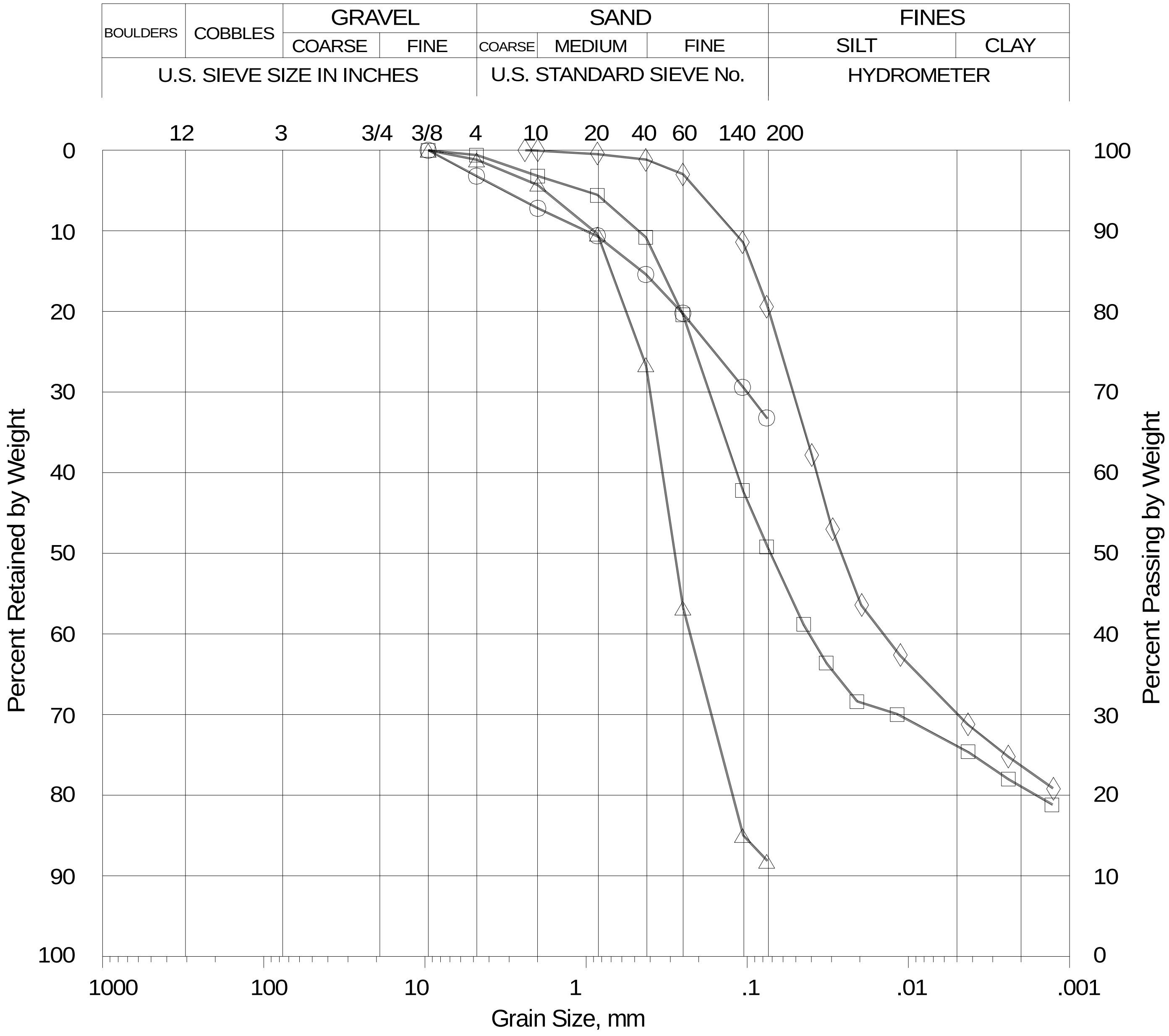
Grain Size

Figure

C-2

(2 of 6)



SITE LOCATION	TEST SYMBOL	SAMPLE NO.	DEPTH (ft)	GROUP SYMBOL	USCS DESCRIPTION (based on grain size)
PS2 (Redwood City PS)	○	B-2-8	23½-24	CH	sandy fat clay
	□	B-2-9	28-28½	CL	sandy lean clay
	△	B-2-11	32-33½	SW-SM	well-graded sand with silt
	◇	B-2-12	34-35	CH	fat clay with sand

NOTE: The largest particle (grain) size that could have been sampled from our borings by our sample barrels is a function of the inside diameter of the sample barrels used (see Figure A-1). Therefore, there may be larger particles (e.g., coarse gravel, cobbles or boulders) in the soils sampled than reflected on the boring logs and grain size distribution curves provided in this report.

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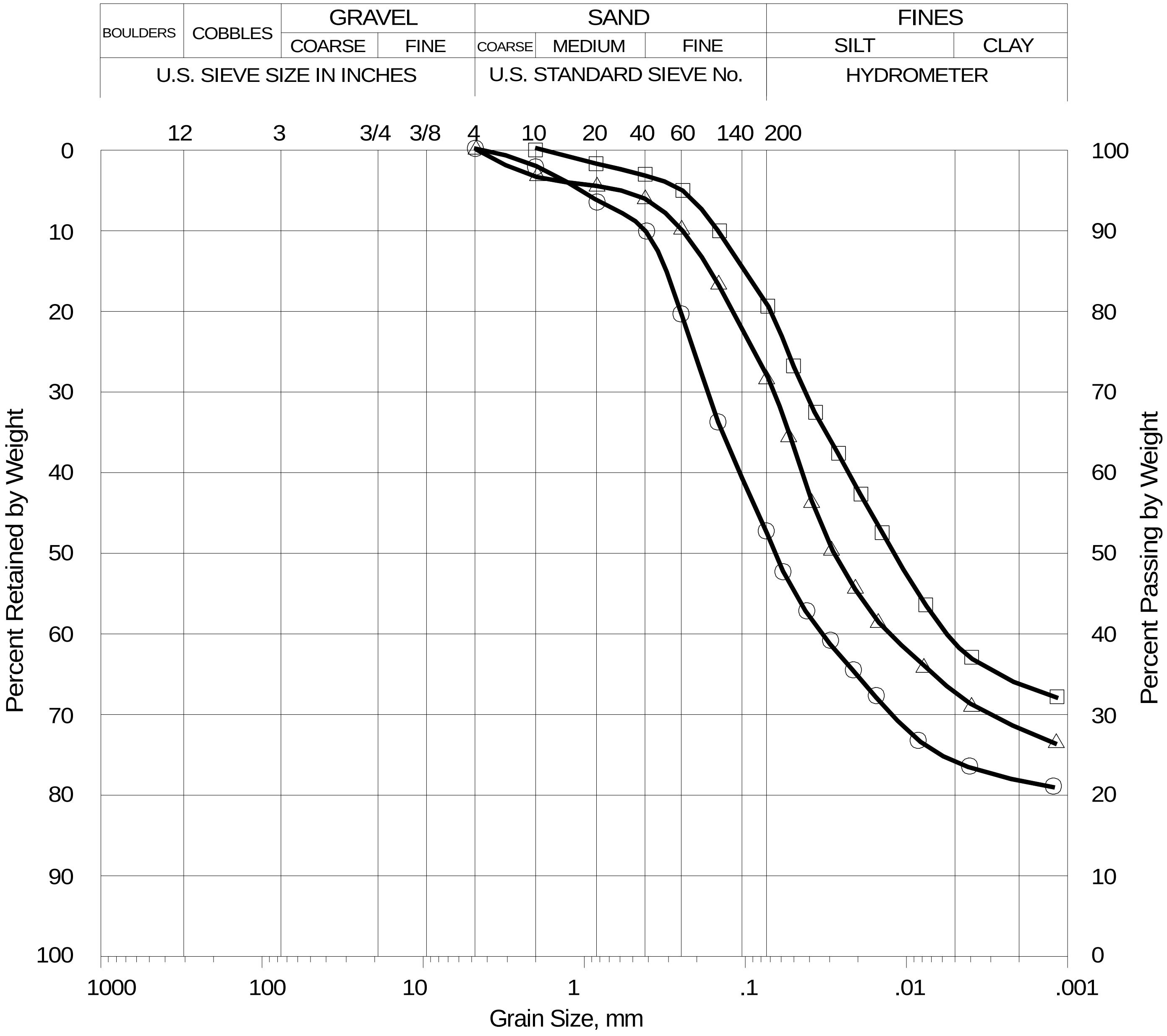
Grain Size

Figure
C-2
(3 of 6)



SITE LOCATION	TEST SYMBOL	SAMPLE NO.	DEPTH (ft)	GROUP SYMBOL	USCS DESCRIPTION (based on grain size)
Belmont Gravity Sewer	□	B3-3A & 4A	13-15	CH	fat clay with sand
	○	B3-5A	18-18½	CL	sandy lean clay
	△	B4-4	13½-15	CL-CH	lean to fat clay with sand

NOTE: The largest particle (grain) size that could have been sampled from our borings by our sample barrels is a function of the inside diameter of the sample barrels used (see Figure A-1). Therefore, there may be larger particles (e.g., coarse gravel, cobbles or boulders) in the soils sampled than reflected on the boring logs and grain size distribution curves provided in this report.

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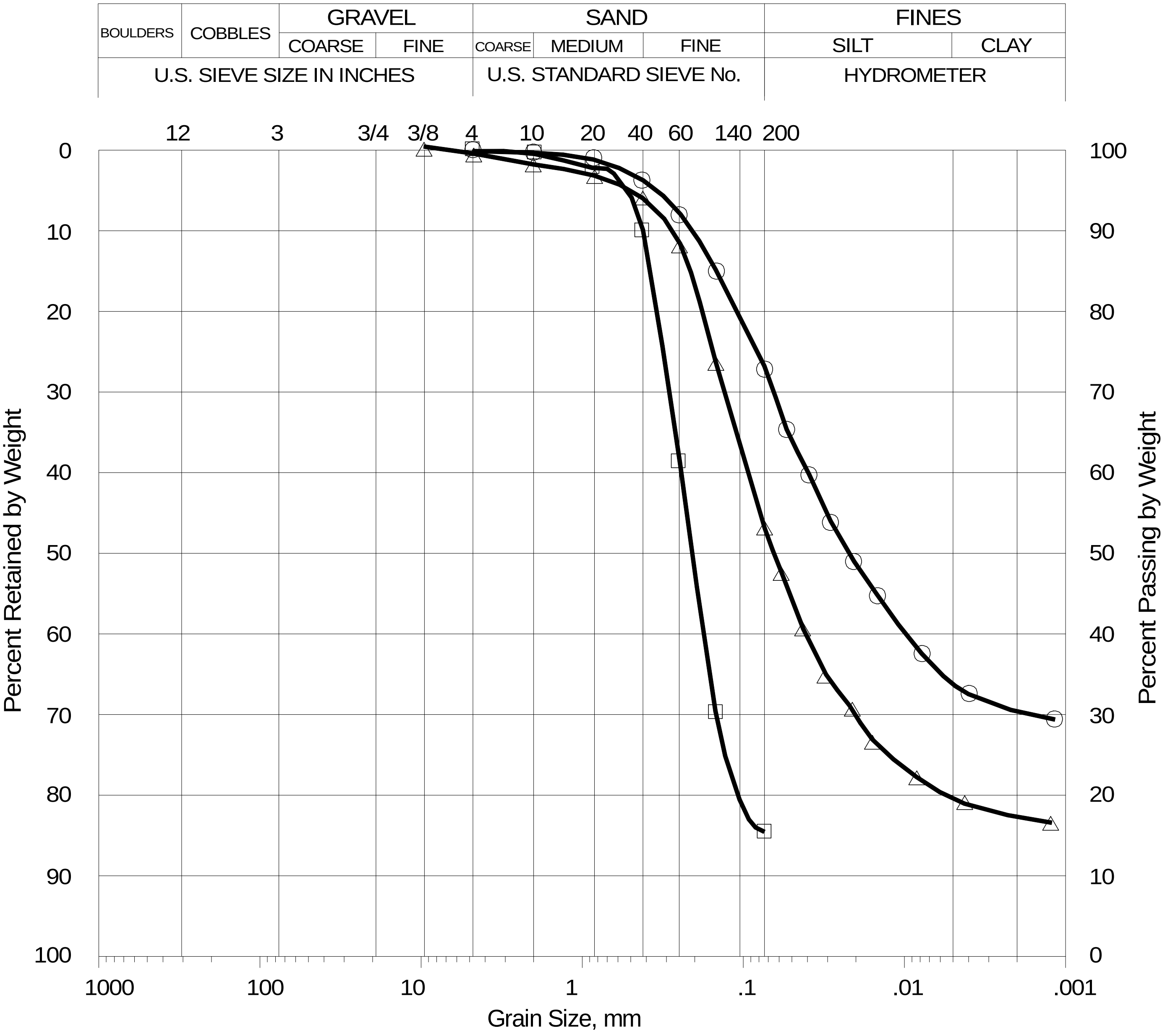
Grain Size

Figure

C-2

(4 of 6)



SITE LOCATION	TEST SYMBOL	SAMPLE NO.	DEPTH (ft)	GROUP SYMBOL	USCS DESCRIPTION (based on grain size)
Belmont Gravity Sewer	○	B5-4A	18-18½	CL/CH	lean/fat clay with sand
	□	B5-10B	32½-33½	SM	silty sand
	△	B5-12A & 12B	37½-38½	CL/CH	sandy lean/fat clay

NOTE: The largest particle (grain) size that could have been sampled from our borings by our sample barrels is a function of the inside diameter of the sample barrels used (see Figure A-1). Therefore, there may be larger particles (e.g., coarse gravel, cobbles or boulders) in the soils sampled than reflected on the boring logs and grain size distribution curves provided in this report.

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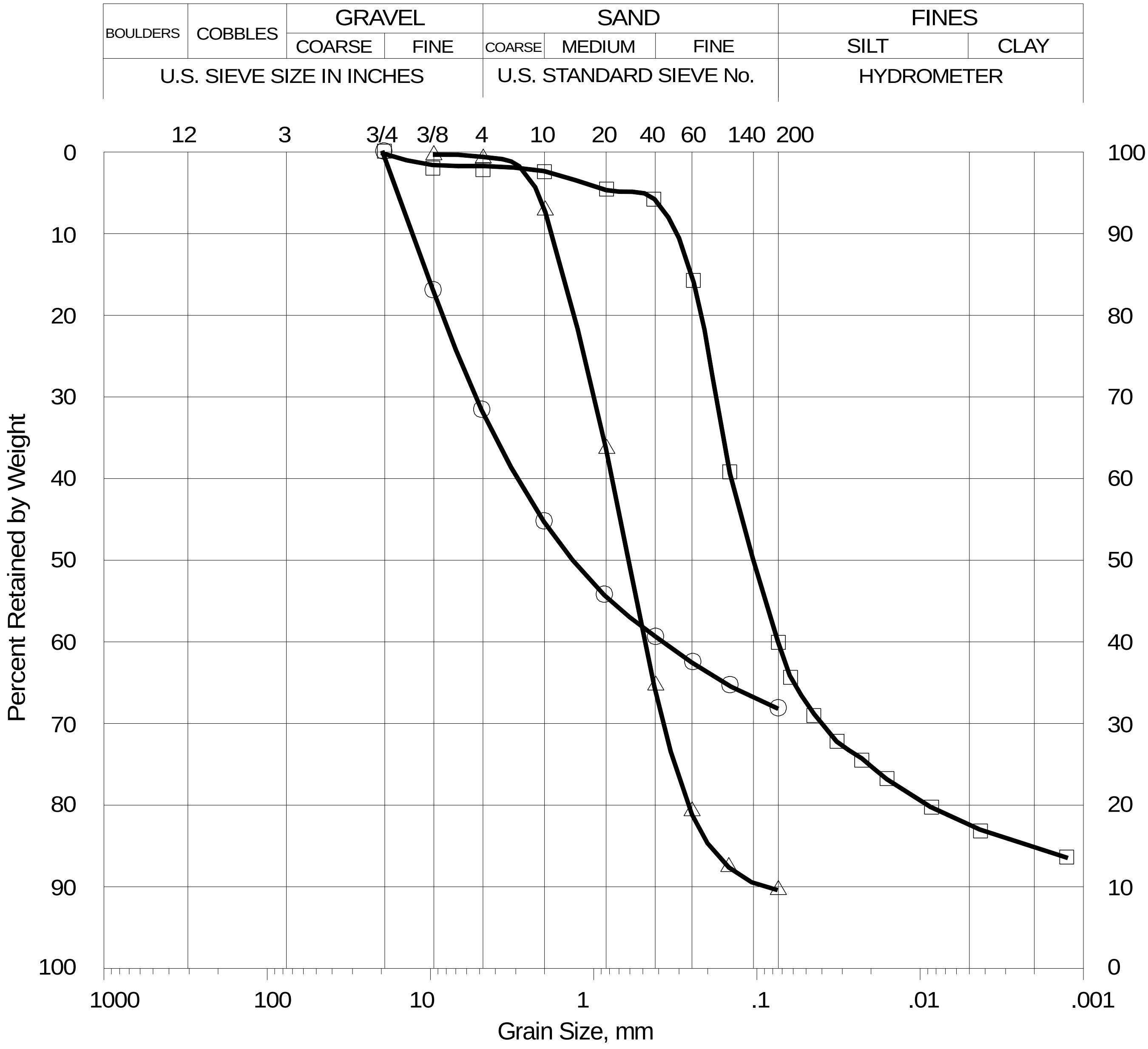
Grain Size

Figure

C-2

(5 of 6)



SITE LOCATION	TEST SYMBOL	SAMPLE NO.	DEPTH (ft)	GROUP SYMBOL	USCS DESCRIPTION (based on grain size)
PS1 (Menlo Park PS)	○	B6-1A	3-3½	SC	clayey sand
	□	B6-4	13½-15	SC	clayey sand
	△	B6-7	22-23½	SW-SM	well-graded sand with silt

NOTE: The largest particle (grain) size that could have been sampled from our borings by our sample barrels is a function of the inside diameter of the sample barrels used (see Figure A-1). Therefore, there may be larger particles (e.g., coarse gravel, cobbles or boulders) in the soils sampled than reflected on the boring logs and grain size distribution curves provided in this report.

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Grain Size

Figure

C-2

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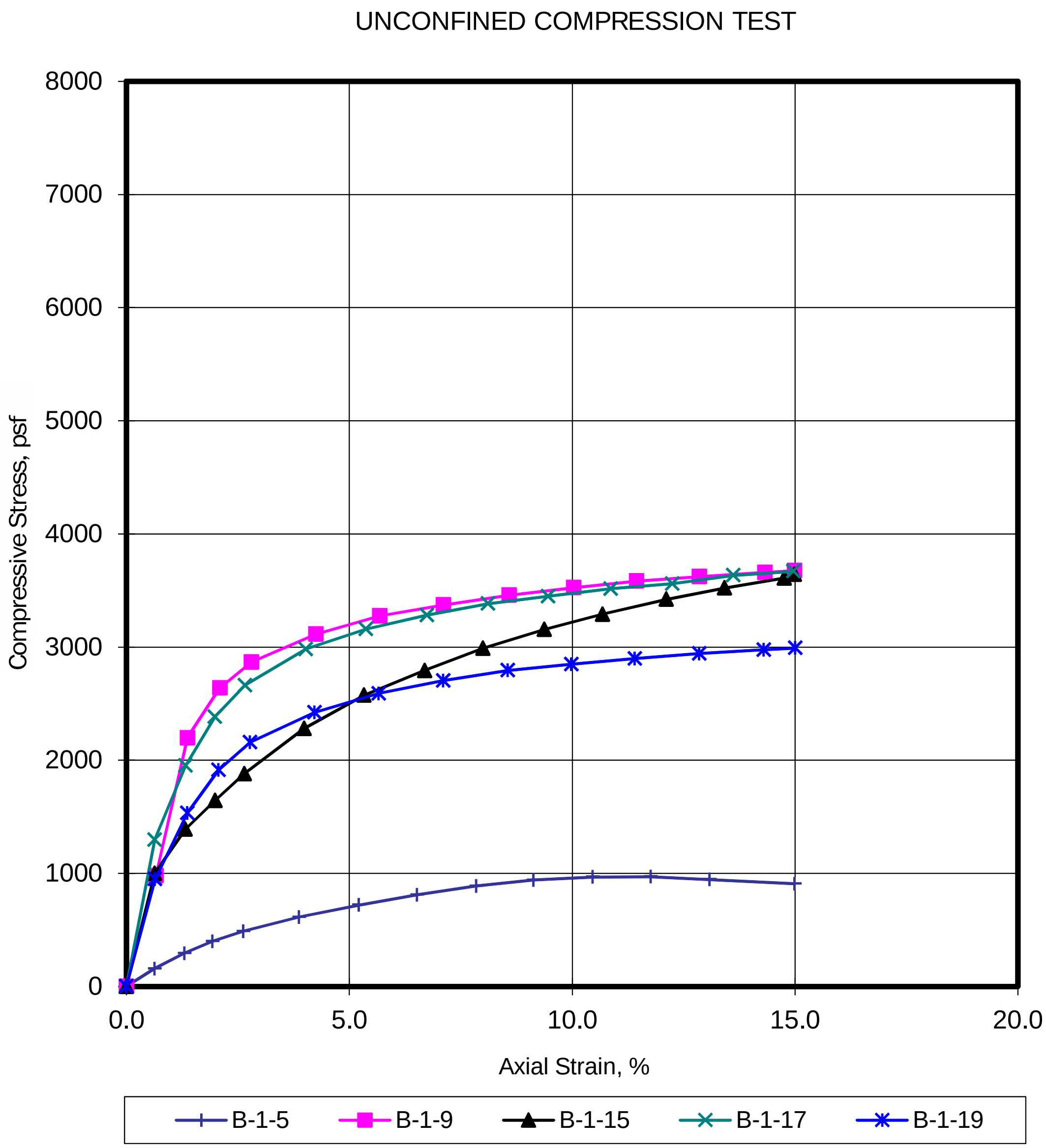

PS3 (San Carlos PS)	BORING SAMPLE NO.	B-1-5	B-1-9	B-1-15	B-1-17	B-1-19
	MAXIMUM UNCONFINED STRESS, psf	971	3675	3643	3670	2991
	%STRAIN @ PEAK STRESS	11.8	15.0	15.0	15.0	15.0
	DEPTH, ft.	12½-13	22½-23	38-38½	43-43½	48-48½
	WATER CONTENT, %	89	28	19	24	32
	DRY DENSITY, pcf	50	97	115	105	94
	SATURATION, %	100	100	100	100	100

Maximum Unconfined Stress cut-off = 15% strain
Average Strain Rate = 0.07 in/min.

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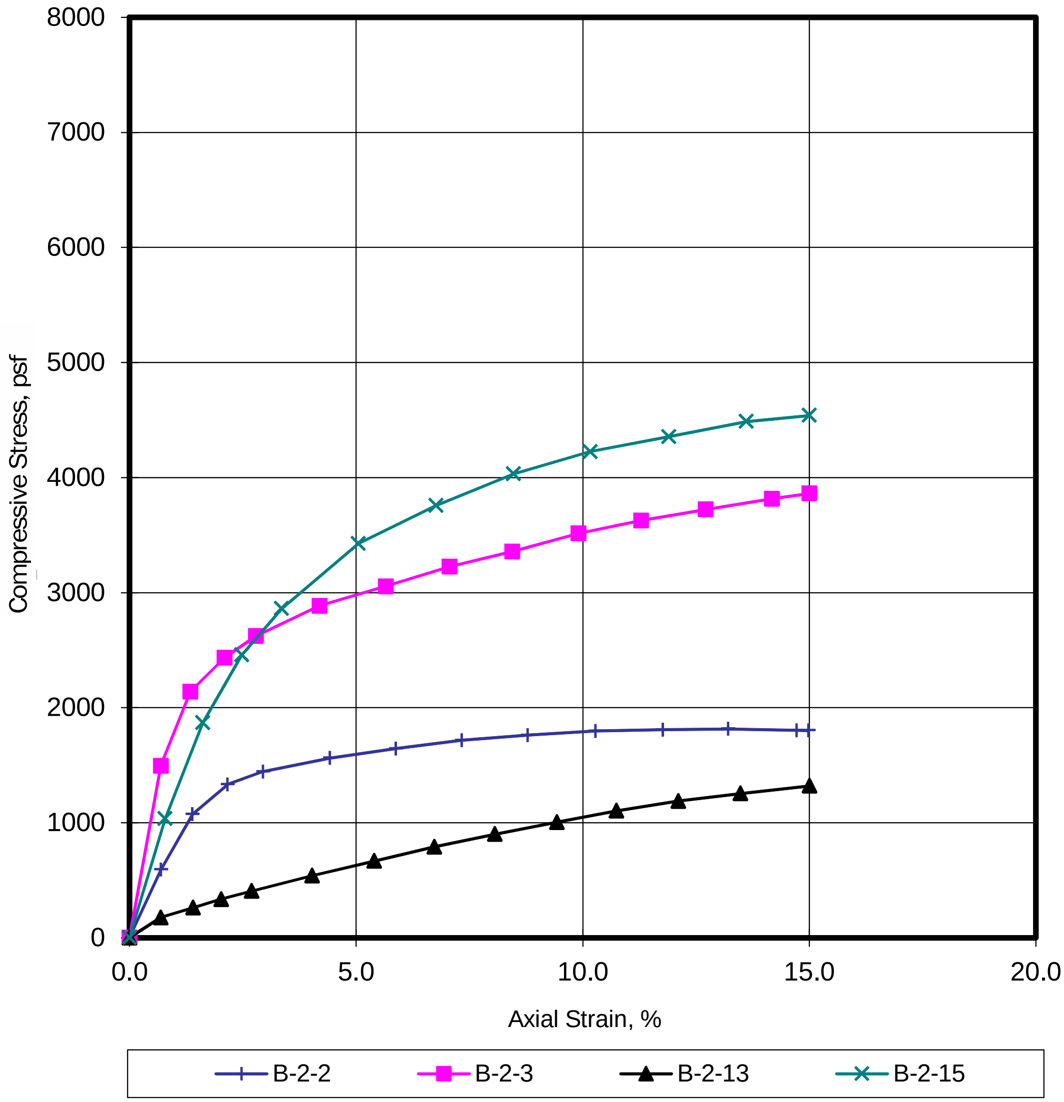
Unconfined Compression

Figure

C-3

(1 of 5)

UNCONFINED COMPRESSION TEST



PS2 (Redwood City PS)	BORING SAMPLE NO.	B-2-2	B-2-3	B-2-13	B-2-15
	MAXIMUM UNCONFINED STRESS, psf	1815	3861	1320	4540
	%STRAIN @ PEAK STRESS	13.2	15.0	15.0	15.0
	DEPTH, ft.	9½-10	13-13½	38-38½	43-43½
	WATER CONTENT, %	38	27	31	20
	DRY DENSITY, pcf	85	100	94	113
	SATURATION, %	100	100	100	100

Maximum Unconfined Stress cut-off = 15% strain
Average Strain Rate = 0.07 in/min.

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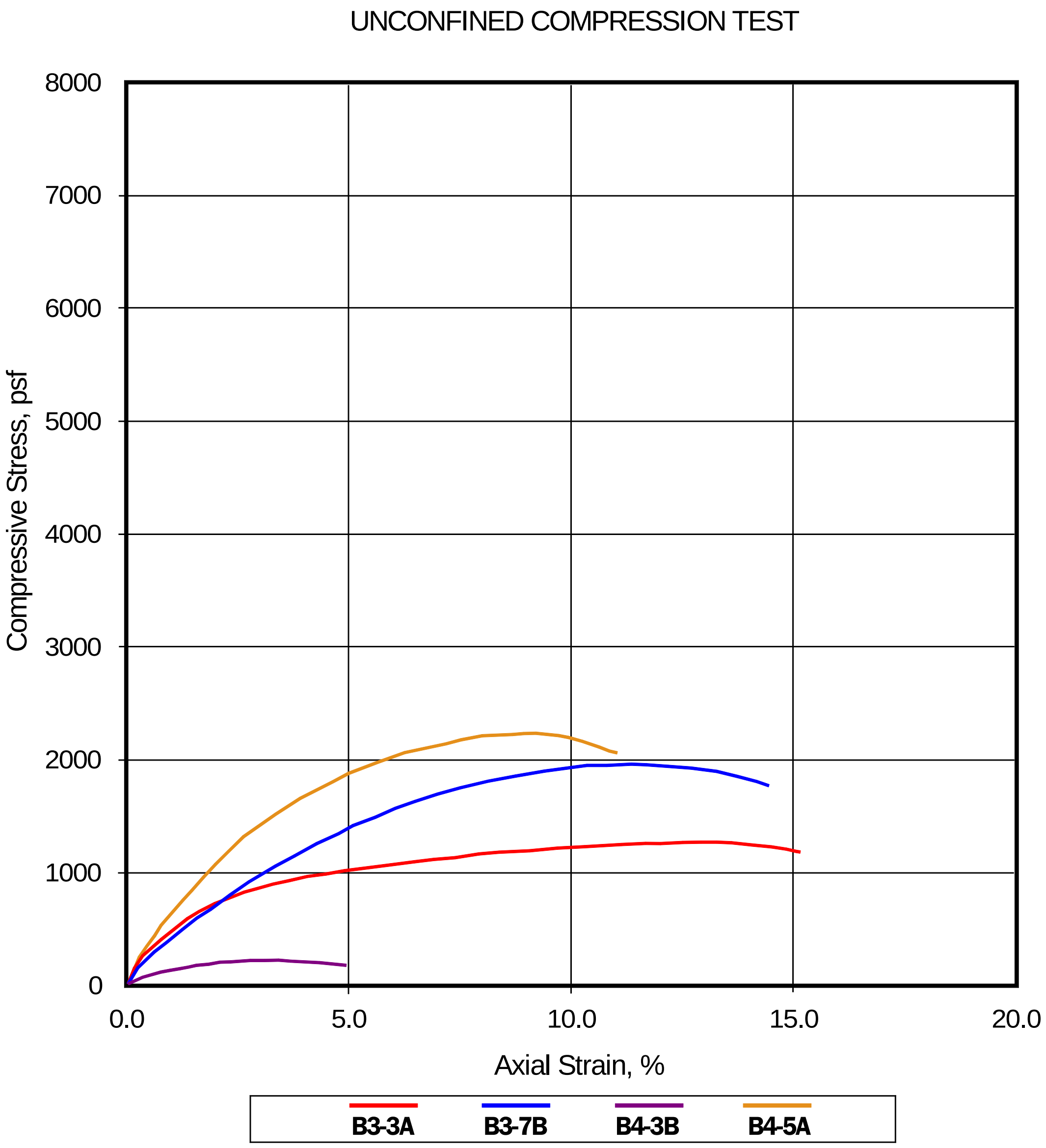
Unconfined Compression

Figure

C-3

(2 of 5)



Belmont Gravity Sewer	**BORING SAMPLE NO.**	**B3-3A**	**B3-7B**	**B4-3B**	**B4-5A**
	MAXIMUM UNCONFINED STRESS, psf	1288	1972	213	2206
	%STRAIN @ PEAK STRESS	13.5	11.3	3.3	8.8
	DEPTH, ft.	13-13½	22½-23	12½-13	17½-18
	WATER CONTENT, %	28	22	22	17
	DRY DENSITY, pcf	95	103	107	116
	SATURATION, %	100	96	102	99

Maximum Unconfined Stress cut-off = 15% strain
Average Strain Rate = 0.08 in/min.

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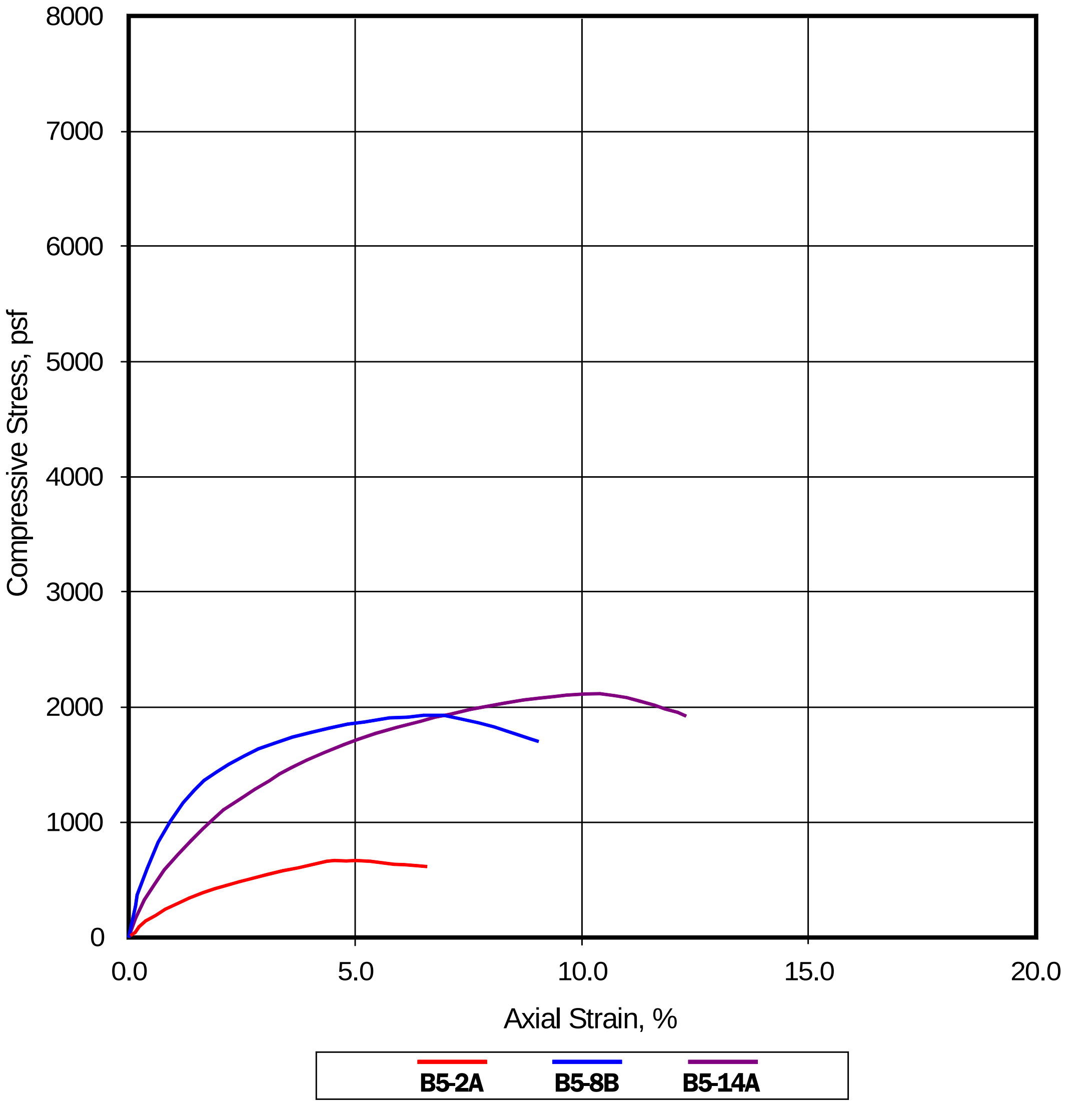
Unconfined Compression

Figure

C-3

(3 of 5)

UNCONFINED COMPRESSION TEST



Belmont Gravity Sewer	**BORING SAMPLE NO.**	**B5-2A**	**B5-8B**	**B5-14A**
	MAXIMUM UNCONFINED STRESS, psf	678	1936	2127
	%STRAIN @ PEAK STRESS	4.5	6.7	10.2
	DEPTH, ft.	8-8½	27½-28	43-43½
	WATER CONTENT, %	90	31	31
	DRY DENSITY, pcf	47	92	91
	SATURATION, %	93	100	100

Maximum Unconfined Stress cut-off = 15% strain
Average Strain Rate = 0.08 in/min.

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File No. 4520.0

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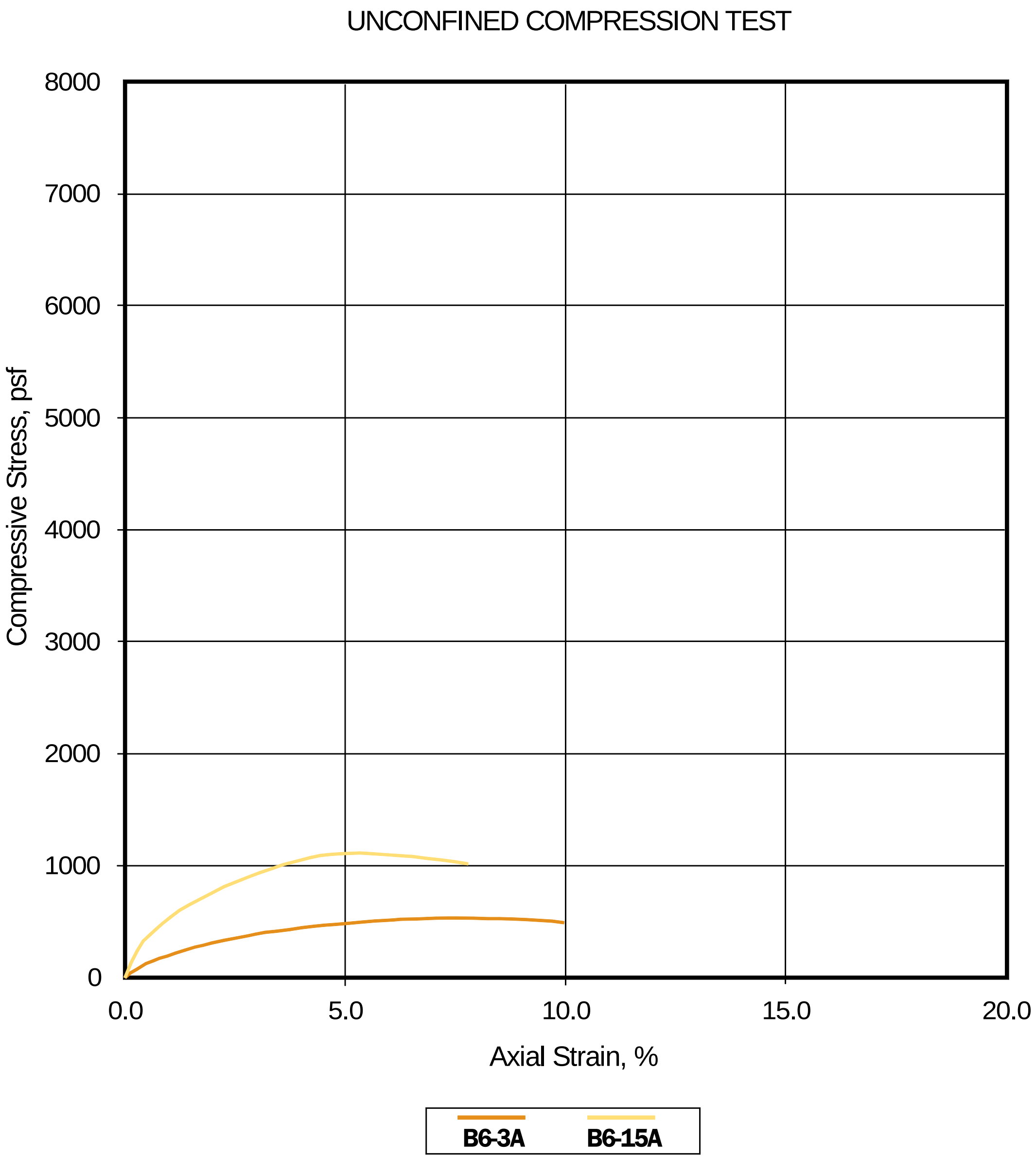
South Bayside System Authority
Pump Station Predesign
San Mateo County, California

Unconfined Compression

Figure

C-3

(4 of 5)



PS1 (Menlo Park PS)	**BORING SAMPLE NO.**	**B6-3A**	**B6-15A**
	MAXIMUM UNCONFINED STRESS, psf	527	1112
	%STRAIN @ PEAK STRESS	7.4	5.3
	DEPTH, ft.	13-13½	43-43½
	WATER CONTENT, %	24	23.5
	DRY DENSITY, pcf	102	99
	SATURATION, %	100	91

Maximum Unconfined Stress cut-off = 15% strain
Average Strain Rate = 0.08 in/min.

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October 2013

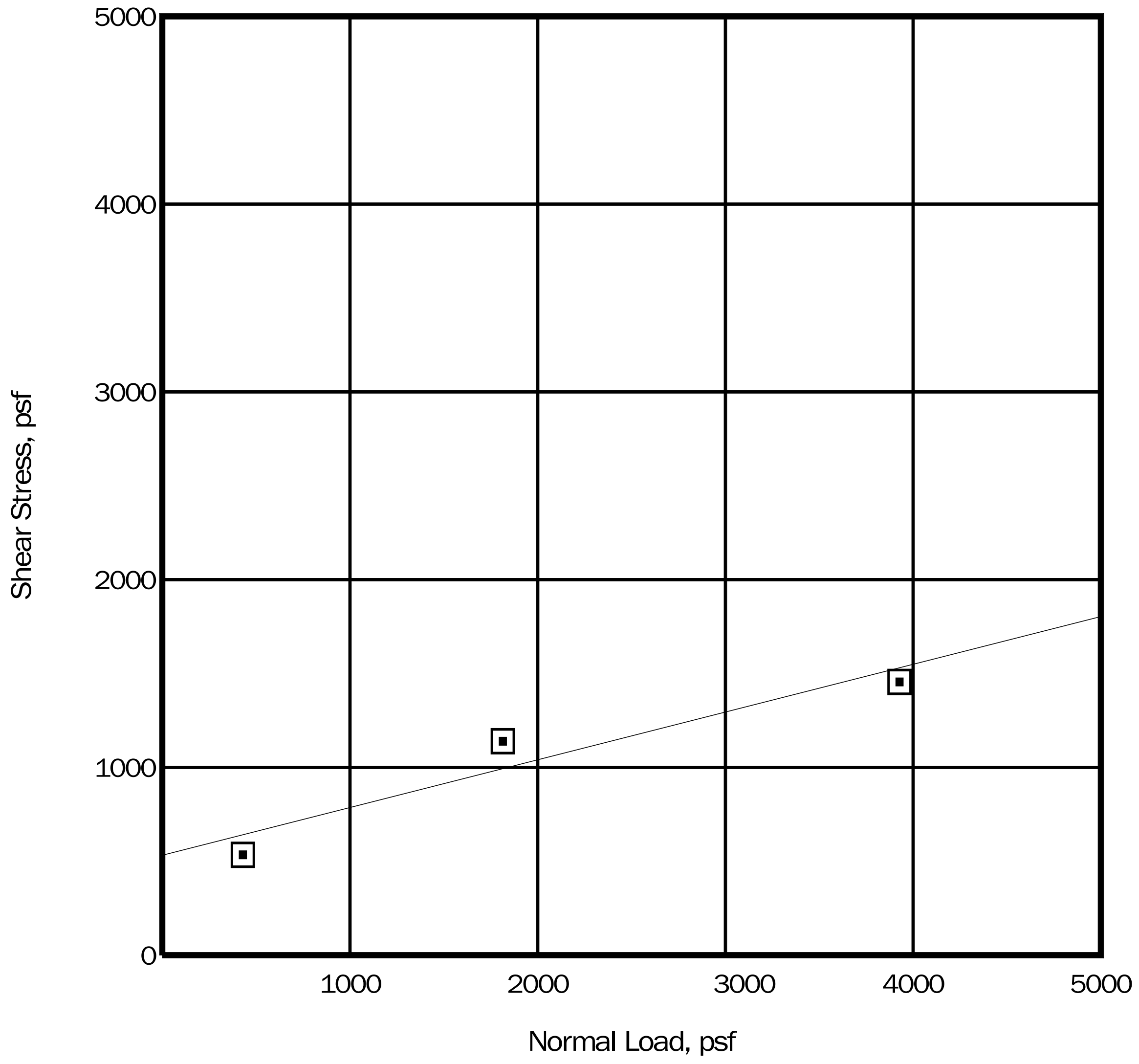
Brown and Caldwell
South Bayside System Authority
Pump Station Predesign
San Mateo County, California

Unconfined Compression

Figure

C-3

(5 of 5)



PS3 (San Carlos PS)

TEST SYMBOL	GRAPH LINE	BORING SAMPLE NO.	DEPTH (ft)	APPARENT COHESION (p.s.f.)	INTERNAL FRICTION ANGLE (degrees)	AVE. DRY DENSITY (pcf)/ MOISTURE CONTENT (%)	
						BEFORE TEST	AFTER TEST
▣	—	B-1-11	28-28½	530	14	102/24	101/26

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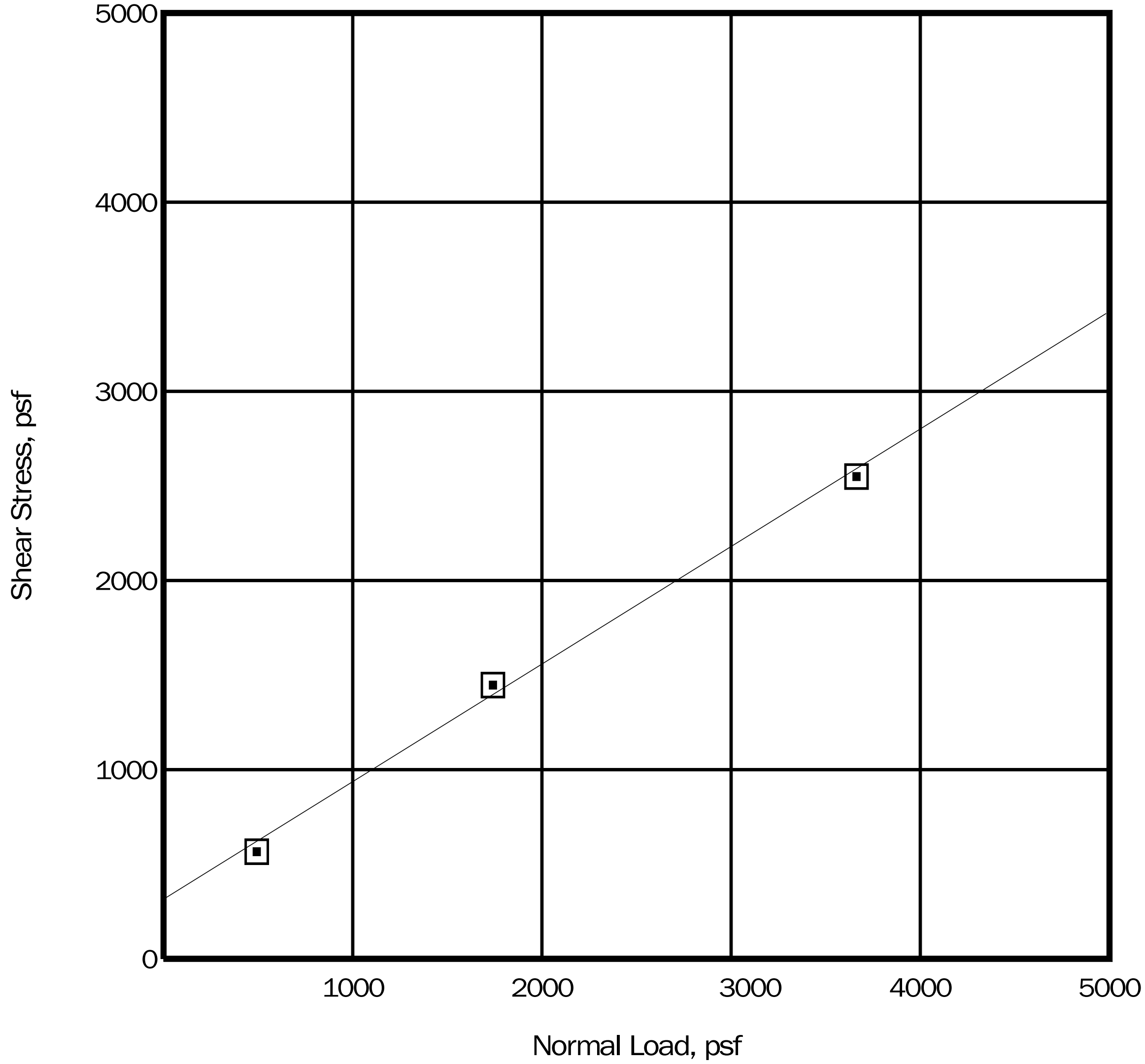
San Mateo County, California

Direct Shear

Figure
C-4
(1 of 6)



PS2 (Redwood City PS)

TEST SYMBOL	GRAPH LINE	BORING SAMPLE NO.	DEPTH (ft)	APPARENT COHESION (p.s.f.)	INTERNAL FRICTION ANGLE (degrees)	AVE. DRY DENSITY (pcf)/ MOISTURE CONTENT (%)	
						BEFORE TEST	AFTER TEST
▣	—	B-2-9	28-28½	310	32	110/20	112/19

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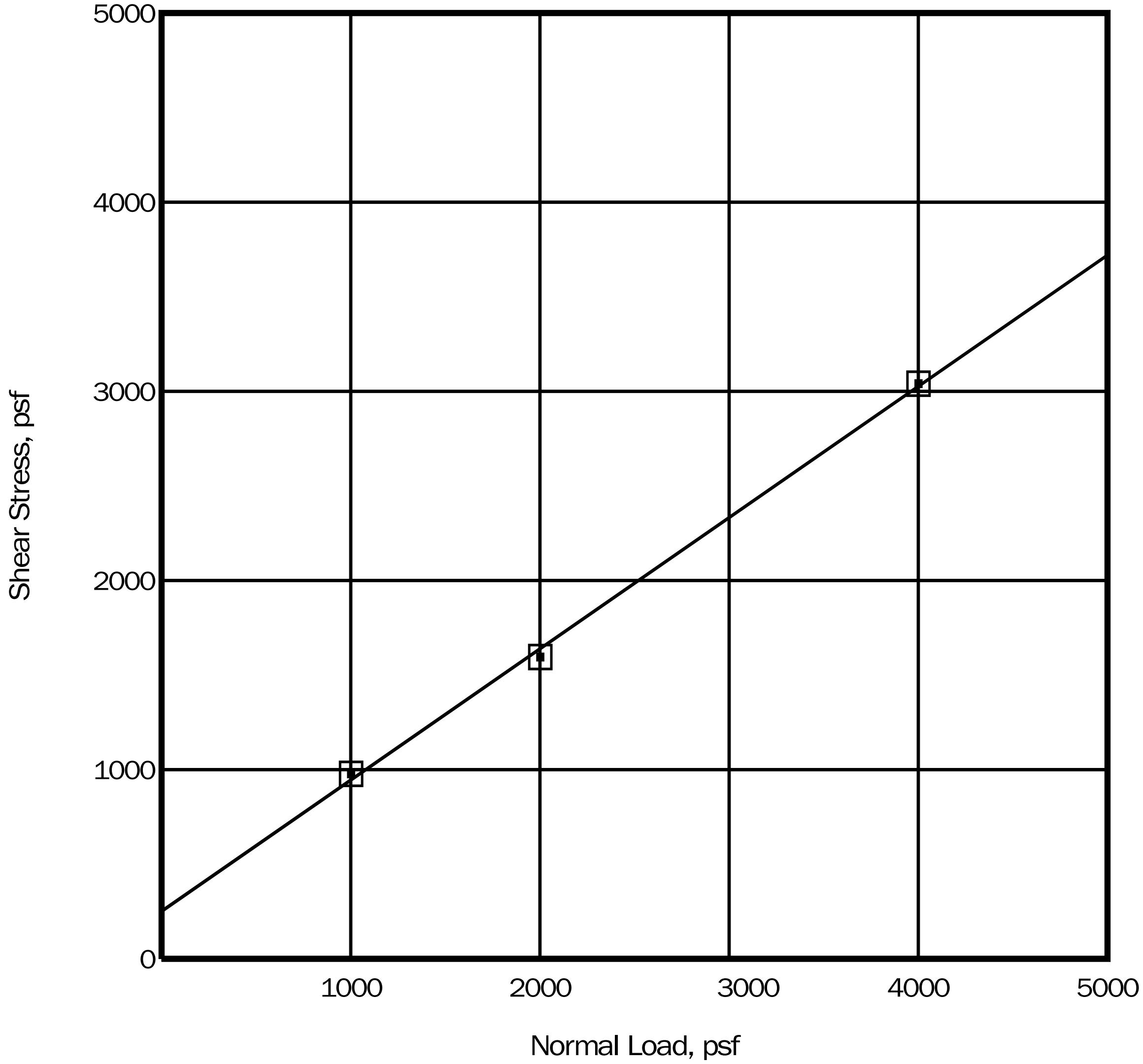
File No. 4520.0

October 2013

Brown & Caldwell
South Bay System Authority
Pump Station Predesign
San Mateo County, California

Direct Shear

Figure
C-4
(2 of 6)



Belmont Gravity Sewer

TEST SYMBOL	GRAPH LINE	BORING SAMPLE NO.	DEPTH (ft)	APPARENT COHESION (p.s.f.)	INTERNAL FRICTION ANGLE (degrees)	AVE. DRY DENSITY (pcf)/ MOISTURE CONTENT (%)	
						BEFORE TEST	AFTER TEST
▣	—	B3-5A	18-18½	260	35	105/16	105/20

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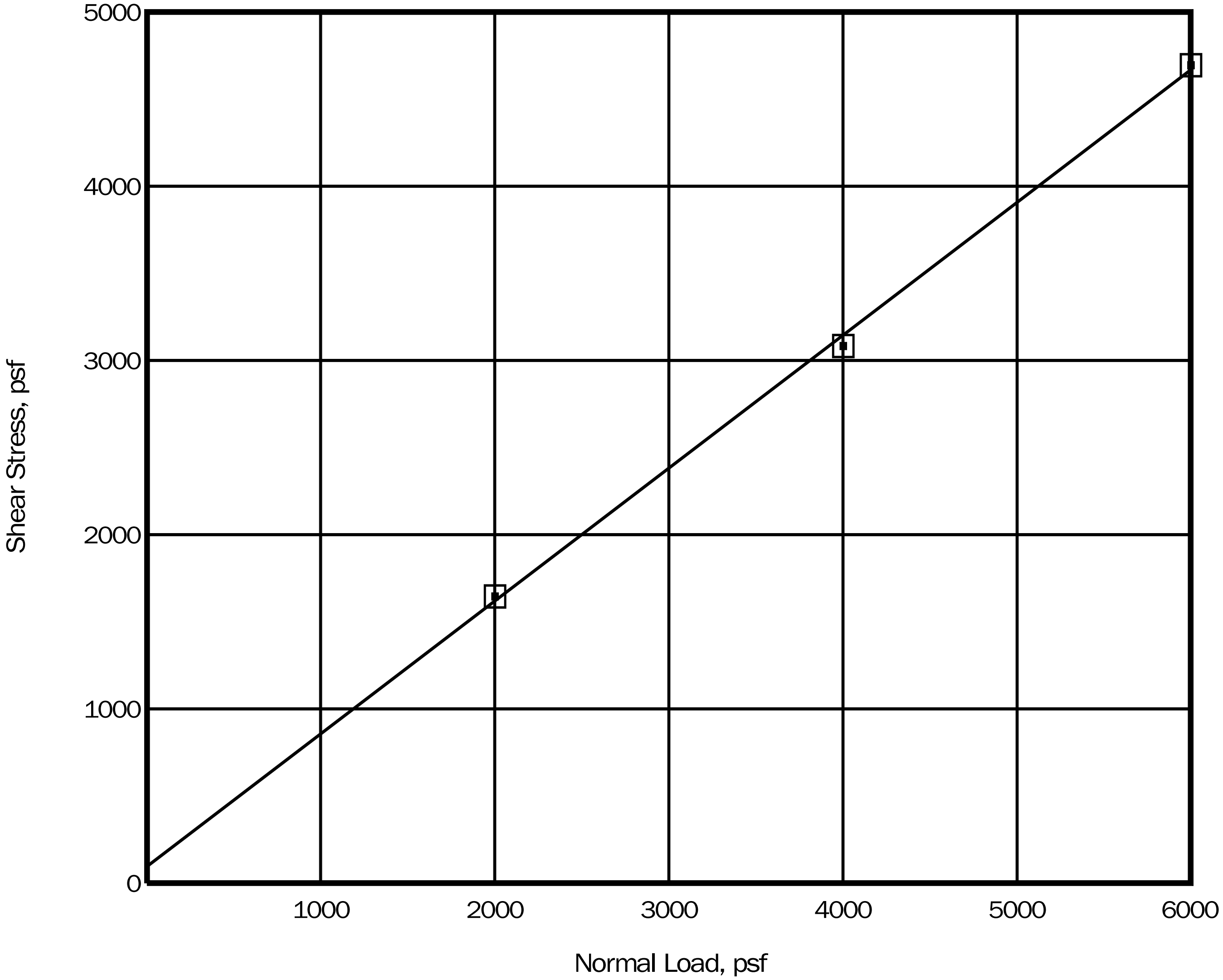
Brown and Caldwell
South Bayside System Authority
Pump Station Predesign
San Mateo County, California

Direct Shear

Figure

C-4

(3 of 6)



Belmont Gravity Sewer

TEST SYMBOL	GRAPH LINE	BORING SAMPLE NO.	DEPTH (ft)	APPARENT COHESION (p.s.f.)	INTERNAL FRICTION ANGLE (degrees)	AVE. DRY DENSITY (pcf)/ MOISTURE CONTENT (%)	
						BEFORE TEST	AFTER TEST
▣	———	B5-12A & 12B	37½-38½	96	37	105/20	106/20

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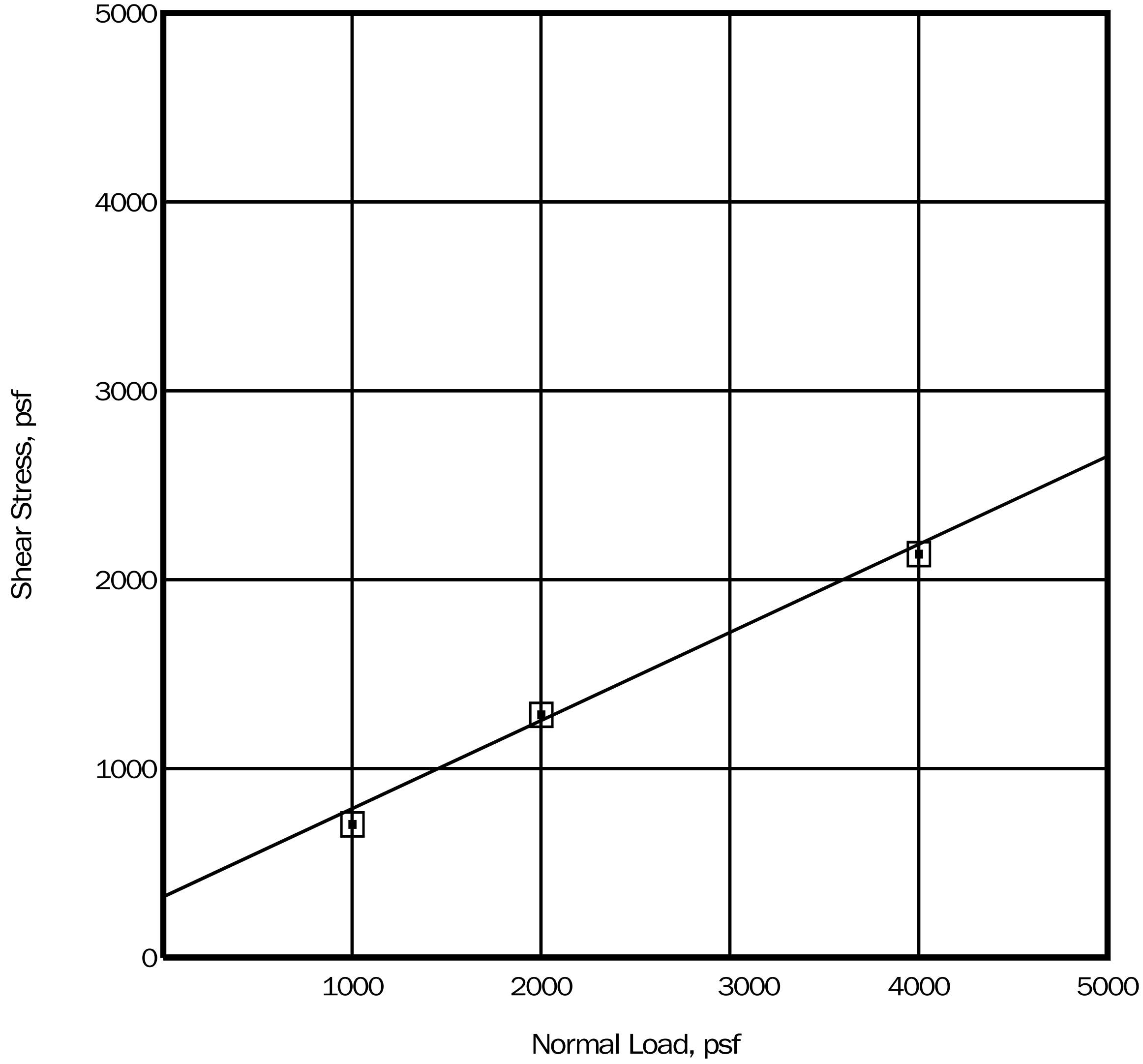
Brown and Caldwell
South Bayside System Authority
Pump Station Predesign
San Mateo County, California

Direct Shear

Figure

C-4

(4 of 6)



PS1 (Menlo Park PS)

TEST SYMBOL	GRAPH LINE	BORING SAMPLE NO.	DEPTH (ft)	APPARENT COHESION (p.s.f.)	INTERNAL FRICTION ANGLE (degrees)	AVE. DRY DENSITY (pcf)/ MOISTURE CONTENT (%)	
						BEFORE TEST	AFTER TEST
▣	———	B6-5A	18-18½	321	25	92/27	93/28

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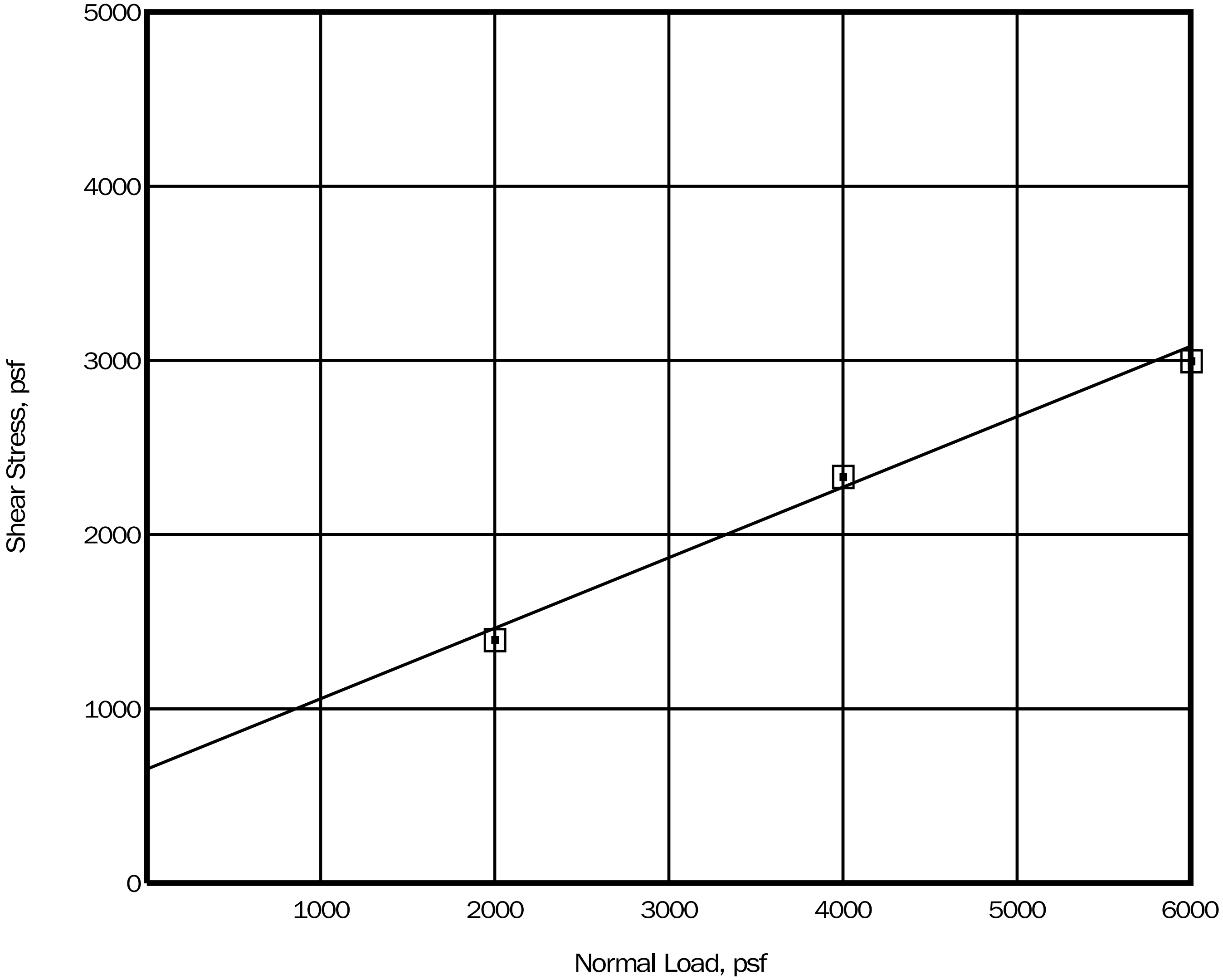
South Bayside System Authority
Pump Station Predesign
San Mateo County, California

Direct Shear

Figure
C-4
(5 of 6)



PS1 (Menlo Park PS)

TEST SYMBOL	GRAPH LINE	BORING SAMPLE NO.	DEPTH (ft)	APPARENT COHESION (p.s.f.)	INTERNAL FRICTION ANGLE (degrees)	AVE. DRY DENSITY (pcf)/ MOISTURE CONTENT (%)	
						BEFORE TEST	AFTER TEST
▣	——	B6-13B	37½-38	645	22	90/31	90/30

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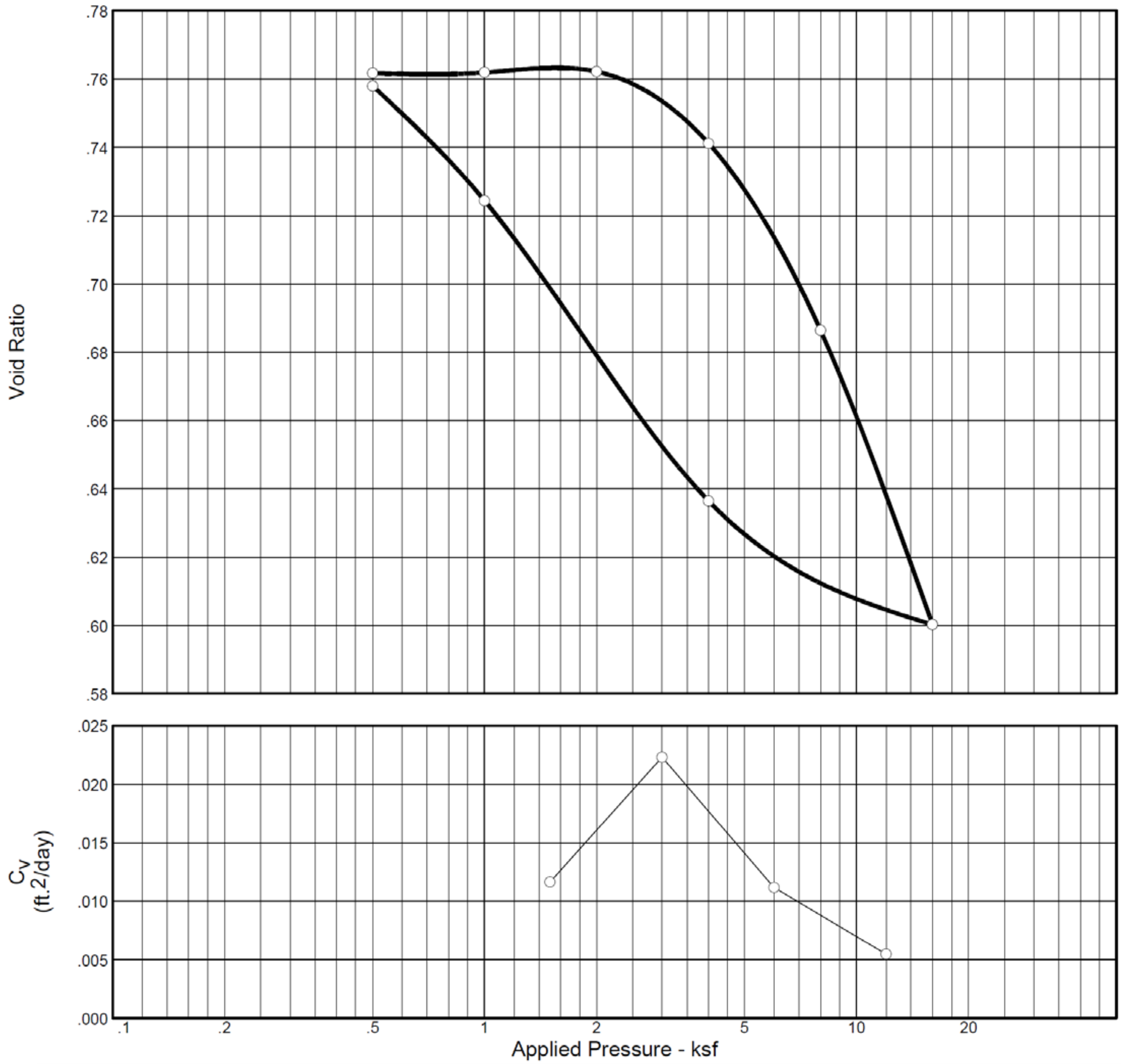
Brown and Caldwell
South Bayside System Authority
Pump Station Predesign
San Mateo County, California

Direct Shear

Figure

C-4

(6 of 6)



PS3 (San Carlos PS)

TEST SYMBOL	BORING SAMPLE NO.	DEPTH (ft)	BEFORE TEST CONDITIONS			PRE-CONSOLIDATION PRESSURES (ksf)	C_r	C_c	e_o
			SATURATION (%)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)				
—●—	B-1-13	32-33½	96	27	98	4.80	0.11	0.29	0.760

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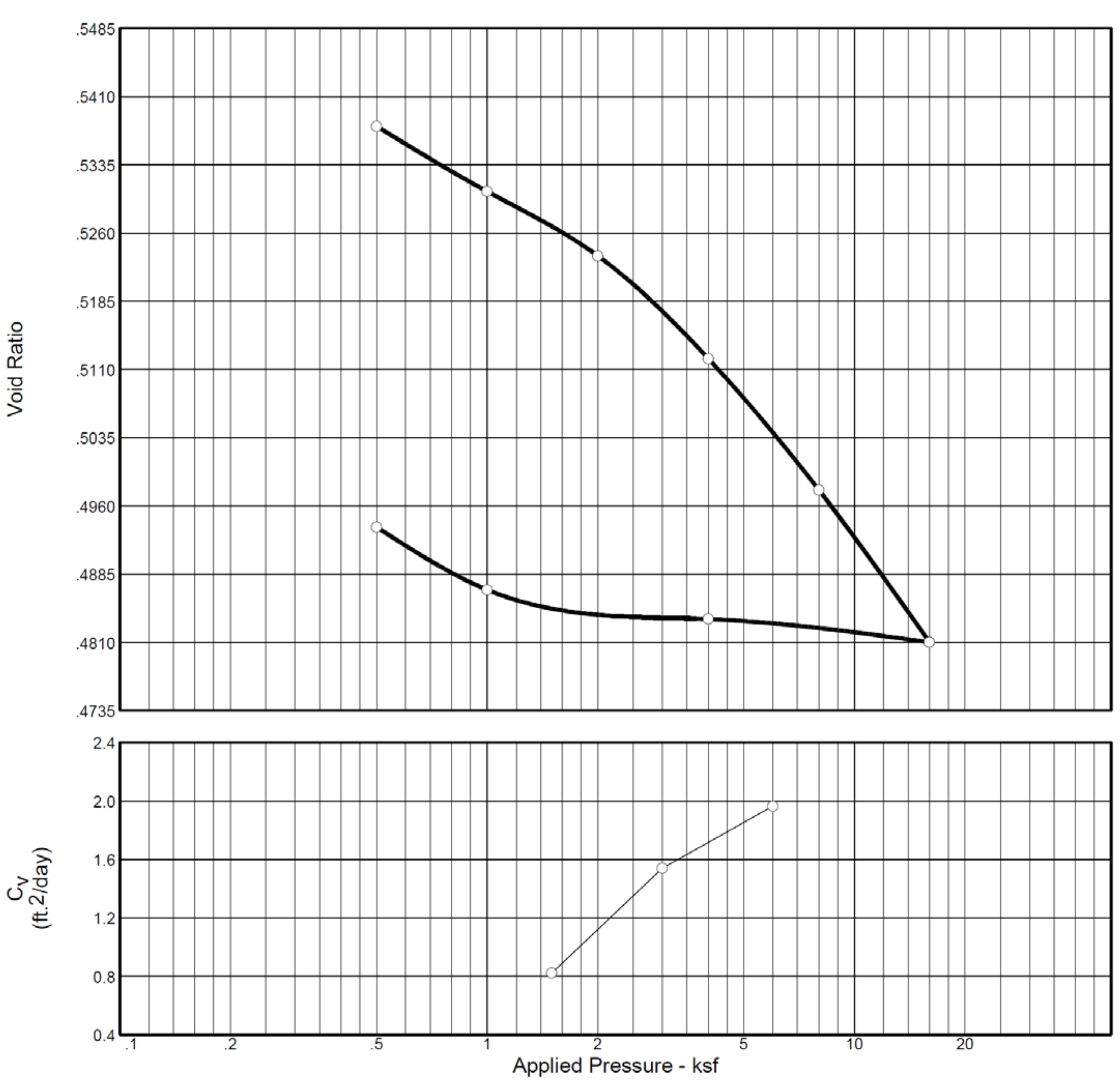
Brown and Caldwell
South Bayside System Authority
Pump Station Predesign
San Mateo County, California

Consolidation

Figure
C-5
(1 of 4)



PS2 (Redwood City PS)									
TEST SYMBOL	BORING SAMPLE NO.	DEPTH (ft)	BEFORE TEST CONDITIONS			PRE-CONSOLIDATION PRESSURES (ksf)	C_r	C_c	e_o
			SATURATION (%)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)				
—●—	B-2-11	33-33½	85	17	112	3.16	0.01	0.06	0.539

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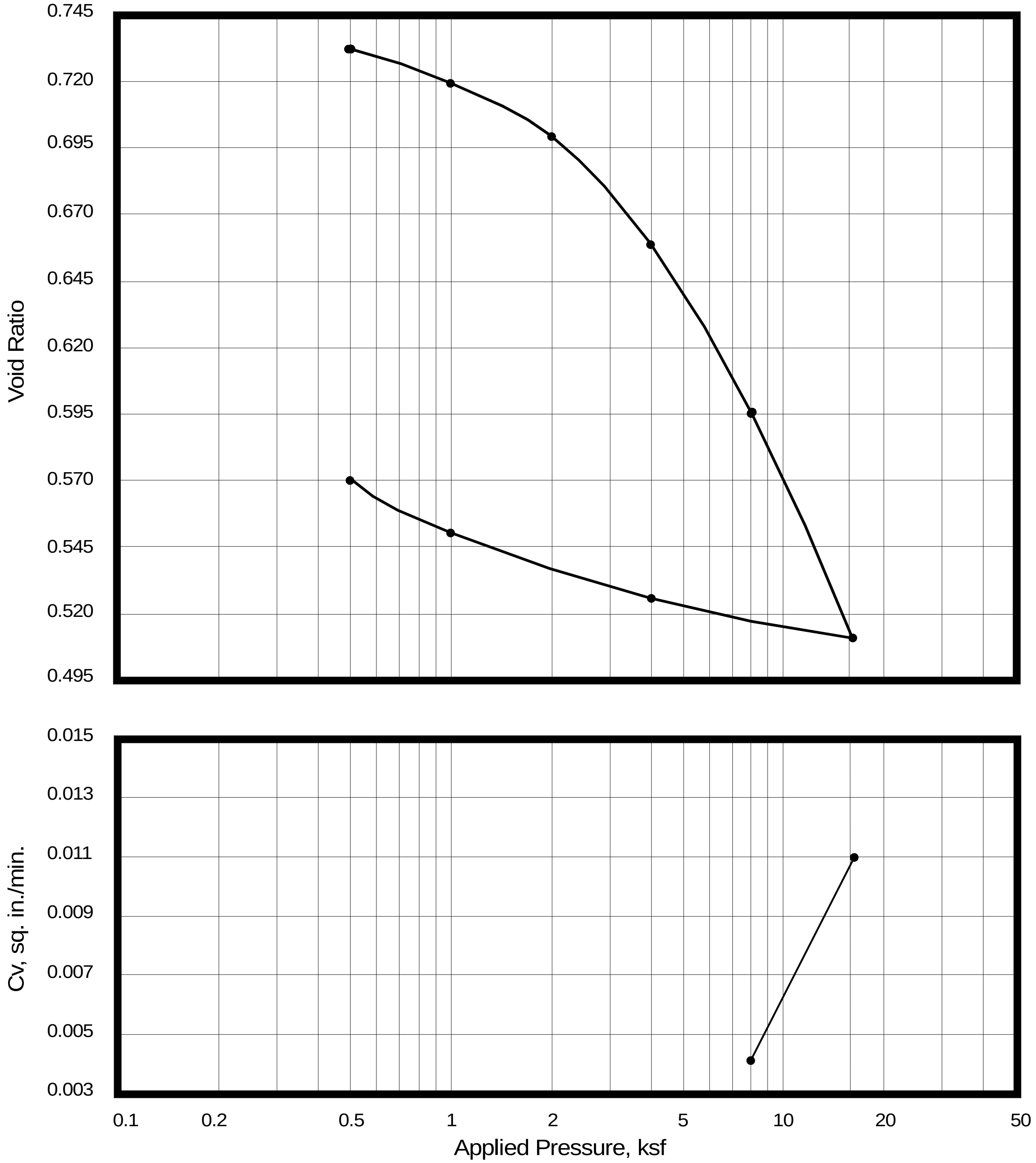
October 2013

Brown and Caldwell
South Bayside System Authority
Pump Station Predesign
San Mateo County, California

Consolidation

Figure
C-5
(2 of 4)



Belmont Gravity Sewer

TEST SYMBOL	BORING SAMPLE NO.	DEPTH (ft)	BEFORE TEST CONDITIONS			PRE-CONSOLIDATION PRESSURES (ksf)	C_c	e_o
			SATURATION (%)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)			
●	B5-8A	28-28½	99	27	97	4.01	0.29	0.74

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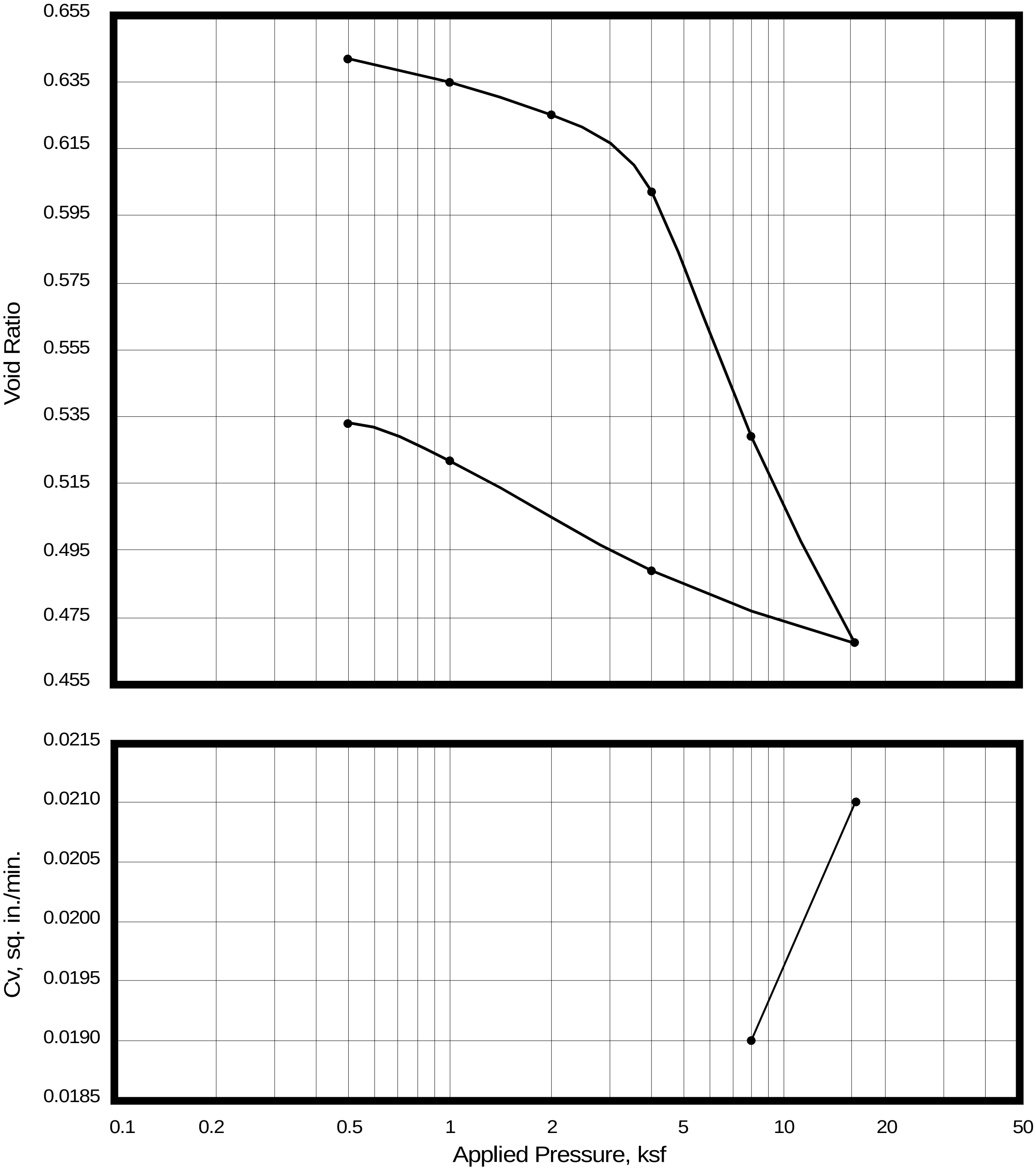
Brown and Caldwell
South Bayside System Authority
Pump Station Predesign
San Mateo County, California

Consolidation

Figure
C-5
(3 of 4)



PS1 (Menlo Park PS)

TEST SYMBOL	BORING SAMPLE NO.	DEPTH (ft)	BEFORE TEST CONDITIONS			PRE-CONSOLIDATION PRESSURES (ksf)	C_c	e_o
			SATURATION (%)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)			
●	B6-11A	33-33½	97	24	102	3.90	0.24	0.66

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October 2013

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South Bayside System Authority
Pump Station Predesign
San Mateo County, California

Consolidation

Figure

C-5

(4 of 4)

Corrosion Test Results

SITE	SAMPLE NO.	RESISTIVITY saturated (ohm-cm)	pH	SULFATE (mg/kg)	CHLORIDE (mg/kg)
San Carlos PS	B-1-3	84*	7.2	340	2,700
Redwood City PS	B-2-3	1,200	9.1	130	320
Belmont Gravity Sewer	B-4-6	120	8.3	260	2,400 (1)
Menlo Park PS	B-6-2b	540	9.1	100	68
Test Method		**CT 532**	**CT 532**	**CT 417**	**CT 422**
Detection Limit		**-**	**-**	**15**	**15**

(1) Detection limit elevated to 75 mg/kg due to dilution

* Smaller box used as limited amount of soil.

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File No. 4520.0

October 2013

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South Bayside System Authority
Pump Station Predesign
San Mateo County, California

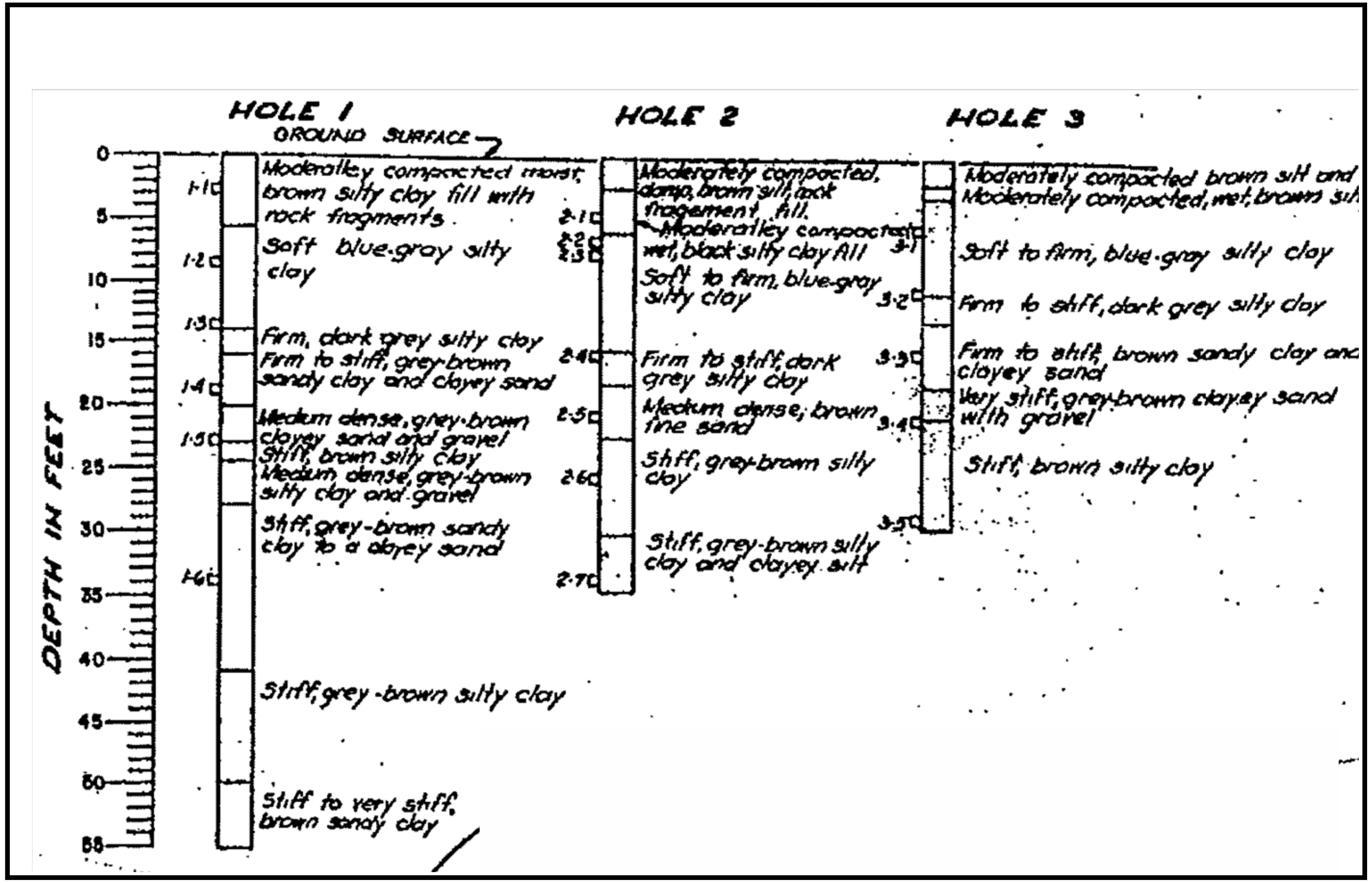
Corrosion

Figure

C-6

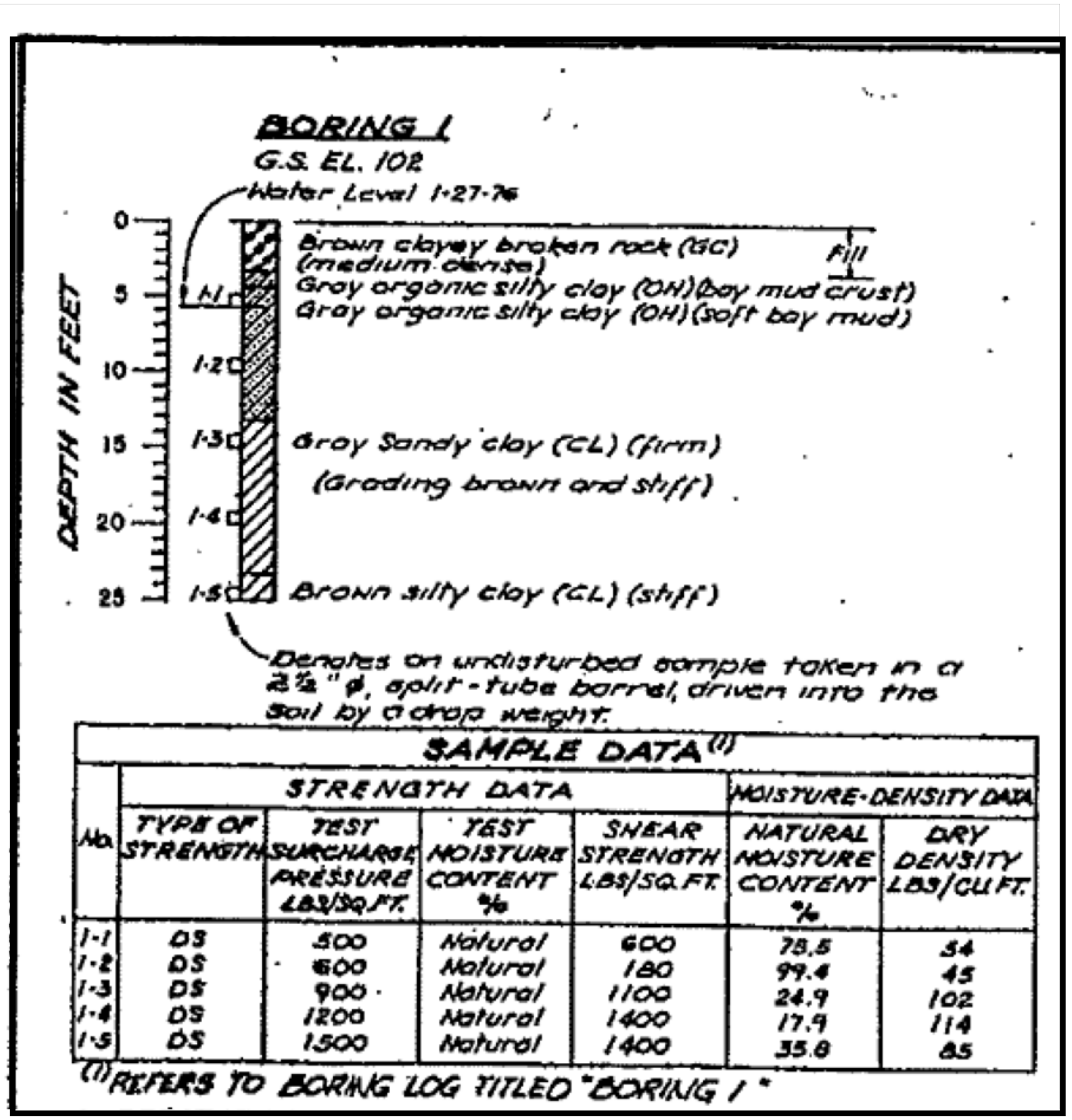
Appendix D

Reference Boring RB-1 **Reference Boring RB-2** **Reference Boring RB-3**



Reference: Holes 1, 2 and 3, Woodward Clyde - Sherard adn Associates, March 27, 1957.

Reference Boring RB-4



SAMPLE DATA(1)

No.	STRENGTH DATA				MOISTURE-DENSITY DATA	
	TYPE OF STRENGTH	TEST SURCHARGE PRESSURE LBS/SQ.FT.	TEST MOISTURE CONTENT %	SHEAR STRENGTH LBS/SQ.FT.	NATURAL MOISTURE CONTENT %	DRY DENSITY LBS/CU.FT.
1-1	DS	500	Natural	600	78.5	54
1-2	DS	600	Natural	180	99.4	45
1-3	DS	900	Natural	1100	24.9	102
1-4	DS	1200	Natural	1400	17.9	114
1-5	DS	1500	Natural	1400	35.8	85

(1) REFERS TO BORING LOG TITLED "BORING 1"

Reference: Boring 1, Cooper-Clark Associates, February 3, 1976.

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File No. 4520.0 | October 2013

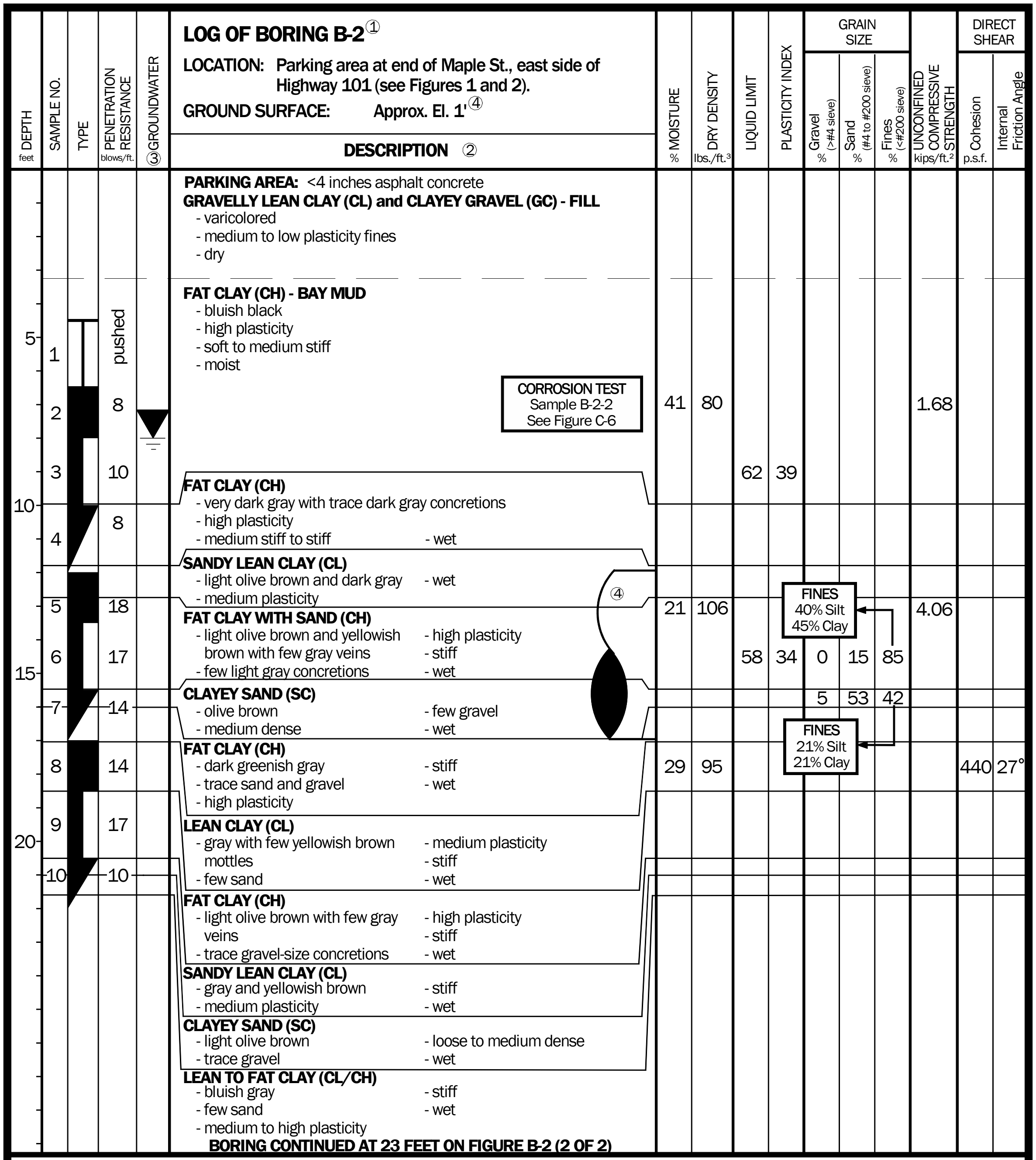
Brown and Caldwell
South Bayside System Authority
Pump Station Predesign
San Mateo County, California
PS3 (San Carlos PS)
Reference Borings 1, 2, 3 and 4

Figure
D-1

LOG OF BORING B-2①

LOCATION: Parking area at end of Maple St., east side of Highway 101 (see Figures 1 and 2).

GROUND SURFACE: Approx. El. 1'④



DESCRIPTION ②

PARKING AREA: <4 inches asphalt concrete
GRAVELLY LEAN CLAY (CL) and CLAYEY GRAVEL (GC) - FILL
- varicolored
- medium to low plasticity fines
- dry

FAT CLAY (CH) - BAY MUD
- bluish black
- high plasticity
- soft to medium stiff
- moist

FAT CLAY (CH)
- very dark gray with trace dark gray concretions
- high plasticity
- medium stiff to stiff - wet

SANDY LEAN CLAY (CL)
- light olive brown and dark gray - wet
- medium plasticity

FAT CLAY WITH SAND (CH)
- light olive brown and yellowish brown with few gray veins - high plasticity
- few light gray concretions - stiff - wet

CLAYEY SAND (SC)
- olive brown - few gravel
- medium dense - wet

FAT CLAY (CH)
- dark greenish gray - stiff
- trace sand and gravel - wet
- high plasticity

LEAN CLAY (CL)
- gray with few yellowish brown mottles - medium plasticity - stiff
- few sand - wet

FAT CLAY (CH)
- light olive brown with few gray veins - high plasticity - stiff
- trace gravel-size concretions - wet

SANDY LEAN CLAY (CL)
- gray and yellowish brown - stiff
- medium plasticity - wet

CLAYEY SAND (SC)
- light olive brown - loose to medium dense
- trace gravel - wet

LEAN TO FAT CLAY (CL/CH)
- bluish gray - stiff
- few sand - wet
- medium to high plasticity

BORING CONTINUED AT 23 FEET ON FIGURE B-2 (2 OF 2)

SAMPLE NO.	PENETRATION RESISTANCE blows/ft.	MOISTURE %	DRY DENSITY lbs./ft.³	LIQUID LIMIT	PLASTICITY INDEX	Gravel (>#4 sieve) %	Sand (#4 to #200 sieve) %	Fines (<#200 sieve) %	UNCONFINED COMPRESSIVE STRENGTH kips/ft.²	Cohesion p.s.f.	Internal Friction Angle
1	pushed										
2	8	41	80						1.68		
3	10			62	39						
4	8										
5	18	21	106						4.06		
6	17			58	34	0	15	85			
7	14					5	53	42			
8	14	29	95							440	27°
9	17										
10	10										

NOTES
① Drilled 10/21/10 using a Mobile B-24, 5" diameter solid stem augers, and a 30" drop by 140 lb. cathead sampling hammer.
② See report text and plates in Appendices A and C for definitions, lab test results, and additional soil descriptions.
③ Free groundwater level encountered at 8' after drilling. Static equilibrium groundwater depth is unknown at this time.
④ Projected elevation, structure, and new 60-inch pipeline depth data from RMC (see Figure 2).

GEOENGINEERS

File No. 19418-001-00 | December 2010

RMC Water and Environment
City of Redwood City
Walnut Street Interceptor Replacement Project
Redwood City, California
Log of Boring B-2

Figure
B-2
(1 of 2)

Reference: Log of Boring B-2, City of Redwood City Walnut Street Interceptor Replacement Project (GeoEngineers, 2010) - Figure 1 of 2.

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File No. 5003.0 | October 2013

Brown and Caldwell
South Bayside System Authority
Pump Station Predesign
San Mateo County, California
PS2 (Redwood City PS)
Reference Boring 1

Figure
D-2
(1 of 2)

LOG OF BORING B-2 (Continued)①

DEPTH feet	SAMPLE NO.	TYPE	PENETRATION RESISTANCE blows/ft.	GROUNDWATER	DESCRIPTION	MOISTURE %	DRY DENSITY lbs./ft.³	LIQUID LIMIT	PLASTICITY INDEX	GRAIN SIZE Gravel (>#4 sieve) %	GRAIN SIZE Sand (#4 to #200 sieve) %	GRAIN SIZE Fines (<#200 sieve) %	UNCONFINED COMPRESSIVE STRENGTH kips/ft.²	DIRECT SHEAR Cohesion p.s.f.	DIRECT SHEAR Internal Friction Angle
					BORING CONTINUED FROM 23 FEET ON FIGURE B-2 (2 OF 2)										
25	11		10		**SANDY LEAN CLAY (CL) and LEAN TO FAT CLAY WITH SAND (CL/CH)** - brownish yellow with few gray spots - medium to high plasticity - medium stiff - wet	25	101								
30	12		13		**SANDY LEAN CLAY (CL)** - brownish yellow - trace gravel - medium plasticity - medium stiff to stiff - stiff - wet	21	114								
	13A		-⑤		**WELL-GRADED SAND (SW)** - varicolored - few gravel - medium dense - wet										
35	13B		27		**POORLY GRADED SAND WITH SILT (SP-SM)** - varicolored - medium dense - wet					12	81	7			
	14		10		**SILTY LEAN CLAY (CL)** - gray - medium plasticity - stiff - wet										
40					**BOTTOM OF BORING AT 40 FEET**										
45															
50															

Borehole sloughing below 30½ (see table below)

SLOUGH DEPTHS ON SAMPLING

Sample No.	Slough Depth*
2-13A	36"
2-13B	14"
2-14	54"

*- slough depth measured from intended sample depth.

NOTES
① See Notes 1 - 4 on Figure B-2 (1 of 2).
⑤ No blow count recorded for Sample 13A due to slough infilling of sample barrel before driving.

GEOENGINEERS

File No. 19418-001-00 | December 2010

RMC Water and Environment
City of Redwood City
Walnut Street Interceptor Replacement Project
Redwood City, California
Log of Boring B-2

Figure
B-2
(2 of 2)

Reference: Log of Boring B-2, City of Redwood City Walnut Street Interceptor Replacement Project (GeoEngineers, 2010)

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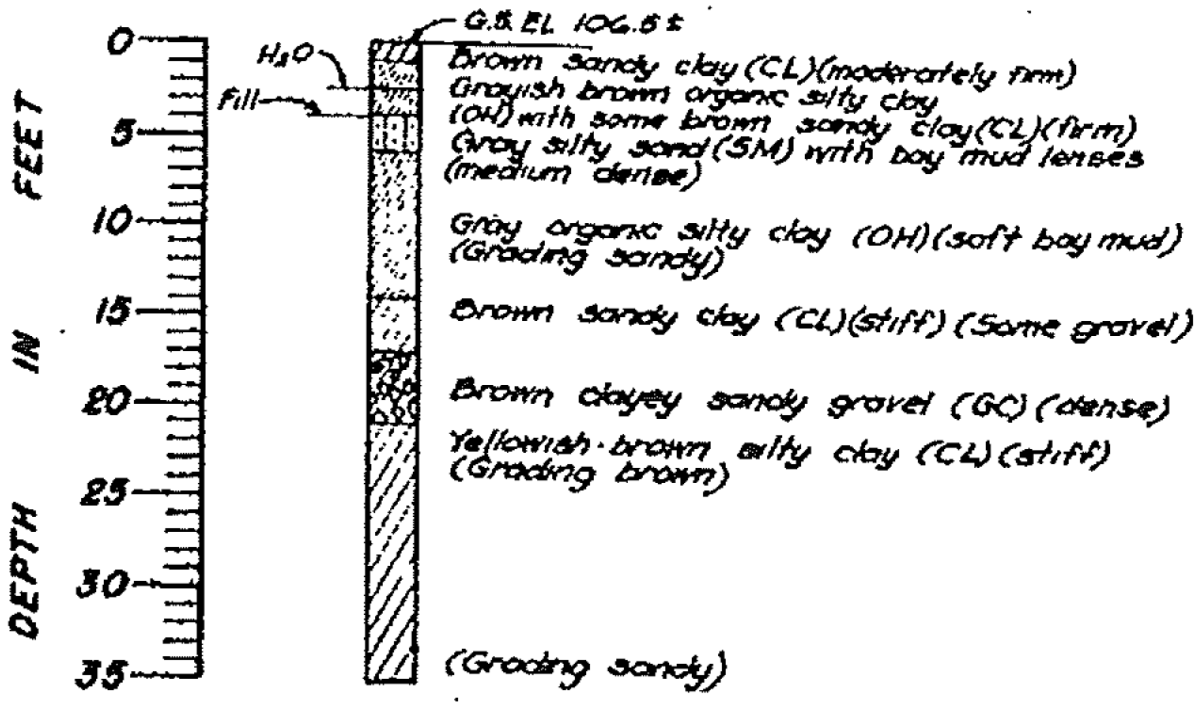
File No. 5003.0 | October 2013

Brown and Caldwell
South Bayside System Authority
Pump Station Predesign
San Mateo County, California
PS2 (Redwood City PS)
Reference Boring 1 (con't)

Figure
D-2
(2 of 2)

BORING LOG NO. 3 TAKEN 1/15/73



Reference: Boring No. 3, Belmont Pump Station Plant Layouts, Jenks & Harrison (8-77/9/79)

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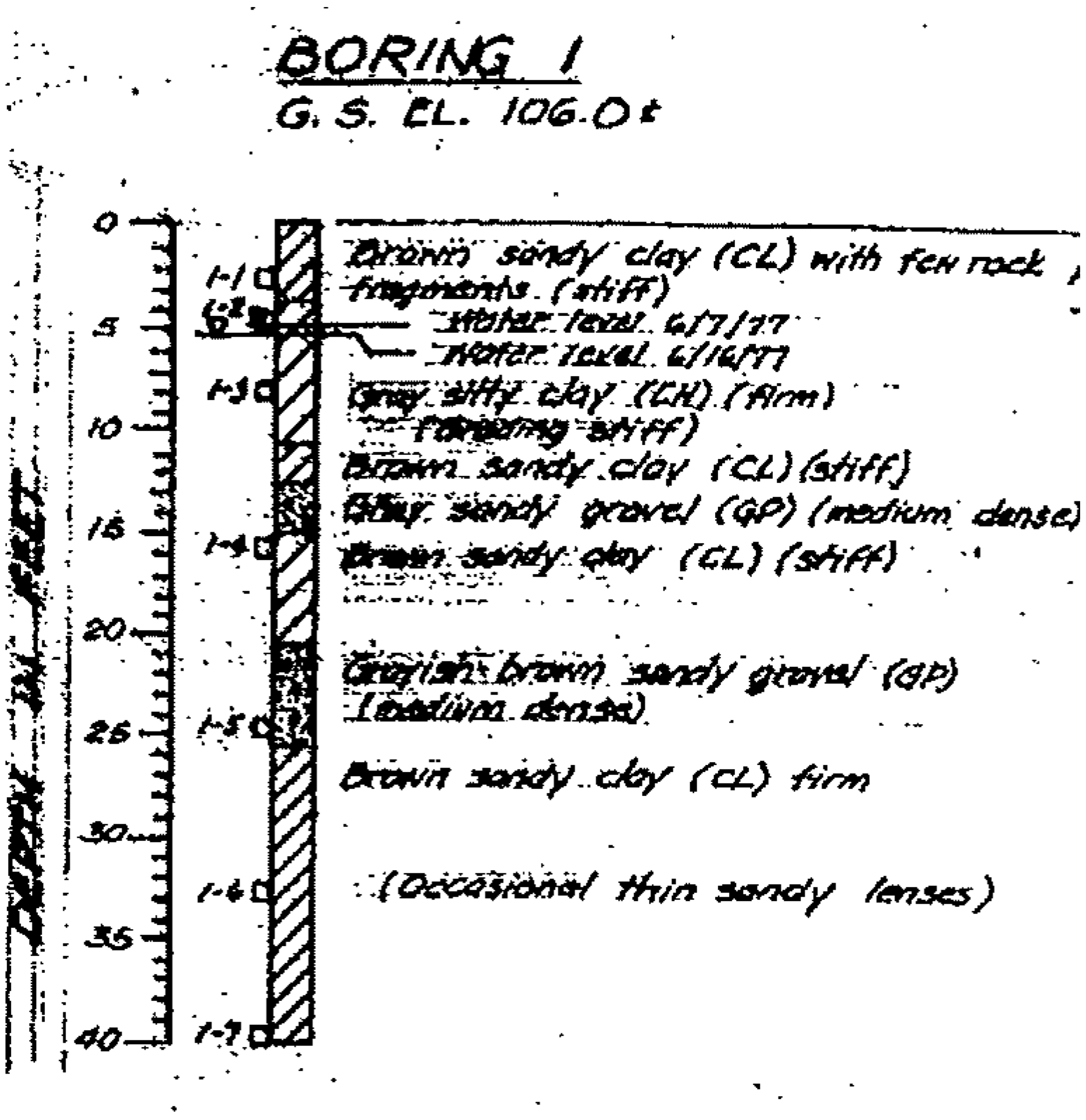
Brown and Caldwell
South Bayside System Authority
Pump Station Predesign
San Mateo County, California

Belmont Gravity Sewer
Reference Boring 1

Figure
D-3



Reference: Boring 1, Menlo Park Pump Station, Cooper-Clark Assocaites (1977)

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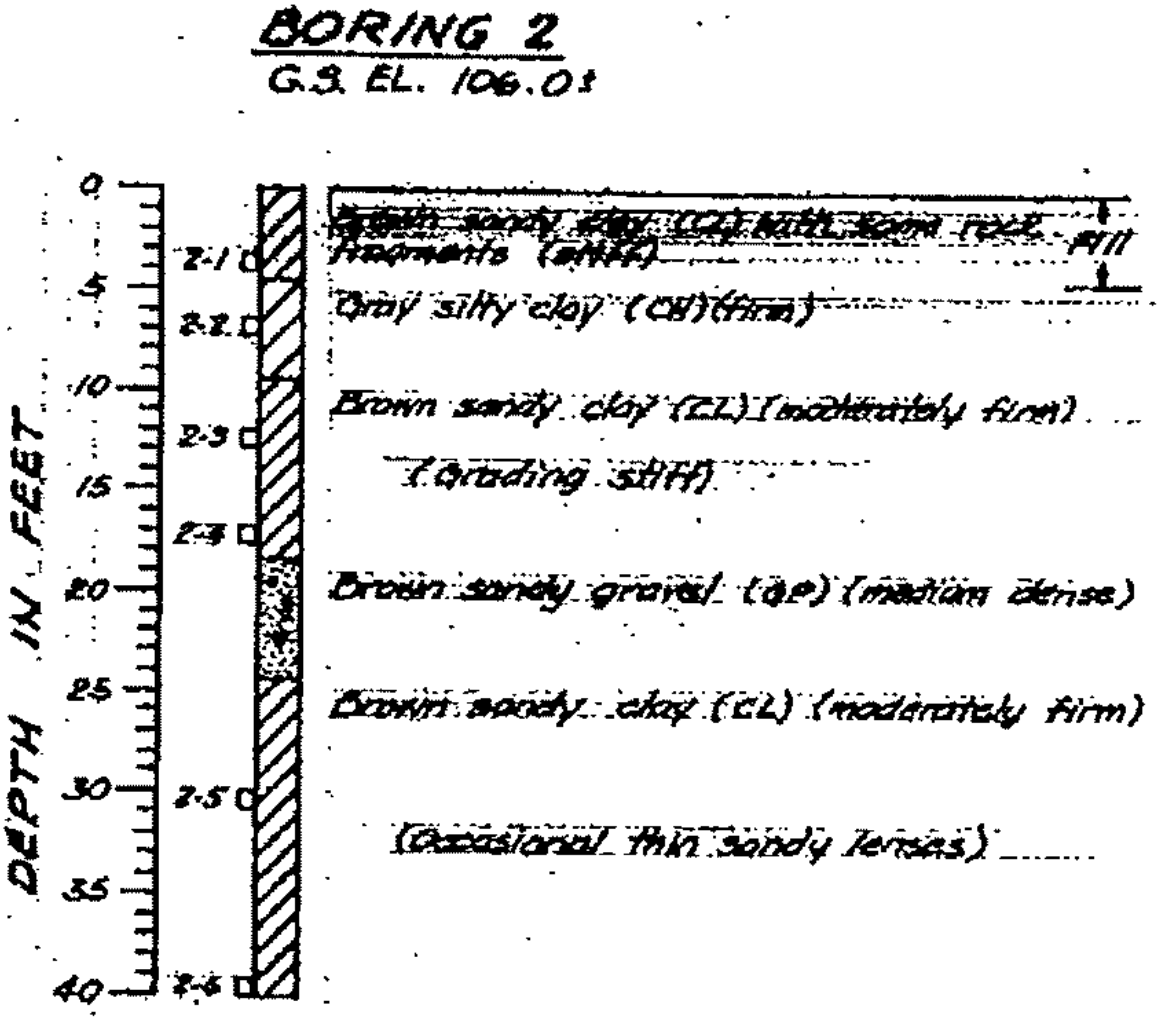
Brown and Caldwell
South Bayside System Authority
Pump Station Predesign
San Mateo County, California
PS1 (Menlo Park PS)
Reference Boring 1

Figure
D-4
(1 of 2)



Reference: Boring 2, Menlo Park Pump Station, Cooper-Clark Assocaites (1977)

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File No. 5003.0

October 2013

Brown and Caldwell
South Bayside System Authority
Pump Station Predesign
San Mateo County, California

PS1 (Menlo Park PS)
Reference Boring 2

Figure

D-4

(2 of 2)

Appendix D: Draft Predesign Geotechnical Interpretive Report

DCM Consulting, Inc., November 25, 2013

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DCM Consulting, Inc.

P.O. Box 225, Lafayette, CA 94549, Telephone: 925.322.9590
www.dcmconsults.com

Draft Technical Memorandum

To: Charlie Joyce
Brown and Caldwell

Date: November 25, 2013

From: Dave Mathy
DCM Consulting, Inc.

File: No. 111

Subject: Draft Predesign Geotechnical
Interpretive Report (GIR)
South Bayside System Authority
Pump Station Predesign
CIP #7010
Task Order No. 2012-01

Reference A: Geotechnical Data Report
South Bayside System Authority
Predesign of Planned Pump Stations
Redwood City, San Carlos and Menlo Park, California
By: Jacobs Associates
Dated: October 22, 2013

Reference B: Conceptual Design of Pump Stations and Flow
Equalization Facility
South Bayside System Authority
San Mateo County, California
By: DCM/GeoEngineers
Dated: September 15, 2009

1.0 INTRODUCTION

This technical memorandum presents the Pre-Design Geotechnical Interpretive Report (GIR) completed by DCM Consulting, Inc. for South Bayside System Authority's (SBSA) Pump Station Predesign Project (CIP #7010). This GIR is based on project information provided by Brown and Caldwell and on a Predesign Geotechnical Data Report (GDR) completed for the project by Jacobs Associates (Reference A). This pump station predesign project is part of SBSA's overall system-wide capital improvements program and includes the following specific elements:

- Pump Station 1 (PS1), a new sanitary sewer pump station at the site of SBSA's existing Menlo Park pump station;
- Pump Station 2 (PS2), a new sanitary sewer pump station at the site of SBSA's existing Redwood City pump station;
- Pump Station 3 (PS3), a new sanitary sewer pump station at the site of SBSA's existing San Carlos pump station; and

- A new gravity sewer pipeline (Belmont Gravity Sewer), between SBSA's existing Belmont pump station and PS3.

The predesign GDR completed by Jacobs Associates includes one test boring to 50 feet deep at PS1, PS2 and PS3 and three test borings to depths of 25 to 45 feet deep along the Belmont Gravity Sewer alignment. The pump stations will include a deep pump station structure as well as surface and near surface to intermediate depth structures including: fuel storage pad (at surface), chemical storage pad (at surface), electrical transformer pad (at surface), surge control tank (at surface at PS2 and PS3 only), valve vault (about 10 to 12 feet deep), flow meter vault (about 10 to 12 feet deep), and manhole/flow control structure (about 5 to 6 feet shallower than the bottom of the pump station wet well excavation). The Belmont Gravity Sewer will be a 36-inch-inside-diameter pipeline approximately 4,400 feet long with invert depths of about 22.5 feet to 27 feet. Based on the depth to invert, surface and existing utility constraints, soil and groundwater conditions and SBSA experience, the Belmont Gravity Sewer will be installed by microtunnel pipe jacking. Microtunneling will require up to 9 shafts for an average shaft spacing and microtunnel drive length of about 550 feet. The gravity pipeline will allow for direct jacking of the product pipe (i.e., single-pass installation, no casing). The following Table No. 1 summarizes the main project components with depth of excavations and geotechnical conditions (geotechnical conditions from the boring logs and laboratory test results in the GDR, Reference A).

Table 1 – Summary of Subsurface Conditions

	Max. Depth of Excav.[1]	**Ref. Boring**	**Depth to Ground-water**[2]	**Fill Thick-ness**	**YBM**[3]	**Soil at and below Base of Max. Excavation**			
						Description	**Average N-value**[4]	**Su**[5]	**OCR**[6]
PS1	26 ft.	B-6	5 ft.	5 ft.	N.E.[7]	Fat Clay (CH)	13 (stiff)	1,500 psf	1.8
PS2	30 ft.	B-2	14.5 ft.	5.5 ft.	N.E.	Lean Clay (CL)	13 (stiff)	1,500 psf	1.3
PS3	34 ft.	B-1	9 ft.	7.5 ft.	7.5 to 16.5 ft.	Lean Clay (CL)	13 (stiff)	(1,800 psf)	2.1
BGS[8]	23 to 27 ft.	B-3, B-4, B-5	11 ft., 8 ft., 7 ft.	2 to 5.5 ft.	2 to 16 ft.	Lean to Fat Clay (CL to CH)	12 (stiff)	(1,000 psf)	--

1. Below ground surface, rounded to the nearest foot.
2. At time of drilling, not equilibrium groundwater depth.
3. Young Bay Mud depth interval.
4. Standard Penetration Test Blow Count (ASTM D1586).
5. Undrained shear strength estimates by N-value or (measured in lab).
6. Over Consolidation Ratio (from consolidation tests).
7. Not encountered.
8. Belmont Gravity Sewer.

2.0 CONCLUSIONS AND RECOMMENDATIONS

2.1. General

Descriptions of individual pump station development history and geologic and seismic setting are contained in the Conceptual Design of Pump Stations and Flow Equalization Facility report by DCM/GeoEngineers (Reference B). The three project pump station sites; PS1 (Menlo Park), PS2 (Redwood City) and PS3 (San Carlos) as well as the Belmont Gravity Sewer are located on the western margin of San Francisco Bay within or immediately adjacent to reclaimed tidal flats. The tidal flat reclamation process started in about the 1930s and 1940s and included construction of drainage channels and levees and then placing artificial areal fills. All predesign test borings for the project encountered artificial fill (see Table 1). The composition and consistency of artificial fills is highly variable and can range from non-cohesive sands and gravels to cohesive clays with oversize natural and manmade materials (e.g., cobble to boulder size). Typically in this Bay margin area, the artificial fills are underlain by Young Bay Mud (YBM). YBM was encountered in test boring B-1 at PS3 (San Carlos) and in reference borings at PS3, reference Boring 1 at PS2 (Redwood City) and in B-4 and B-5 along the Belmont Gravity Sewer alignment and reference Boring 1 along the Belmont Gravity Sewer alignment. The project elements are at the fringe of YBM deposition over older alluvium and therefore YBM deposits, where encountered, are generally of limited thickness. The YBM soils are characterized by extremely high water content, low dry density, low shear strength and high compressibility. Where YBM was not encountered the shallow native soils immediately below artificial areal fills are typically of low quality in terms of strength and compressibility. The YBM is underlain by much stiffer (and older) alluvium referred to as Old Bay Clay. The Old Bay Clay is characterized by lower water content, higher dry density, higher shear strength and lower compressibility (see the descriptions of soils at and below the base of excavations in Table No. 1). The quality of soils (i.e., shear strength and compressibility) in all predesign test borings is noticeably of better consistency at depths of about 20 feet and greater composed predominantly of stiff lean to fat clays of the Old Bay Clay. The Old Bay Clays are known to contain strata of loose to dense sands of relatively high permeability that can transmit large volumes of groundwater and can be pressurized (i.e., artesian). These sand strata can be problematic with respect to excavation base stability and liquefaction settlement. Three of the predesign test borings did encounter limited strata (2 to 5.5 feet thick) of loose to medium dense, non-cohesive sands (see B-2 from about 18 to 23.5 feet, B-5 from about 32 to 34 feet, and B-6 from about 20 to 24 feet) within the Old Bay Clays. In addition, reference boring 1 at PS 2 (Redwood City) encountered a clean sand layer about 6.5 feet thick starting at a depth of about 30 feet. Gravels are occasionally encountered on a limited basis within the Old Bay Clays in the project areas (i.e., along the margin of San Francisco Bay and YBM deposition). Cobbles and boulders have not been encountered within the Old Bay Clays within this project's depths.

Groundwater was encountered in all predesign borings (see Table 1). However, the groundwater levels noted on the boring logs time of drilling measurements and are not stabilized, equilibrium groundwater levels. Along the project area equilibrium groundwater levels are typically at and above the contact between artificial fill and YBM or older alluvium. For design and construction purposes, the groundwater level should be assumed to be at the ground surface. Soils logged in the predesign borings of the GDR did not encounter sand/gravel strata that would be a source of artesian groundwater pressure below the base of excavations. However, reference boring 1 at PS 2 (Redwood City) did encounter a 6.5 foot thick layer of clean sand starting at a depth of about 30 feet. Recommendations for additional final design investigation to evaluate the presence of sand layers and artesian groundwater pressures are discussed in Section 2.6.

2.2. Pump Station and Microtunnel Shaft Excavations

Pump station excavations will vary in depth from 26 to 34 feet deep. Pump station pipeline and associated subsurface structure excavations will be variable but as much as 20 to 28 feet deep. Microtunnel shaft excavations will vary in depth from 26 to 30 feet deep. All project excavations will require vertical shoring (i.e., no side-sloped excavations). All project excavations can be made with appropriately sized conventional excavation equipment. Fill materials will be encountered including one, or a combination of,, the following:

- Areal fills placed as part of the 1930s and 1940s tidal flat reclamation projects. These fills are highly variable in composition and consistency and can contain oversize natural and manmade materials. For example, cobble and boulder size rocks from hillside bedrock excavations to the west and concrete rubble.

- Structure backfill around the existing three SBSA pump stations. These backfills can be granular and non-cohesive soils that are unstable in open cuts (i.e., no stand-up time) and can store and transmit large quantities of groundwater.

- Pipeline and utility trench backfill. Trench backfill and pipe bedding and pipe embedment materials are often granular and non-cohesive soils that are unstable in open cut (i.e., no stand-up time) and can store and transmit large quantities of groundwater.

Native soils below the artificial fill consist of either YBM or alluvium including Old Bay Clays. All soils within project excavations should be assumed to be consistent with Cal OSHA Type C soil. For purposes of shoring design, groundwater should be assumed to be at the ground surface. All project excavations must be fully shored and supported with “watertight” shoring such as internally braced interlocking sheetpiles. Any gaps in shoring, such as at pipeline penetrations, must be fully sealed to maintain excavations “watertightness”. Typical methods for sealing shoring gaps include grouting with jet grouting the preferred alternative. With a “watertight” shoring system, external dewatering should not be required. External dewatering is not advisable as it can cause subsidence of soft ground and settlement of nearby pipelines, utilities and structures. Internal dewatering can be kept to a minimum by establishing adequate toe embedment of sheetpiles to form a cutoff to groundwater inflows. The minimum toe embedment for sheetpiles in these soil and groundwater conditions is 15 feet below base of excavation.

Draft GIR Note: Additional recommendations for shoring pressure diagrams can be provided, if needed for project predesign.

2.3. Pump Station Structures

2.3.1. Deep Pump Station Structures

The following are the geotechnical design criteria used to develop foundation recommendations for deep pump station structures:

- The soil conditions at and below the base elevation of all three pump stations consists of stiff clays (Old Bay Clay) that will adequately support uniformly loaded mat foundations. Pile foundations are not required for the below grade pump stations. Assume mat foundation design for all three pump stations.
- All compensated loading, no net positive loading (i.e. the applied mat foundation load is equal to or less than the effective weight of soil removed for each pump station).
- All pump station mat foundation settlement to be limited to less than 1 inch.
- Design for groundwater level at the ground surface.

2.3.1.1. PS1 – Menlo Park Pump Station

1. Allowable mat bearing pressure (DL = LL) = 1,800 psf with a one-third increase for transient seismic loads.
2. Modulus of subgrade reaction (k) = 75 tcf. This k value is for a 1’ x 1’ steel plate and must be modified for mat size (e.g. see “Foundation Size Effect on Modulus of Subgrade Reaction in Clayey Soil” by Moayed and Janbaz).
3. Poisson’s Ratio = 0.50
4. Young’s Modulus = 900,000 psf.
5. Applied static lateral pressure for pump station walls, use At-rest earth pressure plus hydrostatic pressure = 95 pcf triangular loading.
6. Applied surcharge loading = 240 psf rectangular loading from the ground surface to 10 feet deep and 100 psf from 10 feet to 20 feet deep.
7. Seismic design, site classification = Site Class D.
8. Applied dynamic earth pressure (seismic loading) = 20 x H psf rectangular loading where H is the wall height. Apply resultant between 0.50 and 0.60 up from base of wall.
9. Ultimate Passive earth pressure = 150 pcf.
10. Coefficient of base friction at mat to native soil contact = 0.30.

11. For structure buoyancy, assume that groundwater is at the ground surface. To resist buoyancy, the buoyant weight of pump station backfill above a foundation lip may be taken as 80 pcf (assumes aggregate backfill) and the coefficient of friction between the pump station backfill and pump station wall may be taken as 0.35 (assumes aggregate backfill). The minimum factor of safety against buoyant uplift should be 1.5.

2.3.1.2. PS 2 – Redwood City Pump Station

1. Allowable mat bearing pressure (DL = LL) = 2,100 psf with a one-third increase for transient seismic loads.

2. Modulus of subgrade reaction (k) = 75 tcf. This k value is for a 1’ x 1’ steel plate and must be modified for mat size (e.g. see “Foundation Size Effect on Modulus of Subgrade Reaction in Clayey Soil” by Moayed and Janbaz).

3. Poisson’s Ratio = 0.50

4. Young’s Modulus = 900,000 psf.

5. Applied static lateral pressure for pump station walls, use At-rest earth pressure plus hydrostatic pressure = 90 pcf triangular loading.

6. Applied surcharge loading = 240 psf rectangular loading from the ground surface to 10 feet deep and 100 psf from 10 feet to 20 feet deep.

7. Seismic design, site classification = Site Class D.

8. Applied dynamic earth pressure (seismic loading) = 20 x H psf rectangular loading where H is the wall height. Apply resultant between 0.50 and 0.60 up from base of wall.

9. Ultimate Passive earth pressure = 200 pcf.

10. Coefficient of base friction at mat to native soil contact = 0.40.

11. For structure buoyancy, assume that groundwater is at the ground surface. To resist buoyancy, the buoyant weight of pump station backfill above a foundation lip may be taken as 80 pcf (assumes aggregate backfill) and the coefficient of friction between the pump station backfill and pump station wall may be taken as 0.35 (assumes aggregate backfill). The minimum factor of safety against buoyant uplift should be 1.5.

2.3.1.3. PS 3 – San Carlos Pump Station

1. Allowable mat bearing pressure (DL = LL) = 2,400 psf with a one-third increase for transient seismic loads.

2. Modulus of subgrade reaction (k) = 75 tcf. This k value is for a 1′ x 1′ steel plate and must be modified for mat size (e.g. see "Foundation Size Effect on Modulus of Subgrade Reaction in Clayey Soil" by Moayed and Janbaz).

3. Poisson's Ratio = 0.50

4. Young's Modulus = 900,000 psf.

5. Applied static lateral pressure for pump station walls, use At-rest earth pressure plus hydrostatic pressure = 105 pcf triangular loading.

6. Applied surcharge loading = 240 psf rectangular loading from the ground surface to 10 feet deep and 100 psf from 10 to 20 feet deep.

7. Seismic design, site classification = Site Class D.

8. Applied dynamic earth pressure (seismic loading) = 20 x H psf rectangular loading where H is the wall height. Apply resultant between 0.50 and 0.60 up from base of wall.

9. Ultimate Passive earth pressure = 100 pcf.

10. Coefficient of base friction at mat to native soil contact = 0.30.

11. For structure buoyancy, assume that groundwater is at the ground surface. To resist buoyancy, the buoyant weight of pump station backfill above a foundation lip may be taken as 80 pcf (assumes aggregate backfill) and the coefficient of friction between the pump station backfill and pump station wall may be taken as 0.35 (assumes aggregate backfill). The minimum factor of safety against buoyant uplift should be 1.5.

2.3.2. At-Grade, Near-Grade or Intermediate-Grade Pump Station Structures

The following are the geotechnical design criteria used to develop foundation recommendations for at-grade, near grade or intermediate grade structures at the pump stations:

- All structures to be supported by mat foundations. Pile foundations are not required for relatively light at-grade structures.

- All mat and structure foundation settlement to be limited to less than 1 inch.

- Design groundwater elevation will be at the ground surface.

2.3.2.1. PS 1 – Menlo Park Pump Station

1. For mat foundations at the ground surface (i.e. fuel storage pad, chemical storage pad, electric transformer pad):

   a. Surficial soils consist of about 5 feet of areal fill composed of medium dense Clayey Sand with Gravel (SC) (see B-6 in GDR). All mat foundations at the ground surface must be underlain by a minimum of 18 inches of Class 2 aggregate base rock compacted to a minimum of 95% relative compaction. The Class 2 aggregate base rock to extend a minimum of 2 feet beyond the perimeter of the mats.

   b. Allowable mat bearing pressure (DL + LL) = 1,000 psf with a one-third increase for transient wind and seismic loads.

   c. Modulus of subgrade reaction (k) = 50 tcf. This k value is for a 1' x 1' steel plate and must be modified for mat size (e.g. see "Foundation Size Effect on Modulus of Subgrade Reaction in Clay Soils" by Moayed and Janbez).

   d. Poisson's Ratio = 0.40.

   e. Young's Modulus = 600,000 psf.

   f. Ultimate coefficient of base friction = 0.35.

   g. Seismic design, Site Classification = Site Class D.

2. For the valve vault and flow meter structures (about 10 to 12 feet deep):

   a. At 10 to 12 feet deep the valve vault and flow meter vault will be directly underlain by medium stiff Fat Clay (CH) to loose Clayey Sand (SC) (see B-6 in GDR). The vaults must be underlain by a minimum of 6 inches of Class 2 aggregate base rock which is in turn underlain by a minimum of 12 inches of foundation rock (¾-inch by 1½-inch crushed rock) wrapped with non-woven geotextile filter fabric. Foundation rock to be compacted in place by a minimum of 3 passes of a vibra-plate compactor. Class 2 aggregate base rock to be compacted to a minimum of 95% relative compaction.

   b. Allowable vault bearing pressure (DL + LL) = 800 psf with a one-third increase for seismic loads.

   c. Modulus of subgrade reaction (k) = 25 tcf. Modify for vault size per note 1.c.

   d. Poisson's ratio = 0.50.

   e. Young's modulus = 600,000 psf.

   f. Applied static lateral earth pressure on vault walls, use at-rest earth pressure plus hydrostatic pressure = 95 pcf triangular loading.

   g. Applied surcharge loading = 240 psf rectangular loading from the ground surface to 10 feet deep and 100 psf from 10 to 20 feet deep.

  h. Applied dynamic earth pressure (seismic loading) = 20 x H psf rectangular loading where H = vault depth. Apply resultant between 0.5 and 0.6H up from the base of the vault.

  i. Seismic design, site classification = Site Class D.

  j. Ultimate passive earth pressure = 150 pcf triangular loading.

  k. Ultimate coefficient of base friction = 0.30.

  l. For vault buoyancy, assume that groundwater is at the ground surface. To resist buoyancy, the buoyant weight of the vault backfill above a foundation lip may be taken as 80 pcf (assumes aggregate backfill) and the coefficient of friction between the vault backfill and the vault walls may be taken as 0.35 (assumes aggregate backfill). The minimum factor of safety against buoyant uplift should be 1.5.

3. For the manhole/flow control structure (about 5 to 6 feet shallower than the bottom of wet well excavation:

  a. At 5 to 6 feet above the bottom of the wet well excavation the manhole/flow control structure will be directly underlain by loose to medium dense Sand (SW-SM) (see B-6 in the GDR). The manhole/flow control structure must be underlain by a minimum of 6 inches of Class 2 aggregate base rock which is in turn underlain by a minimum of 12 inches of foundation rock (¾-inch by 1½-inch crushed rock) wrapped in non-woven geotextile filter fabric. Foundation rock to be compacted in place buy a minimum of 3 passes of a vibra-plate compactor. Class 2 aggregate base rock to be compacted to a minimum of 95% relative compaction.

  b. Allowable manhole/flow control structure bearing pressure (DL + LL) = 1,400 psf with a one-third increase for seismic loads.

  c. Modulus of subgrade reaction (k) = 25 tcf. Modify for manhole/flow control structure size per note 1.c.

  d. Poisson's ratio = 0.50.

  e. Young's modulus = 600,000 psf.

  f. Applied static lateral earth pressure on the manhole/flow control structure walls, use at-rest earth pressure plus hydrostatic pressure = 95 pcf triangular distribution.

  g. Applied surcharge loading = 240 psf rectangular loading from the ground surface to 10 feet deep and 100 psf from 10 to 20 feet deep.

   h. Applied dynamic earth pressure (seismic loading) = 20 x H psf rectangular loading where H = manhole/flow control structure depth. Apply resultant between 0.5 and 0.6H up from the base of the manhole/flow control structure.

   i. Seismic design, site classification = Site Class D.

   j. Ultimate passive earth pressure = 150 pcf triangular loading.

   k. Ultimate coefficient of base friction = 0.30.

   l. For manhole/flow control structure buoyancy, assume that groundwater is at the ground surface. To resist buoyancy, the buoyant unit weigh of the manhole/flow control structure backfill above a foundation lip may be taken as 80 pcf (assumes aggregate backfill) and the coefficient of friction between the manhole/flow control structure backfill and manhole/flow control structure walls may be taken as 0.35 (assumes aggregate backfill). The minimum factor of safety against buoyant uplift should be 1.5.

2.3.2.2. PS 2 – Redwood City Pump Station

1. For mat foundations at the ground surface (i.e. fuel storage pad, chemical storage pad, electric transformer pad, surge control tank):

   a. Surficial soils consist of about 5.5 feet of areal fill composed of medium stiff to loose Lean to Fat Clay (CL/CH) and Clayey Sand (SC) (see B-2 in the GDR). All mat foundations at the ground surface must be underlain by a minimum of 18 inches of Class 2 aggregate base rock compacted to a minimum of 95% relative compaction. The Class 2 aggregate base rock to extend a minimum of 2 feet beyond the perimeter of the mat.

   b. Allowable mat bearing pressure (DL + LL) = 1,000 psf with a one-third increase for transient wind and seismic loads.

   c. Modulus of subgrade reaction (k) = 50 tcf. This k value is for a 1' x 1' steel plate and must be modified for mat size (e.g. see "Foundation Size Effect on Modulus of Subgrade Reaction in Clay Soils" by Moayed and Janbez).

   d. Poisson's Ratio = 0.40

   e. Young's Modulus = 600,000 psf.

   f. Ultimate coefficient of base friction = 0.30.

   g. Seismic design, Site Classification = Site Class D.

2. For the valve vault and flow meter structures (about 10 to 12 feet deep):

a. At 10 to 12 feet deep the valve vault and flow meter vault will be directly underlain by stiff Fat Clay (CH) (see B-2 in GDR). The vaults must be underlain by a minimum of 6 inches of Class 2 aggregate base rock which is in turn underlain by a minimum of 12 inches of foundation rock (¾-inch by 1½-inch crushed rock) wrapped with non-woven geotextile filter fabric. Foundation rock to be compacted in place by a minimum of 3 passes of a vibra-plate compactor. Class 2 aggregate base rock to be compacted to 95% relative compaction.

b. Allowable vault bearing pressure (DL + LL) = 800 psf with a one-third increase for seismic loads.

c. Modulus of subgrade reaction (k) = 75 tcf. Modify for vault size per note 1.c.

d. Poisson's ratio = 0.50.

e. Young's modulus = 900,000 psf.

f. Applied static lateral earth pressure on vault walls, use at-rest earth pressure plus hydrostatic pressure = 90 pcf triangular loading.

g. Applied surcharge loading = 240 psf rectangular loading from the ground surface to 10 feet deep and 100 psf from 10 to 20 feet deep.

h. Applied dynamic earth pressure (seismic loading) = 20 x H psf rectangular loading where H = vault depth. Apply resultant between 0.5 and 0.6H up from the base of the vault.

i. Seismic design, site classification = Site Class D.

j. Ultimate passive earth pressure = 200 pcf triangular loading.

k. Ultimate coefficient of base friction = 0.30.

l. For vault buoyancy, assume that groundwater is at the ground surface. To resist buoyancy, the buoyant weight of the vault backfill above a foundation lip may be taken as 80 pcf (assumes aggregate backfill) and the coefficient of friction between the vault backfill and the vault walls may be taken as 0.35 (assumes aggregate backfill). The minimum factor of safety against buoyant uplift should be 1.5.

3. For the manhole/flow control structure (about 5 to 6 feet shallower than the bottom of wet well excavation:

   a. At 5 to 6 feet above the bottom of the wet well excavation the manhole/flow control structure will be directly underlain by stiff Clayey Sand to Sandy Fat Clay (SC/CH) (see B-2 in the GDR). The manhole/flow control structure must be underlain by a minimum of 6 inches of Class 2 aggregate base rock which is in turn underlain by a minimum of 12 inches of foundation rock (¾-inch by 1½-inch crushed rock) wrapped in non-woven geotextile filter fabric. Foundation rock to be compacted in place buy a minimum of 3 passes of a vibra-plate compactor. Class 2 aggregate base rock to be compacted to a minimum of 95% relative compaction.

b. Allowable manhole/flow control structure bearing pressure (DL + LL) = 1,700 psf with a one-third increase for seismic loads.

c. Modulus of subgrade reaction (k) = 75 tcf. Modify for manhole/flow control structure size per note 1.c.

d. Poisson's ratio = 0.50.

e. Young's modulus = 900,000 psf.

f. Applied static lateral earth pressure on the manhole/flow control structure walls, use at-rest earth pressure plus hydrostatic pressure = 90 pcf triangular distribution.

g. Applied surcharge loading = 240 psf from the ground surface to 10 feet deep and 100 psf from 10 to 20 feet deep.

h. Applied dynamic earth pressure (seismic loading) = 20 x H psf rectangular loading where H = manhole/flow control structure depth. Apply resultant between 0.5 and 0.6H up from the base of the manhole/flow control structure.

i. Seismic design, Site Classification = Site Class D.

j. Ultimate passive earth pressure = 200 pcf triangular loading.

k. Ultimate coefficient of base friction = 0.40.

l. For manhole/flow control structure buoyancy, assume that groundwater is at the ground surface. To resist buoyancy, the buoyant unit weigh of the manhole/flow control structure backfill above a foundation lip may be taken as 80 pcf (assumes aggregate backfill) and the coefficient of friction between the manhole/flow control structure backfill and manhole/flow control structure walls may be taken as 0.35 (assumes aggregate backfill). The minimum factor of safety against buoyant uplift should be 1.5.

2.3.2.3. PS 3 – San Carlos Pump Station

1. For mat foundations at the ground surface (i.e. fuel storage pad, chemical storage pad, electric transformer pad, surge control tank):

    a. Surficial soils consist of about 7.5 feet of areal fill composed of Clayey Sand (SC) to Sandy Lean Clay (CL). The areal fill is underlain by about 9 feet of soft Young Bay Mud.

(See B-1 in the GDR.) All mat foundations at the ground surface must be underlain by a minimum of 18 inches of Class 2 aggregate base rock compacted to a minimum of 95% relative compaction. The Class 2 aggregate base rock to extend a minimum of 2 feet beyond the perimeter of the mat.

   b. Allowable mat bearing pressure (DL + LL) = 500 psf with a one-third increase for transient wind and seismic loads.

   c. Modulus of subgrade reaction (k) = 50 tcf. This k value is for a 1' x 1' steel plate and must be modified for mat size (e.g. see "Foundation Size Effect on Modulus of Subgrade Reaction in Clay Soils" by Moayed and Janbez).

   d. Poisson's Ratio = 0.40.

   e. Young's Modulus = 600,000 psf.

   f. Ultimate coefficient of base friction = 0.30.

   g. Seismic design, Site Classification = Site Class D (the soft Young Bay Mud is less than 10 feet thick).

2. For the valve vault and flow meter structures (about 10 to 12 feet deep):

   a. At 10 to 12 feet deep the valve vault and flow meter vault will be directly underlain by soft Young Bay Mud (OH) (see B-1 in GDR). The vaults must be underlain by a minimum of 6 inches of Class 2 aggregate base rock which is in turn underlain by a minimum of 24 inches of foundation rock (¾-inch by 1½-inch crushed rock) wrapped with non-woven geotextile filter fabric. Foundation rock to be compacted in place by a minimum of 3 passes of a vibra-plate compactor in 12-inch lifts. Class 2 aggregate base rock to be compacted to a minimum of 95% relative compaction. Backfill around the valve vault and flow meter structure should consist of lightweight aggregate with a maximum saturated surface dry unit weight of 60 pcf. As an alternative to lightweight backfill, all YBM should be removed from below the structure and backfilled with foundation rock wrapped in nonwoven geotextile fabric.

   b. Allowable vault bearing pressure (DL + LL) = 500 psf with a one-third increase for seismic loads.

   c. Modulus of subgrade reaction (k) = 25 tcf. Modify for vault size per note 1.c.

   d. Poisson's ratio = 0.50

   e. Young's Modulus = 400,000 psf.

   f. Applied static lateral earth pressure on vault walls, use at-rest earth pressure plus hydrostatic pressure = 105 pcf triangular loading.

   g. Applied surcharge loading = 240 psf rectangular loading from the ground surface to 10 feet deep and 100 psf from 10 to 20 feet deep.

   h. Applied dynamic earth pressure (seismic loading) = 20 x H psf rectangular loading where H = vault depth. Apply resultant between 0.5 and 0.6H up from the base of the vault.

   i. Seismic design, Site Classification = Site Class D (the soft Young Bay Mud is less than 10 feet thick).

   j. Ultimate passive earth pressure = 100 pcf triangular loading.

   k. Ultimate coefficient of base friction = 0.20.

   l. For vault buoyancy, assume that groundwater is at the ground surface. To resist buoyancy, the buoyant weight of the vault backfill (assuming lightweight backfill) above a foundation lip should be taken as 0 pcf (i.e. no contribution from lightweight backfill weight) and the coefficient of friction between the vault backfill and the vault walls may be taken as 0.35 (assumes lightweight backfill). The minimum factor of safety against buoyant uplift should be 1.5.

3. For the manhole/flow control structure (about 5 to 6 feet shallower than the bottom of wet well excavation:

   a. At 5 to 6 feet above the bottom of the wet well excavation the manhole/flow control structure will be directly underlain by stiff Fat Clay (CH) (see B-1 in the GDR). The manhole/flow control structure must be underlain by a minimum of 6 inches of Class 2 aggregate base rock which is in turn underlain by a minimum of 12 inches of foundation rock (¾-inch by 1½-inch crushed rock) wrapped in non-woven geotextile filter fabric. Foundation rock to be compacted in place buy a minimum of 3 passes of a vibra-plate compactor. Class 2 aggregate base rock to be compacted to a minimum of 95% relative compaction.

   b. Allowable manhole/flow control structure bearing pressure (DL + LL) = 2,000 psf with a one-third increase for seismic loads.

   c. Modulus of subgrade reaction (k) = 75 tcf. Modify for manhole/flow control structure size per note 1.c.

   d. Poisson's ratio = 0.50.

   e. Young's modulus = 900,000 psf.

   f. Applied static lateral earth pressure on the manhole/flow control structure walls, use at-rest earth pressure plus hydrostatic pressure = 105 pcf triangular distribution.

g. Applied surcharge loading = 240 psf rectangular loading from the ground surface to 10 feet deep and 100 psf from 10 to 20 feet deep.

h. Applied dynamic earth pressure (seismic loading) = 20 x H psf rectangular loading where H = manhole/flow control structure depth. Apply resultant between 0.5 and 0.6H up from the base of the manhole/flow control structure.

i. Seismic design, Site Classification = Site Class D (the soft Young Bay Mud is less than 10 feet thick).

j. Ultimate passive earth pressure = 100 pcf triangular loading.

k. Ultimate coefficient of base friction = 0.30.

l. For manhole/flow control structure buoyancy, assume that groundwater is at the ground surface. To resist buoyancy, the buoyant unit weigh of the manhole/flow control structure backfill above a foundation lip may be taken as 80 pcf (assumes aggregate backfill) and the coefficient of friction between the manhole/flow control structure backfill and manhole/flow control structure walls may be taken as 0.35 (assumes aggregate backfill). The minimum factor of safety against buoyant uplift should be 1.5.

2.4. Pipelines

2.4.1. Pump Station Pipelines

Pump station pipelines will be founded at various elevations and will be underlain by a variety of soil conditions from fill to soft YBM to stiff Old Bay Clay. All pump station pipelines should be underlain by a minimum of 12 inches of foundation rock (¾-inch by 1½-inch crushed rock) wrapped in non-woven geotextile filter fabric. Foundation rock is to be compacted in place by a minimum of 3 passes of a vibra-plate compactor. Pipeline embedment material should extend from foundation rock to 12 inches over the top of pipeline. Pipe embedment material should consist of Class 2 aggregate base rock compacted to a minimum of 90% relative compaction. Trench backfill should also consist of Class 2 aggregate base rock compacted to 90% relative compaction except for PS3 (San Carlos) where shallow and intermediate depth pipelines (e.g., at valve vault and flow meter structures) will be underlain by YBM. At all locations where pipelines are underlain by YBM, trench backfill must consist of lightweight aggregate with a maximum saturated surface dry unit weight of 60 pcf. As an alternative to lightweight backfill, all YBM should be removed from below the pipeline and backfilled with foundation rock wrapped in nonwoven geotextile fabric.

All pump station pipelines should be designed to accommodate up to 1 inch of differential movement at the interface of the pump station structure and pipeline.

Draft GIR Note: This recommendation for pipeline flexibility at structure connections may be modified pending results of the liquefaction settlement analysis recommended in Section 2.6

Draft GIR Note: Additional recommendations for pipeline items such as external dead loads, live loads, E'c and thrust blocks, if needed, can be provided pending determination of pipe types. Also, will inlet/outlet force mains at the pump station structure interface include steel casings?

2.4.2. Belmont Gravity Sewer Pipeline

Based on geologic setting, experience in the project area and the pipe zone soils as described in the GDR, microtunnel pipe jacking is an appropriate and best trenchless method of installation for the Belmont Gravity Sewer. As discussed in Section 2.5, additional geotechnical information is needed for final microtunnel design and as a basis for contractor selection of project specific microtunneling means and methods (e.g., cutter face configuration, slurry pressures to counterbalance external hydrostatic groundwater pressure, front chamber soil cuttings pressure to counterbalance external earth pressures, slurry separation plant configuration, etc.).

2.5. Pavement

The asphalt pavement section at all pump stations should consist of a minimum of 3 inches of asphaltic concrete over 12 inches of Class 2 aggregate base rock. The pavement subgrade soil must be scarified to a depth of 8 inches, moisture conditioned to near optimum moisture content and compacted to a minimum of 95% relative compaction per ASTM D1557.

Asphalt pavement section replacement in City streets must match existing but in no case should be less than 3 inches of asphaltic concrete over 12 inches of aggregate base rock (compacted as described above).

2.6. Final Design

For final design of the three project pump stations, a minimum of two Cone Penetration Tests (CPT) to depths of 75 to 100 feet, or refusal, are recommended at each pump station site to generate a continuous soil profile and serve as the basis for liquefaction settlement analysis. (Recall loose sands encountered at B-5 and B-6 within the Old Bay Clay.) Pore pressure dissipation tests should be performed at all sand layers encountered to evaluate artesian groundwater pressures , if present. The CPT profile/data and seismic setting (i.e., site acceleration) can then be entered into the computer program LiquefyPro (or equivalent) to evaluate individual sand layers that are likely to liquefy and to estimate the resultant seismic settlement (if any) at the ground surface and at the base of the pump stations.

For final design of the Belmont Gravity Sewer, additional test borings must be drilled and sampled at all shaft locations and at mid-drive locations between shafts. Borings at shaft locations must be drilled to a minimum of 2 times shaft depth. Borings at mid-drive locations should be drilled to a minimum of 10 feet below pipeline invert. Of particular importance in this geologic setting is identification of any confined aquifers that could cause base failure of shaft excavations. In addition to final design test borings, the history of the pipeline alignment should be researched with respect to past land use and possible obstructions to microtunneling (e.g., pile foundation, tie-backs, steel well casing, etc.).

3.0 LIMITATIONS

This Technical Memorandum has been prepared for the exclusive use of Brown and Caldwell and SBSA for the Pump Station Predesign project as described herein. This Technical Memorandum may not be used for any other purpose or for any other project. Within the limitations of scope, schedule and budget, DCM Consulting, Inc.'s services have been provided in accordance with generally accepted practices in the field of geotechnical engineering for Geotechnical Report preparation in the San Francisco Bay Area at the time the investigation was completed. The conclusions and opinions presented in this Technical Memorandum are based on the author's professional knowledge, judgment and experience. No warranty or other conditions express or implied should be understood.

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G.E. 569

Draft GIR Note: This Draft GIR will be finalized pending DCM Consulting's review of the 90% Predesign Plans (for consistency between the GIR and Predesign plans) and receipt of Brown and Caldwell's and SBSA's draft review comments.

Appendix E: South Bayside System Authority Lift Station Soils Corrosivity Investigation

V&A Consulting Engineers, Inc., January 8, 2014

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V&A

TECHNICAL MEMORANDUM

South Bayside System Authority Lift Station Soils Corrosivity Investigation

Prepared for:	Charlie Joyce PE, Brown & Caldwell
Prepared by:	Matt Snow, V&A Brian Chapman, P.E., V&A
Reviewed by:	Keith Packard, P.E., V&A Glenn Willson, P.E., V&A
Date:	January 8, 2014

`These are Pump Stations, not lift station. Naming convention is PS1 for Menlo Park, PS2 for Redwood City, and PS3 for San Carlos/ Belmont`

INTRODUCTION

V&A was retained by Brown & Caldwell to perform a soil corrosivity investigation and make recommendations for corrosion control of the buried metallic yard piping at three South Bayside System Authority lift stations. The three lift stations are referred to as the Menlo Park Lift Station, the Redwood City Lift Station, and the San Carlos Lift Station and are located in their respective cities. The objectives of the investigation were to:

1) Perform field soil resistivity testing
2) Review existing corrosion data
3) Perform chemical analysis of selected soil samples
4) Provide corrosion control recommendations for the buried yard piping and concrete structures at each pump station

Based on the average field soil resistivity data, the soil at all three lift stations is *highly corrosive* to buried metallic piping. Recommendations for corrosion control and design of a corrosion control system are presented at the end of this memorandum.

In-situ resistivity of the soil was measured at two locations at each lift station on October 17, 2013.

A vicinity map of the three lift stations is shown in Figure 1. A map of resistivity test locations and soil sample boring locations for each lift station is shown in Figures 2a through 2c.

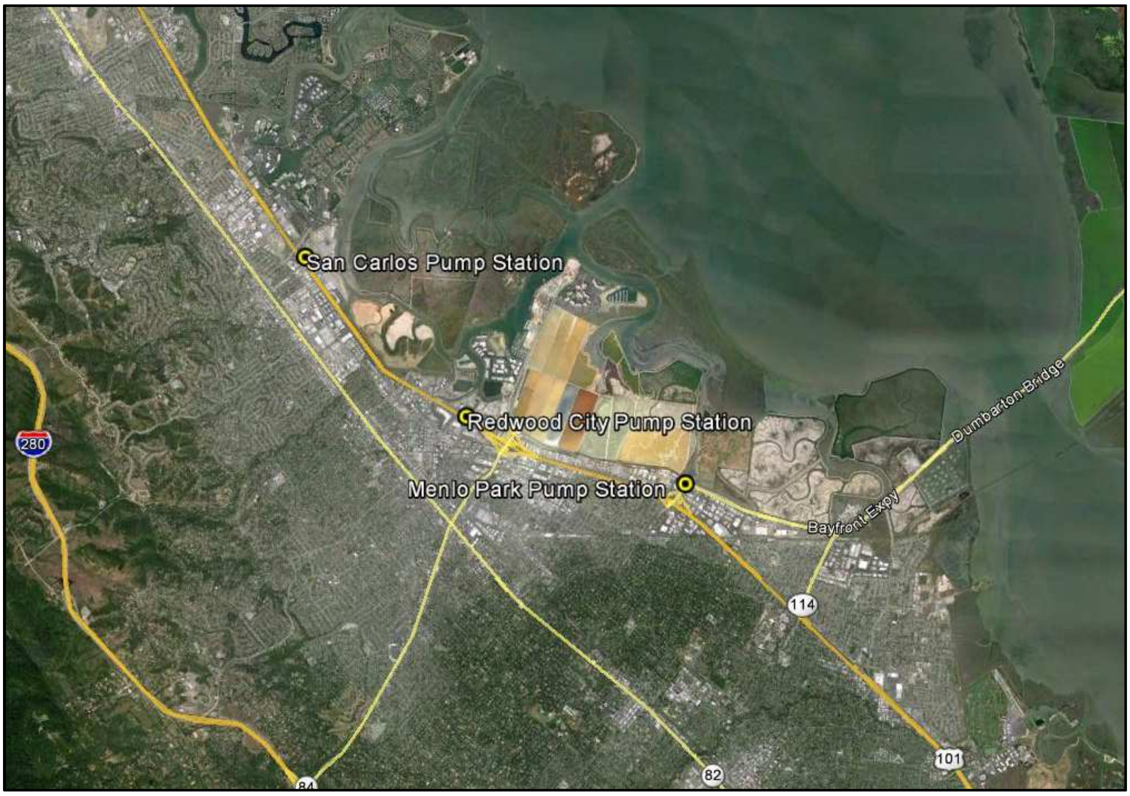

Figure 1. Project Vicinity Map

Figure 2a. Menlo Park Lift Station Resistivity Test Locations and Soil Sample Boring Locations

Figure 2b. Redwood City Lift Station Resistivity Test Locations and Soil Sample Boring Locations

Figure 2c. San Carlos Lift Station Resistivity Test Locations and Soil Sample Boring Locations

TEST METHODS

In attempting to predict corrosion problems associated with a particular type of structure prior to installation, it is necessary to investigate the soil conditions the structure will encounter. Since corrosion is an electrochemical process which is accompanied by current flow, the electrochemical characteristics of a soil are of primary importance when evaluating corrosivity. Test methods utilized during this investigation reflect the current practices for evaluating soil corrosivity.

Field Soil Resistivity Testing

Soil resistivity measurements were conducted by the Wenner 4-Electrode Method, utilizing a Digital Soil Resistance Meter, (Model 4610, manufactured by AEMC). The Wenner method involves the use of four steel pins driven into the ground along a straight line, equidistant from each other, as shown in Figure 3.

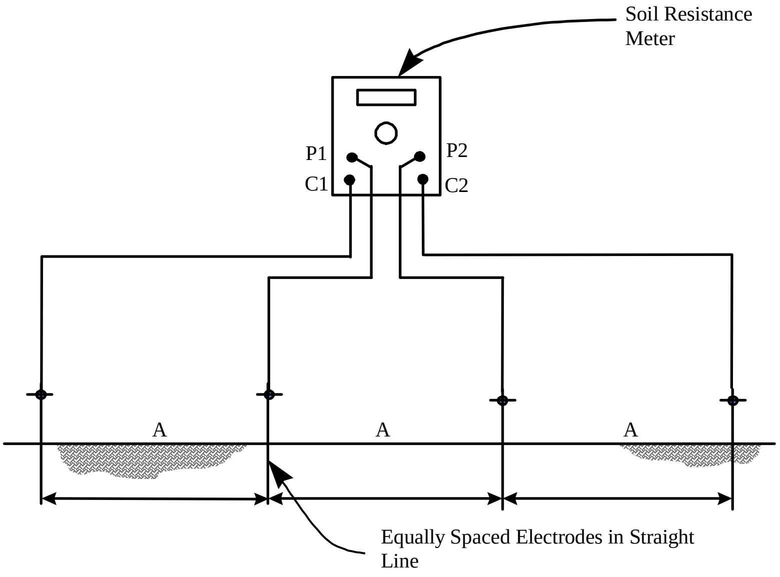

Figure 3. Soil Resistivity Measurement

An alternating current from the Soil Resistance Meter causes a current to flow through the soil between the outside probes, C1 and C2. Due to the resistance of the soil, the current creates a voltage gradient, which is proportional to the average resistance of the soil mass to a depth equal to the distance between probes. The voltage drop is then measured across pins, P1 and P2. Resistivity of the soil is then computed from the instrument reading according to the following formula:

$$\rho = 2 \cdot \pi \cdot A \cdot R$$

Where:

ρ = soil resistivity (ohm-cm)

A = distance between electrodes (cm)

R = soil resistance, instrument reading (ohms)

π = 3.14 (approx.)

Soil resistivity measurements were conducted at probe spacing of 2.5, 5, 7.5, 10, 15, and 20 feet. The resistivity values obtained represent the average resistivity of the soil to a depth equal to the pin spacing. The resistivity of each layer of soil was then calculated using the Barnes Layer Method as follows:

Barnes Layer Soil Resistivity Calculation

$$\rho_{b-a} = KR_{(b-a)}$$

and

$$\frac{1}{R_{b-a}} = \frac{1}{R_a} - \frac{1}{R_b}$$

Where:

ρ_{b-a} = Soil resistivity of layer depth b-a (ohm-cm)

a = Soil depth to top of layer (feet)

b = Soil depth to bottom of layer (feet)

R_a = Soil resistance read at depth a (ohms)

R_b = Soil resistance read at depth b (ohms)

R_{b-a} = Resistance of soil layer from a to b (ohms)

K = Layer constant (cm)

= 60.96 π (b-a)

Laboratory Soil Resistivity Analysis

Soil resistivity data obtained from Jacobs Associates (File No. 4520.0, October, 2013) was used determine minimum, or saturated, soil resistivity using a soil box (see Figure 4). The testing was performed in accordance with Caltrans Test Method 643.

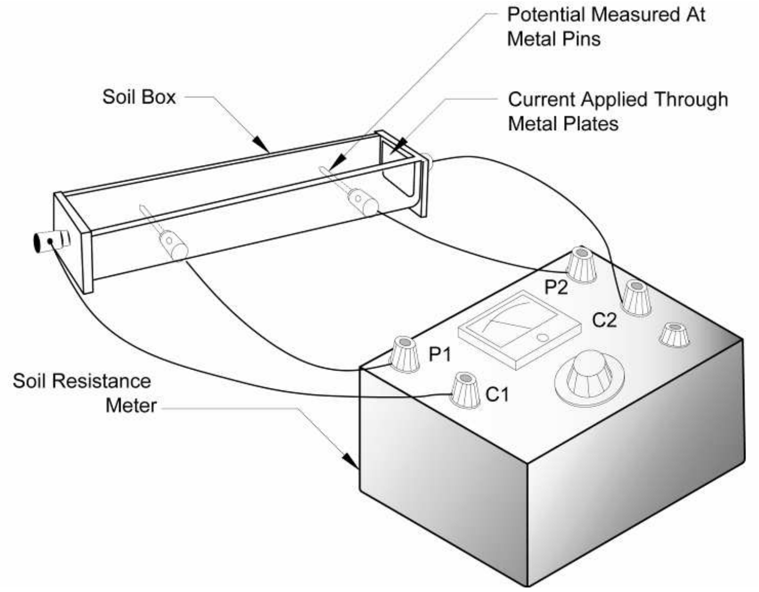

Figure 4. Soil Resistivity Measurement Using the Soil Box Method

This apparatus consists of a small plastic box with metal end plates, for passing current through the soil sample packed tightly into the box. Current is passed through the sample, causing a voltage drop across the sample. The soil resistivity was determined from this known voltage drop utilizing a Soil Resistance Meter, as described earlier.

Soil samples were placed in the soil box and the soil resistivity measured in the "as-received" state. Distilled water was added to the soil sample and the resistivity measured after each watering. As the soil sample became more saturated, the soil resistivity decreased until the minimum soil resistivity was reached.

Chemical Analysis of Soil

Soil chemical analysis data obtained from Jacobs Associates (File No. 4520.0, October, 2013) was used to assess soil corrosivity. This data included pH as well as concentrations of water soluble chloride and water soluble sulfate ions. Standard analytical methods were utilized for determination of these chemical constituents.

TEST RESULTS

Data obtained during this investigation has been summarized in tabular form for analysis and presentation. Table 1 summarizes the results of the Wenner 4-Pin field soil resistivity measurements at all three lift stations. Table 2 lists the minimum (saturated) soil resistivity for each soil sample collected as well as the chemical analysis of each sample.

Table 1. Summary of Field Soil Resistivity Data

Pump Station	Test Number	Depth (feet)	Layer (feet)	Layer Resistivity (Ohm-cm)	Corrosivity of Layer
PS 1 – Menlo Park	Test 1 (Just outside the Menlo Park PS)	2.5	0 - 2.5	3,567	Mild
		5	2.5 - 5	1,336	Moderate
		7.5	5 - 7.5	545	High
		10	7.5 - 10	374	Very High
		15	10 - 15	309	Very High
		20	15 - 20	450	Very High
	Test 2 (Perpendicular to Test 1)	2.5	0 - 2.5	5,372	Mild
		5	2.5 - 5	867	High
		7.5	5 - 7.5	542	High
		10	7.5 - 10	466	Very High
		15	10 - 15	349	Very High
		20	15 - 20	371	Very High
PS 2 – Redwood City	Test 3 (Just outside the Redwood City PS)	2.5	0 - 2.5	3,974	Mild
		5	2.5 - 5	1,607	Moderate
		7.5	5 - 7.5	393	Very High
		10	7.5 - 10	509	High
		15	10 - 15	391	Very High
		20	15 - 20	863	High
	Test 4 (Perpendicular to Test 3)	2.5	0 - 2.5	3,825	Mild
		5	2.5 - 5	1,303	Moderate
		7.5	5 - 7.5	496	Very High
		10	7.5 - 10	196	Very High
		15	10 - 15	476	Very High
		20	15 - 20	109	Very High
PS 3 – San Carlos	Test 5 (Inside San Carlos PS gate)	2.5	0 - 2.5	1,771	Moderate
		5	2.5 - 5	1,148	Moderate
		7.5	5 - 7.5	623	High
		10	7.5 - 10	689	High
		15	10 - 15	383	Very High
		20	15 - 20	377	Very High
	Test 6 (Just outside the San Carlos PS, Perpendicular to Test 5)	2.5	0 - 2.5	1,714	Moderate
		5	2.5 - 5	1,697	Moderate
		7.5	5 - 7.5	121	Very High
		10	7.5 - 10	284	Very High
		15	10 - 15	246	Very High
		20	15 - 20	140	Very High

Table 2. Summary of Laboratory Soil Analysis Data

Site	Sample	Depth (feet)	Saturated Resistivity (ohm-cm)	pH	Sulfate Ions (ppm)	Chloride Ions (ppm)
San Carlos	B-1-3	8	84	7.2	340	2700
Redwood City	B-2-3	12	1200	9.1	130	320
Menlo Park	B-6-2b	8	540	9.1	100	68

Soil Resistivity

Understanding how easily current will travel through a medium surrounding a metallic object is important in evaluating the corrosive environment. Resistivity is an inverse measure of the ability of a soil to conduct an electric current, with higher resistivity resulting in a lesser degree of current flow. Corrosion rate depends on current flow between a metal and the adjacent medium. Normally, the corrosion activity on metals in soil increases as soil resistivity decreases. The following table correlates resistivity values with degree of corrosivity. The interpretation of corrosivity correlation to soil resistivity varies somewhat among corrosion engineers. However, Table 3 is a generally accepted guide.

Table 3. Effect of Soil Resistivity on the Corrosivity of Soil[1]

Soil Resistivity (ohm-cm)	Degree of Corrosivity
< 500	Very High
500 – 1,000	High
1,000 – 2,000	Moderate
2,000 – 10,000	Mild
> 10,000	Negligible

Metallic structures will be installed at all three lift stations at various depths. Most of these structures will be installed between 5 and 20 feet deep.

Menlo Park Lift Station

Soil resistivity at a depth of 5 to 20 feet ranges from 309 ohm-cm to 545 ohm-cm. The saturated soil resistivity of the sample was 540 ohm-cm. These soils are considered *highly corrosive* to *very highly corrosive* to steel.

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[1] Peabody, A. and Parker, M., “Corrosion Basics, an Introduction”, Ed. by Brasunas, A., NACE International, p. 191 (1984)

Redwood City Lift Station

Soil resistivity at a depth of 5 to 20 feet ranges from 109 ohm-cm to 863 ohm-cm. The saturated soil resistivity of the sample was 1,200 ohm-cm. These soils are considered *moderately corrosive* to *very highly corrosive* to steel.

San Carlos Lift Station

Soil resistivity at a depth of 5 to 20 feet ranges from 121 ohm-cm to 689 ohm-cm. The saturated soil resistivity of the sample was 84 ohm-cm. The soil at all three lift stations is considered *highly corrosive* to *very highly corrosive* to steel.

Overall the soils at all three lift stations are considered *very highly corrosive* to steel.

Soil Chemical Analysis

A wide variety of water-soluble salts is typically found in soils. Two soils having the same resistivity may have significantly different corrosion characteristics, depending on the specific ions available. The major constituents which accelerate corrosion are chlorides, sulfates and the acidity (pH) of the soil. Chloride ions tend to break down otherwise protective surface deposits, and can facilitate corrosion of reinforcing steel in concrete structures. Sulfates in soil can be highly aggressive to portland cement by combining chemically with certain constituents of the concrete, principally tricalcium aluminate. This reaction is accompanied by expansion and eventual disruption of the concrete matrix.

Water-soluble Chloride

Chloride ions found in soils tend to break down otherwise protective surface deposits, and can result in corrosion of buried metallic structures and reinforcing steel in concrete structures. Table 4 shows the effect of chloride ions on the corrosivity of the soil.

Table 4. Effects of Chloride Ions on the Corrosivity of Soil

Water-soluble Chloride Concentration (ppm)	Degree of Corrosivity
Over 5,000	Very High
1,500 - 5,000	High
500 - 1,500	Moderate
100 - 500	Mild
Below 100	Negligible

The water soluble chloride level of the soil sample obtained from the San Carlos Pump Station is 2,700 ppm; this soil sample is considered *highly corrosive*. The water soluble chloride level of the soil sample obtained from the Redwood City Pump Station is 320 ppm; this soil sample is considered *mildly corrosive*. The water soluble chloride level of the soil sample obtained from the Menlo Park Pump Station is 68 ppm; this soil sample is considered *negligibly corrosive*.

V&A's experience with soils in the general vicinity of these Lift Stations (east of Hwy 101) are that bay mud which is high in chlorides is present and the soils are very corrosive to buried steel and reinforced concrete. The soils at all three Lift Stations should be classified as *very highly corrosive* to buried steel and reinforced concrete structures.

Acidity

Acidity, as indicated by the pH value, is another important factor of soil with respect to corrosivity. Lower pH (more acidic) will result in a greater degree of corrosivity with respect to buried metallic and concrete structures. When pH increases above 7.0 (the neutral value) the conditions become increasingly more alkaline. In alkaline environments, steel forms a protective layer on its surface. This is referred to as passivation. V&A developed Table 5, which correlates the effect of pH on the rate of corrosion for buried steel or concrete structures.

Table 5. Effects of pH on the Corrosivity of Soil[2, 3]

pH	Corrosivity
< 5.5	High
5.5 - 6.5	Moderate
6.5 - 7.5	Neutral
> 7.5	Negligible

The pH of the tested soil sample from the San Carlos Pump Station is 7.2; this soil sample is considered *neutrally corrosive.* The pH of the tested soil samples from the Redwood City Pump Station and the Menlo Park Pump Station is 9.1; the soil pH of these soil samples is considered to have a *negligible effect on the corrosivity of the soil*.

---

[2] Romanoff, M., "Underground Corrosion", NACE International, p. 8 (1989)

[3] Uhlig H., "Corrosion and Corrosion Control", 2nd Edition, John Wiley & Sons Inc., pp.98-106 (1971); V&A's experience

Water-soluble Sulfates

Soil with high levels of sulfates can chemically attack concrete structures. Table 6 correlates the effect of sulfates on the corrosivity of soil for concrete structures.

Table 6. Effects of Sulfate Ions on the Corrosivity of Soil [4]

Water-soluble Sulfate Concentration (ppm)	Corrosivity
> 2,000	Very High
1,000 - 2,000	Moderate
< 1,000	Negligible

The water soluble sulfate level of the soil sample obtained from the San Carlos Pump Station is 340 ppm. The water soluble sulfate level of the soil sample obtained from the Redwood City Pump Station is 130 ppm. The water soluble sulfate level of the soil sample obtained from the Menlo Park Pump Station is 100 ppm. All three soil samples are considered *negligibly corrosive* to reinforced concrete structures with respect to sulfate ion concentration.

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[4] V&A's interpretation of Table 8.22.2, Bridge Design Specifications, California Department of Transportation (2000)

CONCLUSIONS

The soils at all three Lift Stations are located in an area known to be high in chlorides. The area east of Highway 101 is located on land reclaimed from the bay and contains bay mud and salty soils. The soil analysis confirmed that the soils at all three sites are highly corrosive to both buried steel and reinforced concrete and contain high levels of chlorides.

RECOMMENDATIONS

Buried Metallic Pipes

It is recommended that the following corrosion control measures be taken for buried metallic structures:

- Apply a bonded dielectric coating to the pipe
- Electrically isolate the piping from other metallic structures such as other metallic pipes, reinforced concrete, or where a change in piping or coating material occurs
- Install cathodic protection
- Bond all non-welded, non-insulating pipe joints for electrical continuity of the buried piping

The following coatings are recommended for buried applications:

- 100% Solids Polyurethane
- Fusion Bonded Epoxy
- Tape Wrap conforming to Standard AWWA C209

Cement Mortar Coated Pipelines

Cement mortar coated pipelines obtain their corrosion protection from the passivation effect that the high pH mortar has on the steel. It is therefore critical that all electrically connected steel be mortar coated to maintain an environment similar to that of the pipeline. In environments with high concentrations of chlorides, the passivation effect from the high pH of the mortar coating may not be sufficient to prevent corrosion. It is therefore it is recommended that cathodic protection be provided for mortar coated pipelines.

It is recommended that the following corrosion control measures be taken for cement mortar coated pipelines:

- The joints, valves, and any other steel appurtenances in metallic contact with the pipe shell or steel reinforcement should be coated with a cementitious mortar to maintain an environment similar to that of the pipe. Mortar coating can be performed by grouting the joints with a diaper, backfilling with a controlled low strength material (CLSM) (pH > 10), or applying a cementitious mortar to the surfaces.

- Field applied mortar used to coat the exposed steel should have a minimum cover of 2 inches and be prepared and applied per the manufacturer's directions.
- Electrically isolate the yard piping from other metallic structures such as other metallic pipes, reinforced concrete, or where a change in piping or coating material occurs.
- Install cathodic protection.
- Bond all non-welded, non-insulating pipe joints for electrical continuity of the buried piping.

Concrete and Reinforced Concrete Structures

The soils are corrosive towards reinforced concrete structures. Buried concrete structures should be constructed using the following recommendations:

- Cast-in-place concrete structures should have a minimum cover of 3 inches.
- Precast piles should have a minimum cover of 2.
- Water-to-cement ratio should not exceed 0.4.
- A corrosion inhibitor such as Grace DCI should be used.
- Concrete should be durable concrete such as described in ACI Standards 201.2R and 222R.
- Sand and water used in concrete mixtures should contain a maximum of 100 ppm of water-soluble chloride ions and water-soluble sulfate ions and have a pH in the range of 6.5 to 8.0.
- Water used in concrete mixtures should be potable water.

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Appendix F: TM 8.1 – Design Criteria, Guidelines, and Standards

Brown and Caldwell, January 12, 2015

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Technical Memorandum

DRAFT

Prepared for: Silicon Valley Clean Water

Project Title: Pump Station Predesign

Project No.: 142399

Technical Memorandum 8.1

Subject: Design Criteria, Guidelines, and Standards

Date: January 12, 2015

To: Bill Bryan, Project Manager, Silicon Valley Clean Water

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Limitations:

This is a draft memorandum and is not intended to be a final representation of the work done or recommendations made by Brown and Caldwell. It should not be relied upon; consult the final report.

This document was prepared solely for Silicon Valley Clean Water in accordance with professional standards at the time the services were performed and in accordance with the contract between Silicon Valley Clean Water and Brown and Caldwell dated February 28, 2012. This document is governed by the specific scope of work authorized by Silicon Valley Clean Water; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Silicon Valley Clean Water and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

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List of Abbreviations

ABMA	American Bearing Manufacturers Association
AHJ	Authority Having Jurisdiction
AIC	available interrupting circuit
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
amsl	above mean sea level
AMWA	Association of Metropolitan Water Agencies
ANSI	American National Standards Institute
ASCE/SEI	American Society of Civil Engineers
ASHRAE	Air Conditioning Engineers
ASME B&PV	American Society of Mechanical Engineers, Boiler and Pressure Vessel
ASTM	American Society for Testing and Materials
ATS	Automatic Transfer Switch
AWWA	American Water Works Association
BC	Brown and Caldwell
BEPQ	Best Efficiency Flow
BGS	below ground surface
BPS	Conveyance System Master Plan CSMP) Belmont Pump Station
CBC	California Building Standards Code
CEC	California Electrical Code
CEC	California Energy Code
CMC	California Mechanical Code
CPU’s	central processing units
DLR	Device Level Ring
DPS	Design Production Standard
EJMA	Expansion Joint Manufacturers Association
EJMA	Expansion Joint Manufacturers Association, Inc.
EMT	Electrical Metallic Tubing
ERVSS	Electronic Reduced Voltage Soft-Starter
FC	Foot Candles
FEF	Flow Equalization Facility
FRP	Fiberglass reinforced plastic
FT	feet
FVNR	Full Voltage Non-Reversing Motor Starters
GIR	Geotechnical Interpretive Report
GPD	gallons per day
GPH	gallons per hour

GPM	gallons per minute
HIM	human interface module
HP	horsepower
HSS	Hollow Structural Sections
HVAC	Heating, ventilating, and air conditioning
I/O	input/output
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electron Engineers Association
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
kVA	kilovolt-amps
kW	kilowatts
LEED	Leadership in Energy and Environmental Design
LEL	lower explosive limit
LF	linear feet
LOS	Lock-Out-Stop
MCBS	mechanically cleaned bar screens
MCC	Motor Control Center
MFMA	Metal Framing Manufacturers Association
MGD	million gallons per day
MOP	Manual of Practice
MOVs	metal oxide varistors
MPPS	Menlo Park Pump Station
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
NCS	National CAD Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NETA	InterNational Electrical Testing Association
NFPA	National Fire Protection Association
NPSH3	Net Positive Suction Head Required - 3 Percent Reduction
NPSHA	Net Positive Suction Head Available
OSHA	U.S. Department of Labor Occupational Safety and Health Act
P&IDs	process and instrumentation diagrams
PACL	Pump Application Capacity Limits
PCC	Point of Common Coupling
pcf	per cubic foot
PIPESPEC	piping specification sheets
PLCs	Programmable Logic Controllers
PS1	Menlo Park S.D. Pump Station
PS1	Pump Station 1
PS2	Redwood City Pump Station

PS3	San Carlos Pump Station
PSF	per square foot
PWWF	Peak Wet Weather Flow
RAC	Rigid Aluminum Conduit
RAS-PVC	Rigid Aluminum Conduit, Polyvinyl coated
RCPS	Redwood City Pump Station
RIO	Remote I/O
RTP	reinforced thermoset polyester
RVSS	Reduced Voltage Solid State
SARA	Superfund Amendments and Reauthorization Act of 1986
SCADA	supervisory control and data acquisition
SCAQMD	South Coast Air Quality Management District
SCPS	San Carlos PS
SMACNA	Sheet Metal and Air Conditioner Contractor’s National Association
SVCW	formerly SBSA Silicon Valley Clean Water
TM	technical memoranda
TSDF	transporter treatment, storage and/or disposal facility
UL	Underwriters Laboratories Inc.
UPS	Uninterruptable Power Supply
UV	ultra-violet
VFDs	variable frequency drives
WWTP	wastewater treatment plant

Introduction

This Technical Memorandum 8.1 (TM 8.1) describes the criteria, guidelines, and standards intended for the Silicon Valley Clean Water (SVCW) conveyance system pumping stations.

Background

In December 2011, SVCW (formerly SBSA) authorized Brown and Caldwell (BC) to prepare a Predesign Report for the Conveyance System Pump Stations (Predesign Report). The scope of work was based on building upon the Conveyance System Master Plan (CSMP), which was completed in August 2011. Four pump stations were evaluated: Belmont Pump Station (BPS), San Carlos PS (SCPS), Redwood City Pump Station (RCPS), and Menlo Park Pump Station (MPPS). The use of booster pump stations was also evaluated. Based on the hydraulic analysis and cost/benefit analysis the following decisions were made:

- BPS and SCPS should be combined into one pump station, routing the BPS flows to the SCPS via gravity sewer main;
- No new booster pump station will be constructed

SVCW Member Agencies provided new peak flow rates for the pump station design storm for this analysis. The pump stations are designed to pump the peak design flow from the Member Agencies to the wastewater treatment plant (WWTP) and the future adjacent Flow Equalization Facility (FEF).

The three future pump stations are renamed as PS1 (currently MPPS), PS2 (currently RCPS), and PS3 (the combined BPS and SCPS).

Purpose

The purpose of this document is to guide the pump station final design teams and to ensure consistent quality and similar facilities for ease of operation and maintenance. This document is meant to be a working document for the design teams such that during the design, changes can be made based on design team review and consensus.

Federal, State and Local Regulations and Standards

The latest versions of regulations, standards, and codes referred to during development of and/or referenced in this TM will need to be confirmed during final design. The final design shall be updated to the latest versions of regulations, standards and codes such that the pump stations are in compliance with current requirements at the time of construction.

Document Contents

This document includes criteria and guidelines that have been identified during the pump station predesign project for the pumps, approach conditions and wet well design, hydraulic transient control, odor control, and bar screens.

There are several attached sections to this document that cover design standards for all three pump stations. For this draft, two of these attachments noted below are being prepared by sub-consultants and are not included in this draft. These attachments will be incorporated in a subsequent draft. The attachments include:

- Civil Design Criteria and Geotechnical Requirements (Attachment A)
- Security Criteria (Attachment B)
- Corrosion Control (Attachment C)

- Architectural Design (Attachment D) – to be included as part of final design
- Structural Design (Attachment E)
- Process and Instrumentation Diagram Requirements (Attachment F)
- Mechanical Design (Attachment G)
- Piping Specifications (Attachment H)
- HVAC Design (Attachment I)
- Electrical and Power (Attachment J)
- Instrumentation and Control (Attachment K)
- Noise Attenuation Requirements (Attachment L) – to be included as part of final design
- CADD Standards (Attachment M)
- Standard Details (Attachment N)

Additional Technical Documents

A series of technical memoranda (TM) and reports were written as part of the Predesign Report. Several of these TMs contain pertinent technical information that will be used during final design of the pump stations. These TMs and other documents are listed below:

- SBSA Conveyance System Master Plan, August 2011
- TM 3.1 – Field Investigation Summary (Contaminated Materials Survey)
- TM 3.2 - Hazardous Materials Study for MPPS and the proposed gravity sewer from BPS to SCPS
- Phase I Environmental Site Assessment report, completed by David J. Powers & Associates in January 2012 as part of the 48-inch Reliability Improvement Project, which covers the Redwood City and San Carlos PS sites
- TM 6.1 – Hydraulic Evaluation
- TM 6.2 – Transient Analysis
- SBSA Security Guidance Document, Draft October 2011
- Corrosion Control TM by V&A, Draft January 8, 2014
- SBSA Corrosion Control and Odor Master Plan, June 29, 2010
- Geotechnical Data Report by Jacobs Associates, October 22, 2013
- Geotechnical Report by DCM Consulting Inc., Draft November 25, 2013
- SVCW Hard Assets Standard Naming Convention (latest document available)
- SVCW Automation Standards (latest document available)
- TM 5.1 Control Narratives (includes P&IDs)
- SVCW CAD Standards

Section 1: Pumps

Each of the three SVCW pump stations shall have a dedicated set of wet weather and dry weather pumps. This section discusses the operating conditions for the pump stations.

There are three main operating condition points that shall be used for pump selection. These points are where the pump curves meet the system curve. A hydraulic model of the Conveyance System was developed in MWHSoft InfoWater. The results from the hydraulic model were used to produce the system curves for each pump station. The model and system curves will need to be updated during the final design phase to determine the effects of each individual pump station on the overall conveyance system.

1.1 Operating Condition Point Definition

Operating Condition Points A, B, and C are defined below and a generic figure illustrates the points in Figure 1-1:

Operating Condition Point A is defined as the peak design flow per pump and the pressure required to pump the peak flow based on the intersection of the pump curve with three pumps operating and the corrected system curve. The corrected system curve accounts for static head.

Operating Condition Point B is defined as the flow for one pump operating and the pressure required to pump the flow based on the intersection of the pump curve with one pump operating and the corrected system curve.

Operating Condition Point C is defined as the flow for one pump operating at fifty percent speed and the pressure required to pump the flow based on the intersection of the pump curve and the corrected system curve.

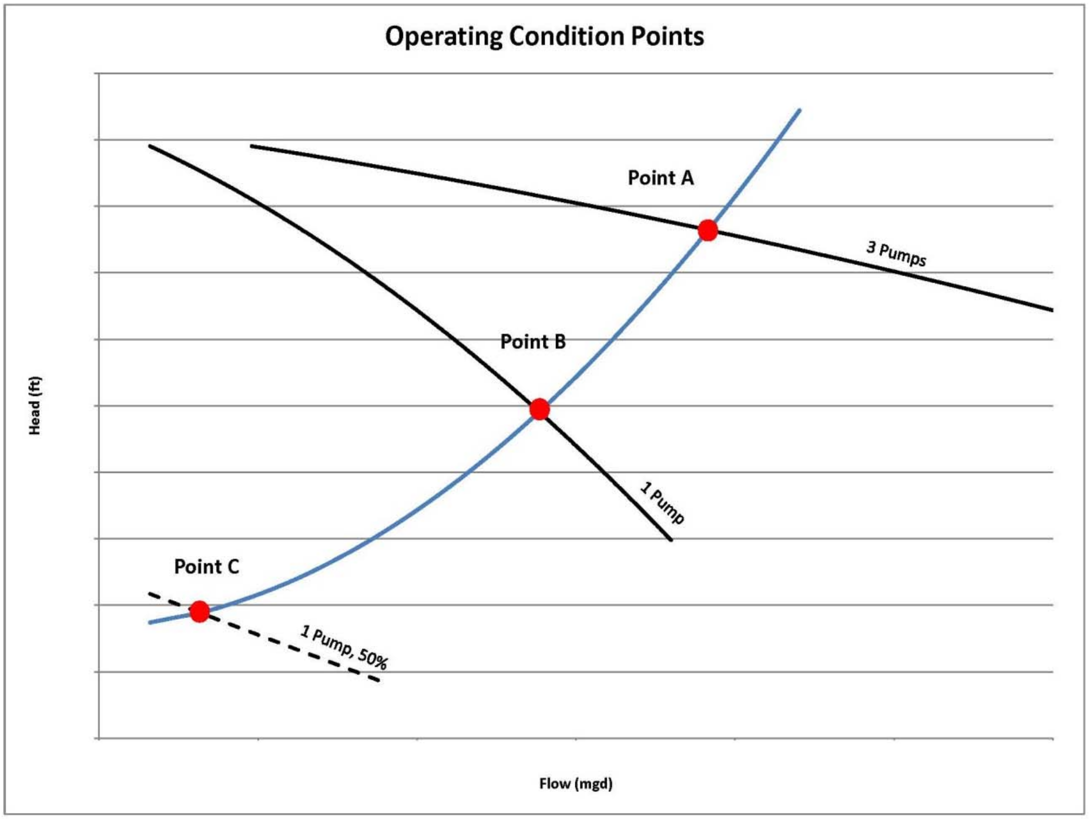

Figure 1-1. Operating Condition Points A, B, and C

1.2 Dry Weather Operating Conditions

Operating condition points A:

Table 1-1. Summary of Operating Condition Point A for Dry Weather Pumps at Pump Stations

Pump Station	Peak Dry Weather Flow Condition			
	Total Peak Dry Weather Flow at Pump Station (MGD)	Flow per Pump[1] (MGD)	Pressure at Peak Dry Weather (FT)	Pressure at Peak Dry Weather (psi)
PS3	9.0	3.0	42	18
PS2	14.5	4.8	49	21
PS1	10.0	3.3	56	24

[1] *Individual pump capacity is the pump station capacity divided by three.*

Operating condition points B:

Table 1-2. Summary of Operating Condition Points B for Dry Weather Pumps at Pump Stations

Pump Station	Peak Dry Weather Flow Condition			
	Total Peak Dry Weather Flow at Pump Station (MGD)	Flow per Pump (MGD)	Pressure at Peak Dry Weather (FT)	Pressure at Peak Dry Weather (psi)
PS3	3.5	-	38	17
PS2	6.5	-	36	16
PS1	5.5	-	37	16

No peak dry weather conditions are available for operation condition C.

Operating condition points B and C are as defined above in Section 1.1.

1.3 Wet Weather Operating Conditions

Operating condition points A:

Table 1-4. Summary of Operating Condition Point A for Wet Weather Pumps at Pump Stations

Pump Station	Peak Wet Weather Flow Condition			
	Total Peak Wet Weather Flow at Pump Station (MGD)	Flow per Pump[1] (MGD)	Pressure at Peak Wet Weather (FT)	Pressure at Peak Wet Weather (psi)
PS3	42.9	14.3	88	38
PS2	38	12.7	151	65
PS1	22	11	183	79

[1] *Individual pump capacity is the pump station capacity divided by three for PS2 and PS3, and divided by 2 for PS1.*

Operating condition points B:

Table 1-5. Summary of Operating Condition Point B for Wet Weather Pumps at Pump Stations

Pump Station	Peak Wet Weather Flow Condition			
	Total Peak Wet Weather Flow at Pump Station (MGD)	Flow per Pump (MGD)	Pressure at Peak Wet Weather (FT)	Pressure at Peak Wet Weather (psi)
PS3	25	-	55	24
PS2	28	-	100	43
PS1	18.7	-	127	55

Operating conditions points C:

Table 1-6. Summary of Operating Condition Point C for Wet Weather Pumps at Pump Stations

Pump Station	Peak Wet Weather Flow Condition			
	Total Peak Wet Weather Flow at Pump Station (MGD)	Flow per Pump (MGD)	Pressure at Peak Wet Weather (FT)	Pressure at Peak Wet Weather (psi)
PS3	-	-	-	-
PS2	6.4	-	38	17
PS1	6.6	-	42	18

Operating condition points B and C are as defined above in Section 1.1.

1.4 Pump Operational Requirements

In addition to pumps being able to meet the head and flow requirements for each pump station, the pumps have operational criteria that need to be met as well. These criteria include the pump application capacity limits (PACL) and net positive suction head (NPSH) requirements. The operating conditions must also fall within the allowable operating range (AOR) per pump manufacturers' definition.

1.4.1 PACL

Pump selection for a given application shall be predicated on locating the specified most frequent operating condition(s) in the PACL. These points shall always include Condition Points A and B and additionally shall include any other Condition Points indicated as continuous duty conditions, or any additionally specified for inclusion in the PACL. Condition Point A shall be the pump's rated condition and shall be guaranteed to meet both specified head and flow within the limit established in ANSI/HI 14.6, acceptance grade 1U.

A given pump's PACL shall be determined as a percentage of Best Efficiency Flow (BEPQ) at the given speed, the pump's suction specific speed as determined in accordance with ANSI/HI 1.3, paragraph 1.3.2.2 and the relationships presented in the Table 1-7 below.

Table 1-7. Limiting Flow, Percent Best Efficiency Point Flow (BEPQ)[1]

Suction Specific Speed, less than but not greater than:	Solids Bearing Liquids Pumps, minimum limit (Percent)	Solids Bearing Liquids Pumps, maximum limit (Percent)
7000	70	125
8000	75	122
9000	80	120
10000	83	117
11000	85	112
12000	88	110
13000	91	110

[1] *Straight line interpolation may be used for intermediate values of suction specific speed*

Exceptions to the foregoing shall be considered only when certified test data demonstrating conclusively a wider region of stable pump performance can be provided. The test data shall include suction pressure pulse information as well as actual service information for the same impeller design and trim, operating at the same speed, capacities and head for the same size pump as required for the specified application.

Pumps shall function without loss of head due to cavitation or excessive vibration over the entire specified range of flow and head conditions defined by the region bounded by Condition Points A, B and C. Operating Condition Points B and C shall reside within the region defined by the PACL limits shown in Table 1-7 based upon the pump's suction specific speed. Operating Condition A may reside in the area outside the PACL limits.

1.4.2 NPSH Requirements

- NPSHA/NPSHR > 1.1 for centrifugal pumps with suction specific speeds less than 8500 at any operating condition within 85 and 115 percent for BEP. The minimum acceptable NPSH margin ratio at any other location on the pump's head/capacity curve shall be 1.2.
- Pumps with suction specific speeds greater than the above limitations shall have NPSH margins of 1.5 and 2 applicable to the capacity envelope limitations defined previously. Under no circumstances shall the absolute value of the margin above NPSH3 be less than 3.5 feet.
- Pumps with suction specific speeds greater than the above limitations and pumps with impeller materials that do not meet the requirement for duplex cast stainless steel, and all pumps with suction specific speeds greater than 10,000 shall have NPSH margins not less than 2.5 at operating conditions within ±15 percent of best efficiency capacity and not less than 3.5 for all operating conditions falling outside the ±15 percent of best efficiency capacity envelope. Under no circumstances shall the absolute value of the margin for pumps qualifying with the foregoing restrictions, be less than 3.5 feet greater than NPSH3.

Section 2: Wet Well Design

This section establishes criteria for the design of trench-style wet wells for variable speed pumps. The design of trench-style wet wells incorporates features to optimize the scouring velocities within the wet well during cleaning operations and to minimize pump problems resulting from the flow currents. The wet well design shall primarily follow the Hydraulic Institute American National Standard for Rotodynamic Pumps for Pump Intake Design (ANSI/HI 9.8) with modifications. Each pump station will have two wet wells that each contains two dry weather pumps and two wet weather pumps. In total, there are three duty dry weather pumps, three duty wet weather pumps, one standby dry weather pump, and one standby wet weather pump at each pump station.

2.1 Wet Well Approach Conditions and Hydraulic Profile Elevations

The influent sewers and wet well approach pipes shall be designed such that no surcharging is experienced under the full range of design flows. The designer shall account for all head losses occurring over the full range of design flows from the collection system into the wet well.

2.1.1 Influent Sewer

Flow from the collection system will be conveyed to the pump station by gravity through an influent sewer. Influent sewers shall be designed to convey the full range of design flows without surcharging the upstream collection system. The influent sewer shall be designed to maintain velocities of 2.5 FT/s to 3.5 FT/s at average daily dry weather or peak daily dry weather conditions to flush settled debris within the sewer on a daily basis.

2.1.2 Wet Well Approach Pipe

The flow from the influent sewers at each pump station will be conveyed by gravity to the wet well by two approach pipes. The pump station influent sewers will combine in a junction structure upstream of the wet well and be split into two distinct approach pipes, one for each wet well. The approach pipes shall be isolated from the junction structure by a slide gate when the associated wet well is not in service.

The velocity in the approach pipe, upstream from the wet well, shall be no greater than 4.0 FT/s. If possible, target velocities for the approach pipes under peak dry weather flow conditions shall be a minimum of 2.5 FT/s to provide sufficient carriage of solids into the wet well on a daily basis. If this minimum velocity cannot be achieved during peak dry weather flow conditions, the approach pipes will achieve adequate cleaning during wet well cleaning cycles.

The approach pipe upstream from the trench shall be straight and free of fittings or devices that will disrupt the flow uniformity entering the trench for a distance equal to a minimum of eight times the approach pipe diameter.

2.2 Wet Well Configuration Design Criteria

The wet well configuration and dimensions are largely based on the pump inlet bell diameters. The wet well dimensions are shown on details for each pump station and are located in Attachment N. The following components determine the configuration of the wet well.

2.2.1 Pump Inlet Bell

A suction nozzle, fitted with a flared bell inlet, shall be installed on each pump. The suction nozzle will be required to reduce the suction velocity to 4.0 feet per second (no less than 3 feet per second and no more than 5 feet per second) at Condition Point B as defined in Section 1.1. The nozzle length must exceed the difference between the inlet and outlet diameter of the nozzle. The dry weather pump inlet bell diameter,

$D_{dryweather}$, and wet weather pump inlet bell diameter, $D_{wetweather}$, shall be varied in size to meet the criteria stated above.

2.2.2 Wet Well Cross Section

The wet well cross section dimensions are a function of the pump bell inlet diameter and the incoming approach pipe diameter. The wet well cross section consists of a rectangular trench with a trapezoidal section above the trench. Dimensions of the wet well cross section are discussed below.

2.2.2.1 Trench Width

The wet well trench width shall be a minimum of $2D_{wetweather}$. The designer shall also confirm that the trench width can accommodate the selected pump volute diameter plus a minimum of four inches of clearance on each side of the volute. Depending on the pump manufacturer, the pump volute diameter may be much larger than the designed pump inlet bell diameter. The trench with shall be consistent throughout the length of the wet well.

2.2.2.2 Minimum Submergence

The recommended minimum submergence for reducing free surface vortices as recommended by ANSI/HI 9.8-2012 is as follows:

$$S = D + 0.574\frac{Q}{D^{1.5}}, \text{ where}$$

- D = pump bell inlet diameter (inches)
- Q = Design Flow Gallons per minute (GPM)
- S= Submergence, the distance between the minimum liquid level and the height of the inlet (not minimum level to floor; inches)

Calculate the minimum submergence for peak wet weather conditions. Compare the submergence to the NPSHA and NPSH3 as discussed in Attachment G.2. Trench depth shall be adjusted accordingly to meet both the minimum submergence and NPSH3.

2.2.2.3 Above the Trench

Above the trench, the sides shall be sloped outward, away from the trench at a minimum of 45 degrees and lined with PVC or HDPE to facilitate solids falling back into the trench. The sides shall extend to half the depth of the fillet at the wall/floor (partially anchored into the fillet). The entire wet well above the low water level shall be lined with PVC or HDPE to prevent corrosion.

The liquid level in the wet well shall match the approach pipe liquid level. Also, the maximum velocity in the trapezoidal area above the trench shall be a maximum of 1.0 FT/s. The level in the trapezoidal area above the trench shall not exceed the incoming approach pipe water level as this will cause surcharging in the upstream collection system.

2.2.2.4 Water Guide

A water guide is required at the top of the trench and extended to the middle of the ogee ramp. In section view, a water guide fills the sloped sections of the wet well at the top of the trench extending the trench vertically to the length of the first half of the ramp. The water guide keeps the water confined within the width of the trench to guide it down the ramp and prevent it from creeping up the sloped sides of the wet well upon exiting the approach pipe. The water guide shall extend to the height of the approach pipe. The top of the water guides shall be sloped two percent towards the trench to drain any water that may accumulate on the water guide.

2.2.3 Design Ramp for Cleaning

An ogee ramp is required to gather speed down the ramp to cause a hydraulic jump during cleaning cycles. The hydraulic jump occurs at the base of the ramp that moves along the trench floor to the last pump. The purpose of inducing a hydraulic jump is to scour the trench floor and mobilize solids for suction by the last pump. The ogee ramp shall consist of an upper curve and a lower curve connected by a 45 degree tangent.

2.2.3.1 Upper Ramp Radius

The radius of curvature for the upper portion of the ramp, R_{upper}, shall be at least 2.3 times the pressure head of the approach pipe upstream of the sluice gate during cleaning or $2D_{wetweather}$, whichever is greater. The radius using the pressure head of the approach pipe shall be calculated as follows:

$$R_{upper} = FS \cdot 2.33v^2/2g, \text{ where}$$

- R_{upper} = Upper ramp radius (FT)
- FS = 2; Factor of Safety
- v = Cleaning Velocity (FT/s); Calculated using the velocity of the approach pipe at half of the last pump's capacity when the flow freely discharging from the approach pipe is at critical velocity
- g= 32.2 FT/s^2; acceleration of gravity

2.2.3.2 Lower Ramp Radius

The radius of the curvature at the bottom of the ogee, R_{lower}, shall be large enough for a smooth transition to horizontal flow. The lower ramp shall be 0.5 to 1.0 times R_{upper}.

2.2.3.3 Dimensions of the Ramp

The ramp angle shall be 45 degrees and connect the upper ramp radius to the lower ramp radius. The following equations shall be used to determine the horizontal and vertical projections of the ramp:

Horizontal Projection of Upper Curve, H_{upper}:

$H_{upper} = R_{upper} \cdot \sin(\theta_{ramp\_angle})$;

Vertical Projection of Upper Curve, V_{upper}:

$V_{upper} = R_{upper} - R_{upper} \cdot \cos(\theta_{ramp\_angle})$;

Horizontal Projection of Lower Curve, H_{lower}:

$H_{lower} = R_{lower} \cdot \sin(\theta_{ramp\_angle})$;

Vertical Projection of Lower Curve, V_{lower}:

$V_{lower} = R_{lower} - R_{lower} \cdot \cos(\theta_{ramp\_angle})$;

Vertical and Horizontal Projection of Tangent Between Curves, $H_{tangent}$ and $V_{tangent}$;

$H_{tangent} = V_{tangent} = S + 0.5D_{wetweather} - V_{upper} - V_{lower}$; and

Total Horizontal Projection of Ramp, H_{total_ramp} :

$H_{total\_ramp} = H_{tangent} + H_{lower} + H_{upper}$; where

- R_{upper} = Upper ramp radius (FT)
- R_{lower} = Lower ramp radius (FT)
- S = Required Submergence (see Section 2.2.2.2)
- θ_{ramp_angle}= angle of tangent connecting upper and lower radius of the ramp (degrees)

2.2.4 Pump Spacing

Pump intakes shall be spaced a minimum of $2.5D_{wetweather}$ from pump centerline to centerline. The first pump shall be spaced a minimum of $0.5D_{dryweather}$ from the end of the ogee ramp. See Section 2.2.7 for spacing of the last pump from the end wall.

2.2.5 Inlet Floor Clearance

The pump inlet clearance from the floor for the first three pumps shall be a minimum of $0.5D_{wetweather}$ for the wet weather pump and $0.5D_{dryweather}$ for the dry weather pump unless otherwise specified. A minimum of three inches of clearance between the pump inlet and the flow splitter is required to allow solids to enter the inlet. Therefore, the pump inlet clearance from the floor may be raised slightly to meet the three inches of clearance

2.2.6 Flow Splitters and Fillets

Fillets shall be installed along the sides of the trench floor the entire length of the wet well trench to eliminate sidewall vortices. The fillets shall extend from the top of the ogee ramp to provide a good flow pattern down the ramp to the end wall. Fillets shall have a 45 degree slope with a height of $0.38D_{wetweather}$.

Fillets shall be made of shotcrete (Gunite) sprayed, screeded, and troweled smooth. The fillets shall be anchored into the corners of the trench.

Flow splitters help control flow vortices within the wet well and retain the hydraulic energy from the ramp to produce a swift flow of water along the floor during cleaning. A flow splitter shall be installed on the floor of the wet well at the centerline of the trench. The flow splitter shall start at the top of the ramp and end just short of the recessed portion of the wet well for the last pump. The flow splitter shall consist of a triangular section with a height of $0.38D_{dryweather}$ and side slopes of 45 degrees. At the top of the ramp, the flow splitter shall have a nose that tapers to zero to minimize hydraulic disturbances. The flow splitter nose shall extend $1.67D_{dryweather}$ down the ramp and connect to the full triangular flow splitter. Flow splitters shall consist of a stainless steel plate exterior filled with grout and attached with adhesive anchors or stainless steel headed studs to the wet well floor.

A vertical stainless steel plate shall be installed beneath the second pump from the wet well inlet to minimize floor vortices from entering the second pump. The stainless steel plate shall start at the wet well flow and extend beyond the apex of the flow splitter with the plane of the plate perpendicular to the length of the flow splitter. The stainless steel plate shall be $1.5D_{wetweather}$ long and centered below the second pump. The height of the stainless steel plate shall be $0.38D_{wetweather}$.

2.2.7 Last Pump

The end wall clearance to the last pump centerline shall be spaced at 0.75 times the wet weather pump bell inlet diameter unless the selected pump's volute dimensions prevents the specified clearance. If the pump's volute diameter is too large to allow the $0.75D_{wetweather}$ clearance, then the last pump shall be placed as close to the end wall as physically possible with a minimum of 3 inches of clearance between the pump volute and the end wall.

Elevation of last pump shall be calculated by the following method:

Calculate the sequent depth of the hydraulic jump during cleaning near the end of the wet well. The design flow for a cleaning cycle shall be between 1/3 and 2/3 of the last pump's capacity.

Set the bottom of the pump inlet bell at $0.5D_{wetweather}$ below the sequent depth.

Set the floor $0.25D_{wetweather}$ below the pump inlet bell. This will create a recessed floor beneath the last pump where solids may accumulate during the cleaning cycle.

The floor between the last two pumps shall be sloped 30 degrees to reach the floor elevation beneath the last pump. The recessed floor for the last pump shall be large enough to accommodate the pump bell inlet outside diameter.

2.2.8 Anti-rotation Baffle and Floor Cone at Last Pump

An anti-rotation baffle shall be placed between the last pump and the back wall to prevent circulation of liquid between the pump and the pump wall. The anti-rotation baffle shall consist stainless steel plate that protrudes towards the pump as far as possible. The anti-rotation baffle shall extend from the floor of the trench at the end wall to the crown of the approach pipe in the wet well unless the volute of the pump prevents this configuration. The anti-rotation baffle shall be placed such that it does not interfere with the installation and removal of the pump. If the volute dimensions of the pump prevent the baffle from extending from the floor of the wet well to the crown of the approach pipe, then the baffle shall extend from the floor to just below the pump volute with 3 inches of clearance. The pump volute dimensions shall be coordinated with the pump manufacturer. Adhesive anchors shall be used to fasten the baffle to the wall.

A floor cone shall be placed under the last pump. Two vanes, a fore and aft vane, shall be attached to the cone. The floor cone height shall be three inches below the inlet bell of the last pump with 45 degree side slopes. The vanes shall be centered beneath the pump inlet bell parallel with the longitudinal section of the wet well and extend the length of the inlet bell outside diameter. Both the vanes and the cone shall be made of stainless steel and welded to a stainless steel plate that is then attached to the wet well floor with stainless steel headed studs.

2.3 Cleaning

Cleaning shall be conducted between flow rates of 1/3 to 2/3 of the capacity of the last pump. At these flow rates, the wastewater shall move down the ramp at supercritical velocity and form a hydraulic jump at the base of the ramp. The hydraulic jump mobilizes settled solids and conveys it to the last pump. The Froude number at the last pump shall be greater than 3.5. Only the last pump will be in operation during the cleaning cycle.

2.4 Wet Well Level Control

Duty-Standby and lead-lag wet wells shall be determined based on the Operator’s selected pump sequence configuration in both wet wells. Flow control and sequenced pump starts and stops shall be accomplished based upon the water surface level in the pump station duty or lead wet well. Variable frequency drives will vary the speed from each of the pumps to maintain the normal depth level of the approach pipe. The automation control narratives and process and instrumentation diagrams (P&IDs) are described in detail and included in TM 5.1 – Control Narratives.

Section 3: Hydraulic Transient Control

Hydraulic transient control is used to prevent damage to the system under possible transient conditions.

3.1 Hydraulic Transient Control Requirements

Hydraulic transient control and analysis is described in detail in TM 6.2 - Transient Analysis. Design conditions for transient control include Peak Wet Weather Flow (PWWF) and Peak Dry Weather Flow (PDWF). Transients occurring during design conditions shall be contained to within the pressure rating of the force main pipes. Full vacuum conditions shall be prevented in the event of power loss to the pump stations.

Surge protection measures shall be incorporated to prevent downsurge pressures from falling below -7 psig anywhere in the pipeline. This criterion shall be used for the selected HDPE force main as a safety factor against vapor cavity formation.

3.2 Equipment

Transient control equipment used in the design will include hydro-pneumatic surge tanks, vacuum breaker valves, combination air-release/vacuum breaker valves, and recirculation pumps. Valves and surge tanks will be installed in pairs to allow for isolation and maintenance. Space limitations prevent the use of surge tanks at Pump Station 1.

Hydro-pneumatic surge tanks shall be installed at Pump Stations 2 and 3. Surge tanks shall be provided with pumped mixing/recirculating loops to prevent grease layer formation. The hydro-pneumatic surge tanks at PS2 and PS3 will completely empty during a high flow surge event; therefore, vacuum breakers are required on the pipe connecting the tanks to the force main. Air release shall be prevented at these locations so that air admitted to the force main by the vacuum breakers may return to the tanks to the greatest extent possible during system re-start. Vacuum breaker valves shall be Vent-Tech model SWG-N.

Hydro-pneumatic surge tanks shall be the air pressurized, non-bladder type. Air compressors shall be sized to charge the surge tanks to operating pressure in less than three hours. Pipeline vacuum breaker valves shall be the combination air-release/vacuum breaker type.

Horizontal, constant speed, end suction, frame mounted, high pressure chopper pumps for pumping fluids containing wastewater and wastewater solids shall be installed for each surge tank facility. The pumps will be used for recirculating raw municipal wastewater in the surge tank. A dedicated pump will be provided for each surge tank. The pumps shall be installed within an acoustical enclosure capable of reducing the noise level of the pump and motor, including all ventilation fans, to a maximum of 85 dbA at 3 feet in any direction.

Suction will be from the recirculation outlet piping from the surge tanks and discharge back to the surge tank via the recirculation inlet piping to the surge tank. The pumps will operate at constant speed. Surge tank operating pressure will be 50 psi with infrequent transient surges up to 60 psi occurring during power failures and less or transient pressure surges occurring when the pump station pumps start up and shut down. The on/off frequency of the pumps will be a minimum of 1 to 4 cycles per hour. The recirculation pumps shall be designed to withstand these surge pressures as well as the operating pressures in the system.

Materials in the pumped fluid shall be macerated and conditioned by the pump as an integral part of the pumping action. The pump must have demonstrated the ability to chop through, mix and pump high concentrations of solids such as plastics, heavy rags, grease and hair balls, wood, paper products and stringy materials without plugging. The pump effluent shall not contain solids larger than 3 inches in the longest dimension. The fluid to be pumped is anticipated to range between 55 degrees F and 85 degrees F and contain up to 10,000 mg/L of solids consisting of grit and organic material with small quantities of petroleum products and animal fats and greases. All components shall be designed to safely withstand forces resulting from flow reversals up to 125 percent of maximum speed within the pump during shutdowns caused by power failure. The pump shall perform in accordance with the conditions listed in Table 3-1 below.

Table 3-1. Condition A[1,2,3] (Guaranteed Performance)

	PS2	PS3
Capacity, GPM	350	350
Total head, feet	8	7
Piping connection size, inches, minimum		
Inlet	6	6
Discharge	4	4
Speed, rpm, maximum	1150 or 1750	1150 or 1750
Horsepower, maximum[4,5]	7.5	7.5

NOTES:

1. Condition A shall be taken as the rated, continuous-duty operating condition. Performance at the rated condition shall be guaranteed in accordance with tolerances set forth in the Test Standards of the Hydraulic Institute, except that any increase in head or capacity or both which results in a power requirement greater than the pump motor's nameplate rating will be cause for rejection.

2. Total head in the above tabulation is the algebraic difference between the discharge head and suction head as defined in the standards of the Hydraulic Institute. Net positive suction head available (NPSHA) in the above tabulation is calculated in accordance with Hydraulic Institute standards for the worst combination of fluid temperature and barometric pressure.

3. Because the pumps are to operate at constant speed, the pump shall be selected so that the rated condition (Condition Point A) lies within 5 percent (based upon capacity) of the best efficiency point on the pump's head-capacity curve.

4. The motor shall be non-overloading. Pump selections which do not conform to this requirement without requiring a motor with a nameplate rating greater than that listed are not acceptable.

5. The motor shall have internal thermal protective devices and self-resetting relay interlock in the unit control.

Section 4: Odor Control

Each of the three raw sewage pump stations (PS1, PS2, and PS3) will have an on-site odor control system treating odors from wet wells and other odorous areas. Foul air from the existing wet wells at MPPS and RCPS is currently being ventilated directly to the atmosphere (no odor control). At RSPS, foul air from the existing wet wells is currently exhausted to two at-grade biofilters; however, these biofilters have not been functioning well since 2009.

4.1 Treatment Options

Three odor control technologies were initially evaluated; activated carbon, chemical scrubbers, and bulk media modular biofilters using inorganic, engineered media. Because of the large footprint required for a biofilter system, SVCW eliminated this technology from further predesign evaluation. Therefore, the recommended odor control technologies for consideration at each pump station are chemical scrubbers and activated carbon. Chemical scrubbers were chosen over activated carbon because the carbon would need replacement frequently due to high loads, which increases operating costs.

Single-stage odor control systems are assumed for this preliminary design. A two-stage system may be needed if it is determined in subsequent design stages that a single stage will not provide enough odor reduction at offsite sensitive receptors. Of the three pump stations in the design, PS2 and PS3 have potential nearby sensitive receptors, including a police station approximately 20 FT from the PS2 fence line and a restaurant approximately 180 FT from the PS3 fence line. PS1 is located in a comparatively remote area, which indicates that a single stage of odor treatment may be sufficient.

Because current odor concentration data were not available for the pump station sites, a gas-phase H_2S concentration of 5 ppmv was assumed for odor control system inlets in this predesign. This is the estimated concentration for the inlet of each odor control system for each pump station. It is recommended that further odor sampling over a two-week period should be performed for detailed design to confirm average and peak H_2S loads to the new odor control systems.

4.2 Pump Station 1 Odor Control Design Criteria

The preliminary odor control design criteria for PS 1 are shown below in Tables 4-1 and 4-2.

Table 4-1. PS1 General Odor Control Design Criteria

Parameter	Units	Value	Notes
Air Stream Design Criteria			
Total Air Flow Rate	cfm	2,800	Based on wet well volume and air changes per hour
Air Change Rate	ACH[1]	12	To meet NFPA Class 1, Division 1 requirements
Total Air Stream H_2S Concentration	ppmv	5	Estimated for calculations purposes; typical range may be from 0 to 100 ppmv, depending on upstream conditions
Fan Design Criteria			
Number of Supply Fans (Duty/Stand-By)	-	2/0	One per wet well
Supply Fan Horsepower	HP	1	
Number of Exhaust Fans (Duty/Stand-By)	-	2 / 1	Constant speed exhaust fans; one per wet well
Exhaust Fan Horsepower	HP	5	

1 – ACH = Air Changes per Hour

Table 4-2. PS1 Chemical Scrubber Odor Control Design Criteria

Parameter	Units	Value	Notes
Scrubber Design Criteria			
Number of Scrubbers	-	1	Single-stage using hypochlorite and caustic
Vessel Diameter	FT	3	Based on maintaining the optimal design gas flow loading rate through scrubber
Gas Flow Loading	lb/hr/FT^2	2,000	Typical range is 1,800 to 2,250 (MOP 25)[1]
Liquid Flow Rate (Recirculation Rate)	GPM	50	Calculated using gas flow rate, scrubber area, and water density
Liquid Flow Rate (Recirculation Rate)	lb/hr/FT^2	3,500	Typical range is 3,000 to 4,000 (MOP 25)
Packing Height	FT	10	Standard height; typical range is 8 to 12 FT
Blowdown Flow Rate	GPM	4.0	Estimated at 2 percent of recirculation rate; typical assumed range is 1 to 5 percent of recirculation rate
Makeup Water Flow Rate	GPM	4.0	Assume equal to approximate blowdown rate
Hypochlorite (12.5% strength) Flow Rate	GPD	12.8	Typical average flow rate based on stoichiometry
Caustic Soda (25% strength) Flow Rate	GPD	1.3	Typical average flow rate based on stoichiometry
Number of Acid Metering Pumps (Duty/Stand-By)	-	1 / 1	
H_2S Removal	%	99.5	Minimum removal rate through scrubber
Recirculation Pump Horsepower	HP	0.2	Each pump
Pressure Drop through Packing	i.w.c.	1.5	Assuming 0.15 i.w.c. per FT of packing; typical range is 0.1 to 0.2 i.w.c. per foot of packing
Scrubber Footprint Dimensions	FT	5	Diameter - includes concrete support pad assumed at 1 FT on each side. Does not include fan space.
Chemical Storage Design Criteria			
Caustic Soda Storage Tank Volume	gal	100	Polyprocessing vertical tank
Caustic Soda Storage Tank Diameter	FT	2	Selected tank is 5.6-FT tall
Hypochlorite Storage Tank Volume	gal	400	Polyprocessing vertical tanks
Hypochlorite Storage Tank Diameter	FT	3.75	Selected tank is 5.25-FT tall
Chemical Storage Footprint Area	FT x FT	12 x 22	Includes containment area
Chemical Storage Tank Material	-	HDPE	High-Density Cross-linked Polyethylene: Double Walled
Days of Chemical Storage	days	30	Maximum, design for 25 days

[1] *Water Environment Federation Manual of Practice (MOP) 25*

4.3 Pump Station 2 Odor Control Design Criteria

The recommended design criteria for PS 2 are shown below in Tables 4-3 and 4-4.

Table 4-3. PS2 General Odor Control Design Criteria

Parameter	Units	Value	Notes
Air Stream Design Criteria			
Total Air Flow Rate	cfm	19,300	Based on wet well volume and air changes per hour
Air Change Rate	ACH[1]	12/20	12 for wet wells, 20 for screen building
Total Air Stream H_2S Concentration	ppmv	5	Estimated for calculations purposes; typical range may be from 0 to 100 ppmv, depending on upstream conditions
Fan Design Criteria			
Number of Supply Fans (Duty/Stand-By)	-	5 / 1	One supply fan per wet well. Two duty supply fans for lower level of screening building. One duty fan and one standby fan for lower level of screening building.
Horsepower, Screen Building Supply Fan (Lower Level/Upper Level)	HP	3/1	
Horsepower Wet Well Supply Fan	HP	1	Current estimate; will be confirmed upon final duct routing
Number of Exhaust Fans (Duty/Stand-By)	-	4/1	Two duty fans and one standby fan for wet well and two duty fans for screenings building.
Horsepower, Screen Building Exhaust Fan	HP	10	
Horsepower Wet Well Exhaust Fan	HP	3	Current estimate; will be confirmed upon final duct routing

1 – ACH = Air Changes per Hour

Table 4-4. PS2 Chemical Scrubber Odor Control Design Criteria

Parameter	Units	Value	Notes
Chemical Scrubber Design Criteria			
Number of Scrubbers	-	1	Single-stage using hypochlorite and caustic
Vessel Diameter	FT	8	Based on maintaining the optimal design gas flow loading rate through scrubber
Gas Flow Loading	$lb/hr/FT^2$	2,000	Typical range is 1,800 to 2,250 (MOP 25)
Liquid Flow Rate	GPM	350	Also referred to as recirculation rate
Liquid Flow Rate	$lb/hr/FT^2$	3,500	Typical range is 3,000 to 4,000 (MOP 25)
Packing Height	FT	10	Standard height; typical range is 8 to 12 FT
Blowdown Flow Rate	GPM	7	Estimated at 2 percent of recirculation rate
Makeup Water Flow Rate	GPM	7	Assume equal to approximate blowdown rate
Hypochlorite (12.5% strength) Flow Rate	GPD	88.4	Typical average flow rate based on stoichiometry
Caustic Soda (25% strength) Flow Rate	GPD	9.1	Typical average flow rate based on stoichiometry
Number of Acid Metering Pumps (Duty/Stand-By)	-	1 / 1	
H_2S Removal	%	99.5	Minimum removal rate through scrubber
Recirculation Pump Horsepower	HP	2.8	Each pump
Pressure Drop through Packing	i.w.c.	1.5	Assuming 0.15 i.w.c. per FT of packing

Table 4-4. PS2 Chemical Scrubber Odor Control Design Criteria

Parameter	Units	Value	Notes
Scrubber Footprint Dimensions	FT	20	Diameter - includes concrete support pad
Chemical Storage Design Criteria			
Caustic Soda Storage Tank Volume	gal	615	
Caustic Soda Storage Tank Diameter	FT	4	Selected tank is 7.75-FT tall
Hypochlorite Storage Tank Volume	gal	2,750	
Hypochlorite Storage Tank Diameter	FT	8.2	Selected tank is 9.3-FT tall
Chemical Storage Footprint Area	FT x FT	16 x 28	Includes containment area
Chemical Storage Tank Material	-	HDPE	High-Density Cross-linked Polyethylene: Double Walled
Days of Chemical Storage	days	30	Maximum, design for 25 days

4.4 Pump Station 3 Odor Control Design Criteria

The recommended design criteria for PS 3 are shown below in Tables 4-5 and 4-6.

Table 4-5. PS3 General Odor Control Design Criteria

Parameter	Units	Value	Notes
Air Stream Design Criteria			
Total Air Flow Rate	cfm	6,900	Based on wet well volume and air changes per hour
Air Change Rate	ACH[1]	12	To meet NFPA Class 1, Division 1 requirements
Total Air Stream H_2S Concentration	ppmv	5	Estimated for calculations purposes; typical range may be from 0 to 100 ppmv, depending on upstream conditions
Fan Design Criteria			
Number of Supply Fans (Duty/Stand-By)	-	2 / 0	One fan per wet well.
Supply Fan Horsepower	HP	1	Current estimate; will be confirmed upon final duct routing
Number of Fans (Duty/Stand-By)	-	2 / 1	Constant speed exhaust fans One duty exhaust fan per wet well.
Exhaust Fan Horsepower	HP	5	Current estimate; will be confirmed upon final duct routing

1 – ACH = Air Changes per Hour

2 – TBD = To be Determined

2 – Estimated as the sum of methyl mercaptan, dimethyl sulfide, and dimethyl disulfide concentration

Table 4-6. PS3 Chemical Scrubber Odor Control Design Criteria

Parameter	Units	Value	Notes
Chemical Scrubber Design Criteria			
Number of Scrubbers	-	1	Single-stage using hypochlorite and caustic
Vessel Diameter	FT	8	Based on maintaining the optimal design gas flow loading rate through scrubber
Gas Flow Loading	$lb/hr/FT^2$	2,000	Typical range is 1,800 to 2,250 (MOP 25)
Liquid Flow Rate	GPM	140	Also referred to as recirculation rate
Liquid Flow Rate	$lb/hr/FT^2$	3,500	Typical range is 3,000 to 4,000 (MOP 25)

Table 4-6. PS3 Chemical Scrubber Odor Control Design Criteria

Parameter	Units	Value	Notes
Packing Height	FT	10	Standard height; typical range is 8 to 12 FT
Blowdown Flow Rate	GPM	3	Estimated at 2 percent of recirculation rate
Makeup Water Flow Rate	GPM	3	Assume equal to approximate blowdown rate
Hypochlorite (12.5% strength) Flow Rate	GPD	31.4	Typical average flow rate based on stoichiometry
Caustic Soda (25% strength) Flow Rate	GPD	3.2	Typical average flow rate based on stoichiometry
Number of Acid Metering Pumps (Duty/Stand-By)	-	1 / 1	
H_2S Removal	%	99.5	Minimum removal rate through scrubber
Recirculation Pump Horsepower	HP	1	Each pump
Pressure Drop through Packing	i.w.c.	1.5	Assuming 0.15 i.w.c. per FT of packing
Scrubber Footprint Dimensions	FT	7	Diameter - includes concrete support pad
Chemical Storage Design Criteria			
Caustic Soda Storage Tank Volume	gal	205	
Caustic Soda Storage Tank Diameter	FT	2.6	Selected tank is 6.2-FT tall (for preliminary design)
Hypochlorite Storage Tank Volume	gal	1,000	Volume sufficient for number of days of chemical storage
Hypochlorite Storage Tank Diameter	FT	7.2	Selected tank is 4.67-FT tall
Chemical Storage Footprint Area	FT x FT	15 x 26	Includes containment area
Chemical Storage Tank Material	-	HDPE	High-Density Cross-Linked Polyethylene: Double Walled
Days of Chemical Storage	days	30	Maximum, design for 25 days

Section 5: Bar Screens

Screens shall operate in parallel to provide multiple pathways for flow during maintenance or under PWWF conditions. During PWWF flow conditions, a minimum of two screens will be in operation. A total of three screen channels will run in parallel. Two screen channels will have mechanically cleaned bar screens (MCBS) and the third screen channel will consist of a manually cleaned bar screen. The MCBS shall be front-cleaned by multiple rake bars bolted at selected distances to a pair of drive chains. Each mechanically cleaned bar screen shall consist of a frame, bar rack, deadplate, chain drive assembly, multiple rake bars, discharge chute, gear reducer, motor, mounting brackets, local control panel, and all necessary appurtenances to provide a complete mechanical screening removal system. Designs that employ the use of cables or wire rope assemblies shall not be allowed. The rake bars shall transport the material up out of the sewage flow, across a deadplate and discharge to a fabricated sluicing channel which connects to the screenings conveyor. The mechanically cleaned bar screen rakes shall discharge into a sluicing channel and prevent debris from falling back into the channel. The sluicing channel will convey screenings into a single washer/compactor that will have sufficient capacity to handle solids from both mechanically cleaned bar screens. Screenings from the washer/compactor will be transported to a roll out dumpster by a chute.

Each channel and screen shall be capable of handling half of the PWWF or 19 mgd. Under ADWF, only one of the MCBS will be in operation. Two of the MCBS will operate during PWWF. In the event that both MCBS are out of operation or one MCBS is out of service during a PWWF event, flow will be bypassed to the manually cleaned bar screen channel with a capacity of half the PWWF. SVCW is considering whether each screen should be able to accommodate the full PWWF of 38 MGD for complete mechanical redundancy.

5.1 Performance Guidelines

Bar screens shall be suitable for installation under the conditions in Table 5-1.

Table 5-1. Mechanical Bar Screen Criteria

Peak flow per screen, mgd	19.0
Approach velocity range, FT/s	1.25 – 2.5
Maximum velocity through bars, FT/s	3.0
Channel width minimum, FT	3.5
Channel depth minimum, FT	4.5
Maximum upstream water depth, FT	4.0
Minimum approach length, FT	Twice the screen width
Angle from horizontal, degrees	70-80
Clear spacing between bars, inches	0.75
Bar diameter, inches	0.25
Screen Wash water source	Reclaimed
Material:	
Bar rack	Type 304 stainless steel*
Deadplate	Type 304 stainless steel*
Discharge chute	Type 304 stainless steel*
Cleaning rake, rake arms, and wiper	Type 304 stainless steel*
Side frames	Type 304 stainless steel*
Fasteners and miscellaneous hardware	Type 316 stainless steel*
Connecting arms (rake arms excluded)	Type 304 stainless steel*

Note:

**Type 316 stainless steel shall be considered during final design.*

The approach velocity in the screen channel should be a minimum of 1.25 FT/s during minimum flow for at least one hour of the day to minimize solids deposition in the channel. The maximum slot velocity (through the screens) should not exceed 3.0 FT/s during PWWF.

The maximum upstream water depth shall be based on maintaining normal flow in the incoming sewer line to prevent surcharge.

5.2 Cutthroat Flume

A cutthroat flume shall be installed in each screen channel following the bar screens to regulate the velocity in the channel. Flumes shall be designed to maintain a minimum 20-inch water level differential downstream of the screens during ADWF. The flume shall be designed for free flow conditions during PWWF. The depth of the flume shall be the depth of water in the screen channel during PWWF minus the headloss through the screen.

The following discharge equation of free flow through a cutthroat flume from the Isco Open Channel Flow Measurement Handbook, 5th Edition can be used to determine the width of the flume.

$$Q = KW^{1.025}H^{n_1} = CH^{n_1}$$

Q = flow rate
H = head measured at point H_a
K = free flow coefficient
C = free flow coefficient
W = throat width
n_1 = free flow exponent

K and n_1 depend on the flume length. Values for these coefficients can be found in Table 4-9A from the Isco Open Channel Flow Measurement Handbook, 5th Edition.

5.3 Conveyance

Screened material shall be discharged from the high point of the screen through a chute directly into the washer compactor. Discharge chutes shall be 3/16 inch minimum thickness, suitably reinforced to withstand impacts from large objects (e.g., branches, building materials, etc.) which may occasionally be removed by the rake mechanism.

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A. ATTACHMENT

Civil Design Criteria and Geotechnical Requirements

This attachment outlines the parameters which will form the basis for general civil design including vehicular access to the new or replaced facilities and structures, site drainage, and site grading, and yard piping.

A.1 Purpose

The purpose of this document is to guide the pump station final design teams and to ensure consistent quality and similar facilities for ease of operation and maintenance. This document is meant to be a working document for the design teams such that during the design, changes can be made based on design team review and consensus.

A.2 Codes and Standards

The site work will in compliance with the applicable portions of the following codes and standards:

1. Local respective zoning ordinances (City of Menlo Park, Belmont, San Carlos, Redwood City, and San Mateo County).
2. California Building Standards Code (CBC), latest Code edition adopted by the State of California at the time of design.
3. American Nation Standards Institute (ANSI) standards.
4. U.S. Department of Labor Occupational Safety and Health Act (OSHA).
5. American Society for Testing and Materials (ASTM) standards.
6. State of California Department of Transportation, Standard Specifications, Latest Edition
7. State of California, Department of Transportation, Standard Plans, 2002.
8. State of California, Department of Transportation, Highway Design Manual, 5th Edition, 1995 with amendments.
9. West Bay Sanitary District, City of Belmont, San Carlos, and Redwood City Standard Details.
10. City of Menlo Park, San Carlos and Redwood City Storm Drainage Criteria.

A.3 Soil Information

The geotechnical information, criteria, and recommendations in the geotechnical report entitled “Draft Predesign Geotechnical Interpretive Report (GIR) South Bayside System Authority Pump Station Predesign,” November 2013, prepared by DCM Consulting, Inc. will be used in the design of civil/general site development facilities.

For the final design of the three pump stations, it is recommended that two Cone Penetrometer Tests (CPT) to depths of 75 to 100 feet or refusal at each pump station site be performed to generate a continuous soil profile and serve as the basis for liquefaction settlement analysis. Pore pressure dissipation tests should be performed at all sand layers encountered to evaluate artesian groundwater pressures, if present. The CPT profile/data and seismic setting can then be entered into the computer program LiquefyPro (or equivalent) to evaluate individual sand layers that are likely to liquefy and to estimate the resultant seismic settlement (if any) at the ground surface and at the base of the pump stations.

A.4 General

New facilities to be constructed on the pump station sites include pumps, piping, wet wells, valves, valve vaults, and new building structures for one or more of the pump station sites. The following objectives shall be met with the pump station upgrades:

1. Provide vehicle and pedestrian access to new and upgraded facilities and structures.
2. Provide site grading to minimize earthwork and achieve positive drainage of storm water runoff, whether it be discharged offsite or to the wet well.
3. Provide a secure site.
4. Proper connections to new forcemains.
5. Proper removal of transfer of flows from old pump station to new forcemain.
6. Proper removal and/or abandonment of old pump station facilities.

A.5 Utility Coordination

New utility services will be provided for the new pump stations. The following objectives shall be met with for utility services:

1. Coordination with existing services so that existing pump stations are operational during construction of new, replacement pump stations.
2. Provide fire service lateral to each pump station with proper reduced pressure backflow prevention assemblies. Fire service will provide optional fire sprinkler service and fire hydrant(s). Coordinate with appropriate water departments.
3. Provide domestic water service to each pump station with proper reduced pressure backflow prevention assemblies. Domestic water will provide water for miscellaneous potable needs at each pump station site. Coordinate with appropriate water departments.
4. Provide recycled water service at PS2 and PS3 sites. A 6-inch line from the main RCW line will be provided to each site. Potential uses for RCW are wash down water, chemical scrubber for odor control, screen spray water, screen sluice channel water, and general uses such as toilet flushing and irrigation.
5. Provide major upgrade to electrical services as needed for each pump station. Coordinate with PG&E.
6. Existing utilities may need to be relocated to allow for the installation of new facilities.

A.6 Driveway Layout/Traffic Access

New driveways and drive aisles will be constructed to allow vehicle access to and around the proposed facilities. The following shall be the criteria for design:

1. Asphalt pavement section at all pump stations should consist of a minimum of 3 inches of asphaltic concrete over 12 inches of Class 2 aggregate base rock or as recommended by the geotechnical engineer for pavement sections placed over bay mud.

2. Pavement subgrade soil must be scarified to a depth of 8 inches; moisture conditioned to near optimum moisture content and compacted to a minimum of 95 percent relative compaction per ASTM D1557.
3. Asphalt pavement section replacement in City streets must match existing but in no case should be less than 3 inches of asphaltic concrete over 12 inches of aggregate base rock compacted to a minimum of 95 percent relative compaction per ASTM D1557.
4. Driveways and drive aisles should be designed to a maximum width allowed on each pump station site. This will be site specific based on site constraints. Similarly, turning radiuses shall be maximized based on site constraints. Obtaining a 50' turning radius should be the objective.
5. Improvement details for driveway curb cuts within public right of ways shall be per Standard Details.

A.7 Survey Control

Vertical control for this project will be NGVD 29' datum +100'. Horizontal control will be based on the NAD 83.

A.8 Site Grading

All design site grading and earthwork will be in accordance with the following:

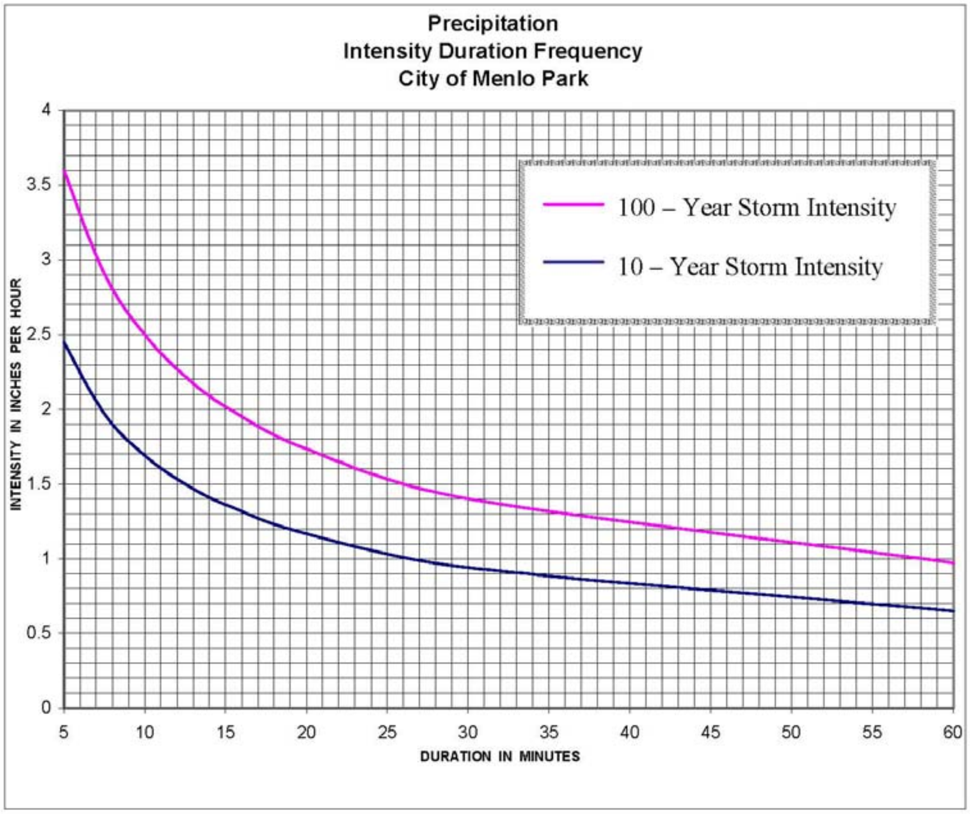
1. Earthwork will meet the minimum design criteria and recommendations of the Geotechnical Data Report by Jacobs Associates, October 22, 2013.
2. Site grading plans shall show intended flow arrows as well as spot elevations
3. Cut slopes shall be 1:1(H:V) maximum up to 20 feet high. Fill slopes will be no greater than 10 percent.
4. Areas that require fill shall be compacted to 90 percent minimum in accordance with ASTM D1557. Areas that will support vehicle pavement structural sections shall have the upper six inches compacted to a minimum of 95 percent.
5. Structural and utility trench backfill shall be per the recommendations of the geotechnical report.
6. Grading will provide positive drainage of storm water runoff and will be collected to pump station wet wells.
7. Sea level rise should be accounted for in the final designs for each pump station site.
8. Retaining walls may be required at the PS2 site. Retaining walls shall be composed of cast-in-place concrete.

A.9 Drainage

The following criteria will be followed for drainage design at each pump station:

1. Storm drainage systems at each pump station will be designed for a 10 year return period. See Figures A-1, A-2, and A-3 for intensity-duration-frequency (IDF) curves for Menlo Park, Redwood City, and San Carlos. Storm runoff will be diverted to the new wet well structures.
2. Storm drainage structures such as drop inlets and curb inlets will be consistent to all pump stations. Inlets shall be 18"x18", H-20 full vehicular traffic rated.
3. Storm drain piping shall be High Density Polyethylene, SDR 17.

4. Curb containment is required for the diesel fuel storage areas. A sump should be placed within the containment area to collect rain water and spills. The sump should be valved and drained to a manhole upstream of the wet well.
5. Local drainage to the wet will should be provided for certain areas within the pump station sites. These areas include diesel fuel storage areas, pump lift areas next to each wet well, chemical storage areas, etc. This is to be determined in final design. Other areas should drain to municipal storm drain systems.



Station	Statio No	County	Lat	Long.	Elev.	Source	Yrs Rec	Slope	Intercept
Menlo Park	E70 553 20	San Mateo	37.451	-122.186		USGS	5	0.462	0.439

CITY OF MENLO PARK STANDARD DETAILS

NO.	REVISIONS	DATE

ATTACHMENT C
MENLO PARK IDF CURVE

APPROVED

Director of Engineering Services R.C.E. No.40998

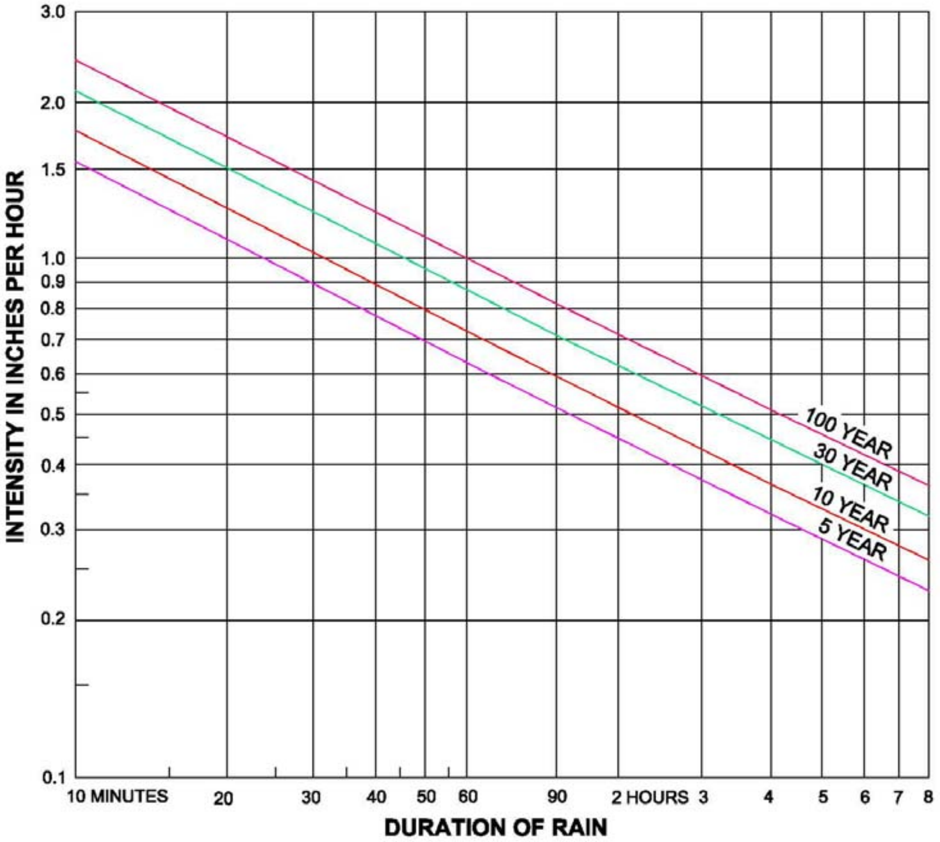
DRAWN DL
CHECKED PS
DATE 07/30/08
SCALE NTS
SHEET

STD. DETAIL No.: IDF

Figure A-1. Menlo Park IDF Curve

ATTACHMENT G

I.D.F. CURVES



RAINFALL INTENSITY FREQUENCY CURVES FOR REDWOOD CITY

Figure A-2. Redwood City IDF Curve

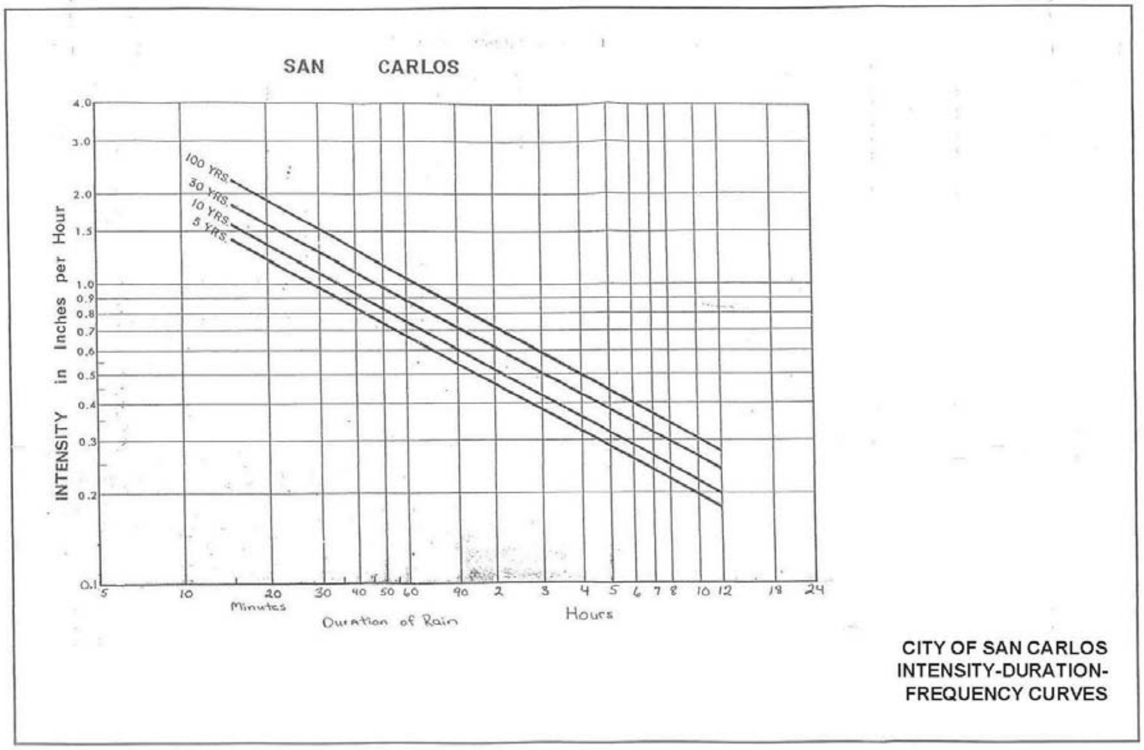


Figure A-3. San Carlos IDF Curve

A.10 Site Security/Access

The following criteria will be followed for site security/access at each pump station:

1. Fencing shall be composed of PVC coated chain link with razor wire.
2. Motorized gate controlled by key pad will be provided at each pump station. Material for gates shall be ?
3. Lighting at each station will be designed with a minimum 1footcandle illumination. Lighting shall be LED and standard established and installed at each pump station.
4. Access to PS2 from the police site. Potential easements will be identified in pre-design. Actual easement process will be part of final design.

A.11 Surface Conditions

The following criteria will be followed for surface conditions at each pump station:

1. Site will be paved with either asphalt concrete (AC) or concrete. Concrete will be placed in loading areas or in storage areas where degradation of AC may occur due to material being stored.
2. Landscaping shall be included at each pump station site. PS2 and PS3 will be coordinated with appropriate City agencies. PS1 will require coordination with the West Bay Sanitary District and the City of Menlo Park due to the City's desire for adjacent intersection to be a "gateway" to the city.

A.12 Standard Details

See Attachment N for standard details. These details include:

1. City of Belmont, City of San Carlos, City of Redwood City and West Bay Sanitary District Standard manholes.
2. Driveway details for the City of San Carlos and the City of Redwood City.
3. Manhole and frame and cover detail for manholes with pump station sites.

B. ATTACHMENT

Security Criteria

The Security Criteria is based on the SVCW (formerly SBSA) Security Guidance Document, September 2011.

B.1 Purpose

The purpose of this document is to guide the pump station final design teams and to ensure consistent quality and similar facilities for ease of operation and maintenance. This document is meant to be a working document for the design teams such that during the design, changes can be made based on design team review and consensus.

B.2 Pump Station 1 (Menlo Park Pump Station)

Pump Station 1 (PS1) should be designed with additional security beyond what is installed at the existing station, such as providing door locks, intrusion alarms, and automation ability with operational parameters used as I/O for the SCADA system to allow remote monitoring. The chemical scrubber shall have a separate security system such as a keypad with an alarm upon opening without permission and should be connected to SCADA. There is an exterior, above-grade diesel fuel tank that will require separate security treatment, such as a separate enclosure, fence and gate, and/or sensors on the tank itself that are provided with alarms connected to SCADA.

B.3 Pump Station 2 (Redwood City Pump Station)

PS2 will require perimeter security and door sensors with alarms for intrusion. The chemical storage tank area shall have a separate security system such as a keypad with an alarm upon opening without permission. All of these alarms should be connected to SCADA. There is an exterior, above-grade diesel fuel tank that will require separate security treatment, such as a separate enclosure, fence and gate, and/or sensors on the tank itself that are provided with alarms connected to SCADA.

B.4 Pump Station 3 (San Carlos/Belmont Pump Station)

PS3 will require perimeter security and door sensors with alarms for intrusion. The Chemical storage tank shall have a separate security system such as a keypad with an alarm upon opening without permission. All of these alarms should be connected to SCADA. Valves shall be separately protected with tamper-resistant valve covers and separate alarm conditions for valve position (e.g., closed when should be open will trigger alarm to SCADA). There is an exterior, above-grade diesel fuel tank that will require security treatment, such as a separate enclosure, fence and gate, and/or sensors on the tank itself that are provided with alarms connected to SCADA.

B.5 Security Data

Incident reports, instructions on handling security data, catalogues of key holders and account numbers and security codes for keypads should all be given special consideration in the data storage scheme.

B.6 Supervisory Control and Data Acquisition (SCADA)

The SVCW SCADA system is comprised of SCADA Servers, SCADA Workstations, Programmable Logic Controllers (PLC) to control individual processes, and network/communications infrastructure. The system has distributed logic such that the individual PLCs can operate independent of the server. Workstations will be located at remote pump stations. Recommended physical security of the SCADA equipment includes:

B.6.1 Instrumentation

Critical instruments for process control should be located within locked cabinets or buildings, with perimeter protections preventing easy access of vandals.

B.6.2 PLC/SCADA Network Panels

Panels should be located in locked, access-controlled buildings. PLCs and SCADA Network equipment should be within locked cabinets. Door switches should be included to provide operator notification through SCADA on access into the PLC or SCADA network panel.

B.6.3 SCADA Workstations

SCADA Workstations should be located in locked, access-controlled buildings. Control for all workstations located outside of the plant server room or plant control room shall require authentication in the form of individually identifiable accounts, with access being logged. Door switches should be included to provide operator notification through SCADA on access into the workstation panel.

B.6.4 Pump Station Network Cabling (including Fiber Cables)

Network cabling should be encased in conduits. All access points to the cabling should be locked or sealed to prevent easy access. Redundant physical paths for in-plant networks should be provided.

B.6.5 Pump Station Remote Communications

Remote communications cabling should be encased in conduits. All access points to the cabling should be locked or sealed to prevent easy access. Dual communications paths should be provided. Encryption should be considered during the design.

B.6.6 Environmental Controls

PLC and SCADA Servers, Workstations, Network Equipment, and PLCs should be installed to avoid flood areas. Seismic bracing should be provided for all SCADA equipment, including all workstations. Power should be protected from surges, with adequate backup and redundancy to maintain power through typical failures.

B.6.7 Security Cameras

Security cameras on SCADA shall be fixed focus and evaluated on a case by case basis. If security systems/measures require separation from the SCADA network, these systems will need to be reviewed and approved by SVCW. PTZ, if used, cannot be controlled by the SCADA network.

B.6.8 Other Considerations

Physical equipment failure protection should be provided in the form of highly available architectures (unit redundancy) to include alternate physical cable paths. Considerations must also include highly available logical data flow paths. These paths can be adversely affected through logical or physical means. Actively monitored access, logical and physical must occur. This includes SCADA servers and workstations as well as User Account control servers which may or may not reside inside of physically secure plant perimeters.

B.7 Summary

Table B-1 below summarizes all of the major recommendations by feature.

For further explanation, refer to the appropriate feature section in the above discussion.

Table B-1. Security Features at Each Pump Station

Feature	Perimeter Fence and Gate	(Interior) Fence and Gate	Gate / Door Locks	Electronic Key Card or Key Pad Access	Intrusion Alarm	PTZ/ Fixed-Focus Cameras	SCADA-based alarm	Hatch locked	Signage	Other	Special Considerations and Notes
PS1	✓		✓		✓	✓	✓	✓	✓	✓	Inlet Structure, Exterior Diesel tank
PS2	✓		✓	✓	✓	✓	✓	✓	✓	✓	Chemical Storage Tank, Inlet Structure
PS3	✓		✓	✓	✓	✓	✓	✓	✓	✓	Graffiti-resistant paint

C. ATTACHMENT

Corrosion Control

For design criteria for Corrosion Control, please refer to the Soils Corrosion Investigation and Control TM by V&A, January 8, 2014 located in Appendix G of the Conveyance System Pump Station Predesign Report.

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D. ATTACHMENT

Architectural Design

Will be completed as part of final design.

E. ATTACHMENT

Structural Design

This section describes the structural design guidelines that will be used for design of the SVCW pump stations, both building and non building structures, including applicable codes and standards, design load criteria, and materials of construction.

E.1 Purpose

The purpose of this document is to guide the pump station final design teams and to ensure consistent quality and similar facilities for ease of operation and maintenance. This document is meant to be a working document for the design teams such that during the design, changes can be made based on design team review and consensus.

E.2 Codes and Standards

The project shall be designed to comply with applicable portions of the codes and standards listed in Table E-1 below. The edition of codes shall be the latest edition adopted by the State of California at the time of the project final design. The edition of the referenced standards shall be the latest published edition at the time of the project final design:

Table E-1. Codes and Standards for Structural Design

Reference	Title
ACI 318	Building Code Requirements for Structural Concrete and Commentary
ACI 350	Code Requirements for Environmental Engineering Concrete Structures and Commentary
ACI 350.1	Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures and Commentary
ACI 350.3	Seismic Design of Liquid-Containing Concrete Structures and Commentary
ACI 530	Building Code Requirements for Masonry Structures
AISC 341	Seismic Provisions for Structural Steel Buildings
AISC 360	Specification for Structural Steel Buildings
AISC Manual of Steel Construction	
ASCE 7	Minimum Design Loads for Buildings and Other Structures
Aluminum Association - Aluminum Design Manual	
AASHTO	American Association of State Highway and Transportation Officials - Standard Specifications for Highway Bridges
CMAA	Crane Manufacturers Association of America - Specifications No. 70 and 74 for Cranes
AWS - D1.1	American Welding Society - Structural Welding Code
CBC	California Building Code, with local amendments

Table E-1. Codes and Standards for Structural Design

Reference	Title
OSHA	Code of Federal Regulations, 24 CFR Part 1910, Occupational Safety and Health Administration Standards, with local amendments
All applicable state and local codes	

E.3 General Service Loads

E.3.1 Dead Loads

Dead loads shall consist of the weight of the structure and all equipment of a permanent or semi-permanent nature including but not limited to pumps, cranes, and HVAC equipment. A superimposed dead load of 20 pounds per square foot (PSF) shall be included in the design of floors and roof structures to account for HVAC ductwork, piping, electrical wiring and lighting. Partition loading allowance shall be computed on the basis of materials used.

Minimum live loads shall be as stated in the CBC, except as stated in Table E-2 below:

Table E-2. Minimum Live Loads by Location

Location	Live Load
Process Areas	Equipment + 50 PSF or 200 PSF minimum or maximum fork lift wheel loads, whichever governs
Mechanical Rooms	150 PSF and 2,000 pounds concentrated load
Electrical/Control Rooms	300 PSF
Storage Areas	250 PSF
Corridors, lobbies, stairways	100 PSF
Catwalks, platforms for access only	100 PSF
Slab-on-grade (vehicle area)	250 PSF
Deck-at-grade (vehicle area)	HS-20 loading or applicable crane/vehicle loading
Building Roof	20 PSF + Equipment Load or 50 PSF, whichever governs
Grating, checkered plate, and hatches	125 PSF or same as adjacent area, whichever is greater

E.3.2 Crane and Monorail Loads:

Design of crane girders or runway beams, monorail beam and supports will be in accordance with CMAA Specifications No. 70 & 74, and AISC Manual of Steel Construction.

E.3.2.1 Lift operation:

- Impact for crane: 25 percent of lift load and trolley/bridge weight
- Impact for monorail: 50 percent of lift load and trolley/bridge weight.
- Lateral force: 20 percent of lift load and trolley/bridge weight.
- Longitudinal force: 10 percent of lift load and trolley/bridge weight.

E.3.2.2 Limitation on deflection:

- Maximum crane girder (not including impact load): L/1000
- Maximum monorail beam (not including impact): L/1000
- Maximum crane girder or monorail beam horizontal deflection (not including impact): L/400
- Where L= span length
- Centrifugal force and torsion shall be considered on curve track.

E.3.3 Heavy Equipment Loads

In areas subject to heavy equipment traffic, the structures shall be capable of supporting existing and planned vehicle loads including impact such as forklifts, maintenance vehicles, mobile cranes, etc. Consideration shall be given for moving, stationary, and operational loads (such as crane setup to lift equipment loads), including expected Contractor’s equipment to be used during construction.

All equipment gallery floors, ground level floors with large access doors shall be designed for forklift loads or any anticipated maintenance vehicle loads.

The design engineer shall coordinate with the SVCW Mechanical Maintenance group to obtain information regarding typical vehicle and forklift used at the facilities.

E.3.4 Differential Settlement Loads

For backfilled foundations, the structure shall be checked for a minimum 1/4 inch differential settlement over 20 feet, or as recommended by the geotechnical engineer.

E.3.5 Mechanical Vibration Control

Critical dynamic response of framing supporting vibrating machinery shall be at least fifty percent out of phase with the disturbing force.

E.4 Seismic Loads

Seismic loads and design requirements shall conform to the CBC and the ASCE 7.

- The Seismic Design Category = D, per CBC Section 1613.5.6.
- The SVCW pump stations are considered “Essential Facilities”, Risk Category IV.
- Importance Factor (I) = 1.5.
- Seismic loads due to earth pressure shall be specified in the project specific geotechnical report.
- Hydropneumatic tanks and small storage tanks shall be designed using the inertia forces from the weight of the tank and its contents.

E.5 Wind Loads

Wind loads and design requirements shall conform to the CBC.

- The pump stations are considered an “Essential Facility” Risk Category IV.
- The SVCW pump stations are located in basic wind speed zone of 115 mph per ASCE7-10.
- The Pump Stations are located in Exposure Category C.
- The Topographic Factor (K_{zt}) = 1.0.

E.6 Soil Information

A Predesign Geotechnical Data Report (GDR) by Jacobs Associates and a subsequent Predesign Geotechnical Interpretive Report (GIR) by DCM Consulting, Inc. were prepared for the project. The design engineer shall be responsible for establishing the actual scope of work for the final GDR and GIR. The GIR shall address all of the information needed for compliance with codes, structural design, buried piping, roads, walkways, and other design elements. The GIR provides information for specific construction concerns related to the integrity of sewers, pavement and structures. Recommendations for use in design include:

- Recommendations for type and depth of foundation. Include alternate systems such as piles or other deep foundation system where required.
- Allowable soil bearing pressures for spread footings – Dead Loads, Dead Loads + Live Loads, Dead Loads + Live Loads + short duration loads such as Wind and Earthquakes.
- Mat foundations: allowable bearing pressures, modulus of subgrade reaction, maximum differential settlement.
- Settlement potential, including total and differential settlement estimates. Differential settlement shall be given for a specific distance.
- Allowable lateral earth pressures – Active, at-rest, passive.
- Surcharge loading – Construction, traffic.
- Friction factors – Soil to concrete base, soil to concrete wall, angle of internal friction.
- Seismic earth pressures and parameters.
- Potential geologic and seismic hazards such as ground shaking, liquefaction potential, and liquefaction induced settlement.
- Groundwater table elevation. If groundwater table is expected to be high, a pumping test shall be required to determine dewatering parameters for inclusion in the specifications.
- Buried structures shall be checked for adequacy for buoyant forces. Minimum safety factor against buoyancy shall be 1.5 for normal ground water elevation, and 1.1 for flooding water elevation.
- Describe and categorize soil types and soil excavation, identify location of hard and stiff soils, evaluate on-site soil backfill suitability, provide backfill compaction criteria and pipe bedding requirements, provide trench shoring requirements.
- Provide recommendations for excavations: Sloped excavations using sheeting and shoring, and recommendations for excavations adjacent to existing structures.

- Address in detail the excavation impact of the proposed work on all existing utility trenches in the vicinity of the proposed project. Evaluate the potential collapse of the earth prism located between existing parallel utilities and the trench excavated for any proposed utility installation.
- Evaluate soil contamination and identify potential for off-site disposal requirements and locations.

E.7 Liquid Loads

A unit weight of 65 pounds per cubic foot (pcf) will be used for the design of structural elements in contact with liquid. The maximum operating fluid level will be used for the static load case. Environmental durability factors in accordance with ACI 350 for a severe environmental exposure will be applied to fluid loads for the static load case. In addition to the static load case, maximum fluid level to the top of an open containment or to the maximum level possible due to overflow will be used for the overflow case. Environmental durability factors will not be applied to the overflow loading condition. Increased liquid pressures due to seismic hydrodynamic effect will be considered in the design assuming a water level at the maximum operating fluid level.

E.8 Load Combinations

The above loads will be combined in accordance with Section 1605 of the CBC for non liquid containing structures. For liquid containing structures, the above loads will be combined in accordance with ACI 350, Section 9.2.1. An environmental durability factor will be applied to load combinations for liquid containing structures as required by Section 9.2.6 of ACI 350.

The design should account for at least two basic soil loading conditions. The first condition to account for is when the tank is empty and the hydrostatic load is not available to counteract the soil pressures. The second condition to account for is when the tank is full to the normal operating level and there is no soil backfill to counteract the hydrostatic pressures. This condition represents the basin during the water tightness test when the tank is filled, but not backfilled.

Vehicular access will be provided to the top of any basin that exceeds 100 feet in any principal direction for removal and maintenance of equipment.

E.9 Structural Systems

Structures should be designed with appropriate and adequate vertical and lateral load resisting systems. A description of the structural lateral load resisting systems shall be provided in the structural calculations and on the drawings.

E.10 Materials – General

General specifications for construction materials shall be as specified in the applicable project technical specifications.

The following is a list of guidelines to be used with the specific materials.

E.10.1 Concrete

All construction and expansion joints shall be shown on the contract drawings. Construction joints shall be placed at points of least shear in the element. The distance between construction joints shall not be more that 40 feet. All construction and expansion joints in liquid-containing structures shall be provided with waterstops.

Minimum shrinkage reinforcing shall comply with ACI 350. Contraction joints will not be considered as a “movement joint”. Only full expansion joints will be considered as a “movement joint” to reduce the minimum shrinkage and temperature reinforcement.

For the purpose of determining the maximum allowable stresses of the flexural reinforcement in accordance with ACI 350, all environmental exposures should be assumed to be “severe”.

Interior surface of the wet-wells fillets shall be provided at wall to floor joints to prevent debris accumulation.

Reinforcing steel shall conform to ASTM A615 or ASTM A706, Grade 60.

Below grade and liquid-containing concrete structures shall be designed to conform to ACI 350. Special attention shall be taken with the performance specifications for concrete for obtaining durable, low shrinkage, concrete mix designs.

Interior surfaces of wet-wells exposed to raw sewage or sewer gas shall be protected by a lining system such as PVC or HDPE. Concrete structures that are protected with a lining system shall have seams located at least 12 inches away from 90-degree corners.

E.10.2 Masonry

Reinforced masonry shall be designed in accordance with Chapter 21 of the CBC and ACI 530.

Masonry structures shall be designed using a specified compressive strength (f’m) of 1,500 psi. Higher compressive strengths require more expensive prism testing and more comprehensive special inspection program.

All reinforced masonry construction requires special inspection.

E.10.3 Structural Steel

All structural steel members and connections shall be designed and detailed in accordance with AISC Specification for Building Structures. The design of structural connections shall not be left to the detailed shop drawings.

All structural steel connections shall be made with high strength bolts conforming to ASTM A325 Type N, bearing type connections with threads excluded from the shear plane, unless otherwise required by the design. The use of machine bolts shall be limited to non-structural applications.

All steel welding qualification and workmanship shall be in accordance with AWS.

Wide Flange shapes shall conform to ASTM A992, Grade 50.

Hollow Structural Sections (HSS) shall conform to ASTM A500, Grade B.

Structural Steel Pipe shall conform to ASTM A53, Grade B.

E.10.4 Stainless Steel

Type 316 stainless steel bars, shapes, plates, fasteners, and anchor bolts shall be used in corrosive damp or submerged areas for long life and low maintenance. For motor control centers (MCCs) Type 316 Stainless (a Molybdenum containing grade) shall be used.

E.10.5 Aluminum

Aluminum shall not be used without specific approval by SVCW.

Aluminum shall be selectively used for miscellaneous structural support systems, walkway grating and diamond plate, hand railing and guard railing, and at cover plates used for odor control. Severe corrosion conditions shall be considered before specifying aluminum.

Aluminum alloy for structural shapes, bars, plates, and sheets shall be 6061-T6.

Bolts and fasteners for aluminum fabrication shall be Type 316 or Type 304 stainless steel.

E.10.6 Fiberglass Reinforced Plastic

Fiberglass reinforced plastic (FRP) or reinforced thermoset polyester (RTP) shall not be used without specific approval by SVCW.

FRP or RTP shall be selectively used for grating, guardrail, and cover plates in corrosive areas, explosive environments, or electrical areas.

A responsible party specializing in fiberglass design shall design FRP or RTP structural elements.

FRP and RTP products shall be manufactured using pultruded process utilizing either flame retardant isotropic polyester or a flame-retardant vinyl ester resin containing an ultra-violet (UV) inhibitor.

E.10.7 Wood

The use of wood construction in permanent structures shall be limited to nonstructural applications such as nailers, cabinetry, etc.

E.11 Seismic Bracing

Seismic bracing shall be included in the design for pipes larger than 12-inches, HVAC, electrical conduits, and light fixtures.

Seismic bracing for pipes larger than 12-inches, non-standard bracing systems for critical equipment, or where the location of the seismic bracing is critical, shall be located on the contract documents.

E.12 Design Loads on Drawings

In order to furnish information for future use, all live loads used in the design of a structure shall be listed under the general notes on the standard structural drawings.

For loadings that do not comply with the general notes, loading information shall be shown and noted on the plan of the area being designed for the special loads.

E.13 Serviceability

Structural systems and members shall be designed to have adequate stiffness to limit deflection and lateral drift. The deflection of structural members over span, shall not exceed that permitted by the Table E-3 below.

Table E-3. Deflection of Structural Members Over Span

Element	Deflection
Steel Floor Plates and Gratings	L/240 Live Load
Beams, Lintels, or Slabs Supporting Masonry	L/720 (3/8 inch maximum for lintels above windows) total load
Roof without Ceilings Roof with Ceilings	L/240 Live Load, L/180 Total Load L/360 Live Load, L/240 Total Load
For metal roof decks without built-up roofing or ceilings	L/180LiveLoad
Floors	L/360LiveLoad,L/240TotalLoad
Steel	RefertoAISC360.
Concrete	RefertoACI318andACI350.

E.14 Special Inspection

Designers shall specify on the structural drawings where special inspections per the CBC are required.

At SVCW, special inspection will typically be required for foundation subgrade preparation, deep foundation systems, reinforcing steel placement for concrete structures, concrete placement, structural steel welding, structural steel connections, reinforced masonry, and post-installed anchor bolts.

Where special inspections are required, the designer shall develop a procedure for the special inspector to follow. The procedure shall include a narrative description of duties, forms, checklists, and any other measures to verify compliance with special inspection requirements. These procedures shall be discussed with the construction manager prior to construction.

E.15 Condition Assessment and Seismic Evaluation of Existing Facilities

The design engineer shall conduct a thorough condition assessment and seismic evaluation of the existing facilities that will need to be modified to accommodate the proposed improvements. The seismic evaluation shall be based on the latest American Society of Civil Engineers (ASCE/SEI) 31- Seismic Evaluation of Existing Buildings. The seismicity level and performance level shall be determined between the Design engineer and SVCW. Structures housing emergency equipment required for the operation of the facilities shall be evaluated for the Immediate Occupancy Performance Level.

E.16 Seismic Rehabilitation of Existing Facilities

If the seismic evaluation of the existing facilities reveals that the structure(s) require rehabilitation then the structure(s) shall be retrofitted based on the latest American Society of Civil Engineers (ASCE/SEI) 41- Seismic Rehabilitation of Existing Buildings.

E.17 Standard Details

Standard details are included in Attachment N.

F. ATTACHMENT

Process and Instrumentation Diagram Requirements

The purpose of this document is to guide the pump station final design teams and to ensure consistent quality and similar facilities for ease of operation and maintenance. This document is meant to be a working document for the design teams such that during the design, changes can be made based on design team review and consensus.

Process and instrumentation diagrams (P&IDs) provide a schematic representation of process piping, equipment, instrumentation and connections to the area, the Programmable Logic Controllers (PLCs) and the main Supervisory Control and Data Acquisition (SCADA) System. P&IDs shall follow the International Society of Automation (ISA) standards and the latest SVCW Automation Standards.

Example P&IDs are shown in the Pre-Design Drawings. Lines and symbols used on the P&IDS are shown on the Instrumentation Symbol Sheet in the SVCW CAD Standards Design Production Standard (DPS) 5.0 (SVCW's CAD Standards).

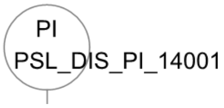
The P&IDs shall be divided into three distinct sections with a dividing line between each section:

1. **Field.** This section of the P&IDs includes equipment and instrumentation located at the pump station sites and is located at the base of the sheet. Major equipment is identified with an equipment number and common name at the bottom of the diagram. Local control panels are also located within the field section.
2. **Motor Control Center (MCC).** MCCs for motor-operated equipment shall be located in the MCC section. MCCs typically include motor circuit breakers, variable frequency drives, programmable controllers, and metering. This section is located between the Field and PLC sections. In some cases, there are no MCCs present; therefore, the MCC section may be eliminated if unnecessary.
3. **PLC.** SCADA tag naming, descriptions, and equipment input/output (I/O) are located in the PLC section. This section is located at the top of each sheet. SCADA tag naming and description conventions shall be per the latest SVCW Equipment & Tag Naming Documents. Standard equipment I/O conventions shall be per latest SVCW Equipment & Tag Naming Documents. In the PLC section, the Control Panel shall be named and numbered in the top left corner of the P&ID drawing.

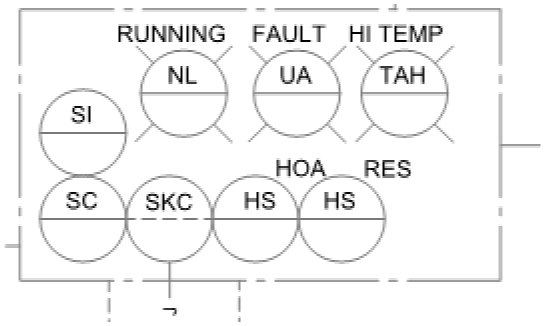
Process flow on each diagram shall be from left to right. Sheet references to areas that flow into the process area shall be located on the left edge of the field section. Page references to which the process area continues on to are located on the right side of the field section.

Additional project-specific considerations that apply to the P&IDs include instrument identifiers, panel indicators, and SCADA I/O Tag Names. Instrument Identifier Bubble and Panel Indicator Bubble conventions and SCADA I/O Tag Names standards shall be labeled and displayed using the following criteria.

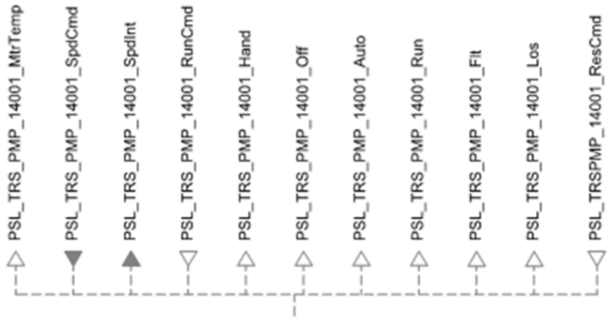
1. **Instrument Identifier Bubbles.** Each instrument bubble will need to include the full instrument name. For example:



2. **Panel Indicator Bubbles.** Equipment numbers shall not be included in the panel indicator bubbles because there is insufficient physical space on the drawing to add the complete tag name. For example:



3. **SCADA I/O Tag Names.** Only the tag shall be shown in the PLC Section of the P&IDs. The tag shall use the Equipment Tag Name, with the appropriate I/O suffix as defined in Table 7-3 of the SBSA's Automation Standards (latest revision, March 2012). Additional I/O suffixes that are not specifically included in Table 7-3 shall be coordinated with SVCW. An example of the SCADA I/O Tag Names is displayed below.



G. ATTACHMENT

Mechanical Design

This section outlines the parameters which shall form the basis of the SVCW Pump Station Design Project mechanical design.

G.1 Purpose

The purpose of this document is to guide the pump station final design teams and to ensure consistent quality and similar facilities for ease of operation and maintenance. This document is meant to be a working document for the design teams such that during the design, changes can be made based on design team review and consensus.

G.2 Codes and Standards

Mechanical equipment and piping systems shall be designed and built to the following codes and standards:

1. Local respective ordinances (City of Menlo Park, Belmont, San Carlos, Redwood City, and San Mateo County).
2. California Building Standards Code (CBC), latest Code edition adopted by the State of California at the time of design.
3. Underwriters Laboratories Inc. (UL) standards.
4. U.S. Department of Labor Occupational Safety and Health Act (OSHA).
5. National Fire Protection Association (NFPA) codes and standards.
6. Metal Framing Manufacturers Association (MFMA) standards.
7. American Iron and Steel Institute (AISI) standards.
8. American Institute of Steel Construction (AISC) standards.
9. American Bearing Manufacturers Association (ABMA) standards.
10. American Society for Testing and Materials (ASTM) standards.
11. American Society of Mechanical Engineers, Boiler and Pressure Vessel (ASME B&PV) Code.
12. American National Standards Institute (ANSI) standards.
13. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) standards.
14. Expansion Joint Manufacturers Association (EJMA) standards.
15. American Water Works Association (AWWA) standards.
16. Hydraulic Institute (HI) standards.

G.3 Pump Equipment

Pump equipment needs to conform to the requirements and objectives of paragraph 6.1, ANSI/API 610. Components associated with the rotating elements in the drive train, including equipment supports and supports for rotating elements, shall be selected and designed to function without damage or disassembly at reverse rotational speeds up to 150 percent of maximum operational speed during flow reversals through the pump. The complete pumping unit shall operate without overload on any component at any point along the pump's entire full-speed operating curve. Pumps required by virtue of the operating conditions to operate against a closed valve or throttled for any period of time exceeding five seconds shall be designed with drivers sized to operate continuously at the power requirement for that condition even though the power requirements at the rated condition may be less.

G.3.1 Pump Selection

Selected pumps shall be proven designs that shall have been in service under similar conditions of service with no objectionable performance characteristics for a period of not less than five years. A list of similar pump installations to the selected pumps shall be provided to SVCW for performance verification. Listed pump shall be of the same size volute or bowl, discharge case and nozzle size, impeller design (including number of vanes) and shall be operating under similar conditions of pumped fluid, head, capacity, speed, rotation, and Net Positive Suction Head Available (NPSHA).

If these above conditions cannot be met, other pumps can be selected under the following conditions:

a. The proposed design has been in successful operation under similar conditions of volute or bowl, discharge case and nozzle size, impeller design (including number of vanes), pumped fluid, head, capacity, rotation and NPSHA, but at a higher speed for a period of not less than three years;

or

b. The proposed design has been in operation in designs where both larger and smaller nozzle size pumps have been in service for a period of not less than five years, and impeller design (including number of vanes), pumped fluid, head, capacity, speed and NPSHA are similar to that for the proposed installation. Under no circumstances shall an existing pump design operating at a higher speed than those currently in service in similar applications be considered.

Pumps that qualify under either exception (a. or b.) shall be demonstrated, by operation of a test pump in a fully equipped hydraulic test facility, to have acceptable operating characteristics under the conditions identified for the proposed installation of the proposed pump in the size and at the speed proposed, with the proposed impeller design. The test pump shall be set up and a witnessed demonstration shall be performed prior to designing, fabrication and testing any of the equipment proposed for the specific installation. Testing shall be included in project bid if required.

G.3.1.1 General Performance Criteria

Pumps shall be designed to operate without loss of head due to cavitation or vibration over the entire specified range of flow and head conditions and shall be specifically selected for NPSH margin requirements detailed in Section G.3.6

G.3.1.2 General Design Criteria

All pumps shall be designed in accordance with applicable portions of ANSI/HI 1.1 – 1.4, 2.1 – 2.4 and ANSI/HI 9.6.2 – 9.6.6. The pumps shall be specifically designed to pump the raw wastewater and shall operate without clogging or fouling caused by material in the pumped fluid at any operating condition within the range of service per the pump's non-clog size rating.

Pump head capacity curves shall slope in one continuous curve within the identified operating conditions. No points of reverse slope inflection capable of causing unstable operation shall be permitted within the specified zone of continuous duty operation. Pumps with head/capacity curves with a reverse inflection are specifically prohibited if these characteristics shall cause unstable operation within the specified range of operating conditions and where startup/shutdown conditions entail operation against a slow opening/closing valve.

Pumps shall have bells selected to provide an intake velocity of not less than 3.5 feet/second nor more than 4.0 feet/second when operating at the maximum specified flow or the flow resulting from the lowest specified operating head at maximum speed, whichever is the greatest ("peak flow").

Pumps specified to operate at variable speed shall function without loss of head due to cavitation or excessive vibration over the entire specified range of flow and head conditions defined by the region bounded by Condition Points A, B and C and any other continuous duty operating condition. Acceptance criteria shall include the following:

a. Operating Condition Points B and C shall reside within the region defined by the PACL limits set forth in this section for the proposed pump selection, based upon the pump's suction specific speed.

b. No more than 10 percent of the region noted above shall reside outside the PACL limits set forth in this section for the proposed pump selection, based upon the pump's suction specific speed. Operating Condition A may reside in the area outside the PACL.

Pumps shall be shall be specifically selected for NPSH margin requirements detailed in Section G.3.6. Pump selections which do not provide the specified margin shall be rejected.

G.3.1.3 PACL

Pump selection for a given application shall be predicated on locating the specified most frequent operating condition(s) in the PACL. These points shall always include Condition Points A and B and additionally shall include any other Condition Points indicated as continuous duty conditions, or any additionally specified for inclusion in the PACL. Condition Point A shall be the pump's rated condition and shall be guaranteed to meet both specified head and flow within the limit established in ANSI/HI 14.6, acceptance grade 1U.

A given pump's PACL shall be determined as a percentage of Best Efficiency Flow (BEPQ) at the given speed, the pump's suction specific speed as determined in accordance with ANSI/HI 1.3, paragraph 1.3.2.2 and the relationships presented in the Table G-1 below.

Table G-1. Limiting Flow, per cent Best Efficiency Point Flow (BEPQ)[1]

Suction Specific Speed, less than but not greater than:	Clear Liquid pumps, minimum limit	Clear Liquid Pumps, maximum limit	Solids Bearing Liquids Pumps, minimum limit	Solids Bearing Liquids Pumps, maximum limit
7000	50	125	70	125
8000	57	122	75	122
9000	60	120	80	120
10000	65	120	83	117
11000	68	110	85	112
12000	72	112	88	110
13000	78	110	91	110

[1] *Straight line interpolation may be used for intermediate values of suction specific speed*

Exceptions to the foregoing shall be considered only when certified test data demonstrating conclusively a wider region of stable pump performance can be provided. The test data shall include suction pressure pulse information as well as actual service information for the same impeller design and trim, operating at the same speed, capacities and head for the same size pump as required for the specified application.

G.3.2 Critical Speeds and Natural Frequencies

Critical speed and natural frequency data submittal requirements depend upon the pump.

G.3.2.1 Lateral Rotor Dynamics

The complete pumping unit, including all related frames, supports, enclosures, and casings, shall be free from dangerous critical speeds from 20 percent below to 30 percent above the operating speeds required to achieve the specified performance characteristics. The logarithmic decrement for each damped natural frequency (forward or backward) shall be greater than +0.3, and the amplitude magnification factor shall not exceed 3, for any natural frequency within this range.

Process sensitivities are such that operation at infinitely variable speed within the specified operational conditions is an absolute requirement. Any remedy imposing a locked-out speed interval or intervals shall not be considered an acceptable remedy for identified critical speeds. Acceptable remedies include combinations of adjustments in rotor geometry or materials, and the substitution of energy absorbing couplings. Other remedies may be considered so long as they are justified in writing and the proposal sealed and signed by the design professional retained by the manufacturer to perform the system mass elastic system analyses.

G.3.2.2 Torsional and Combined Shaft Stress

For constant torque applications, the pump rotor shall be free from torsional response which produces combined (steady plus alternating torque induced) stresses exceeding 30 percent of the material’s elastic limit (but no more than 18 percent of the material’s ultimate tensile strength) at any speed from 10 percent below to 20 percent above that required by the specified operating conditions, or during startup, shutdown or motor control transients.

G.3.3 Impeller Clearances, Vane Passing Frequency and Impeller Keyways

The radial clearance between the tip of the impeller vane and diffuser or volute vanes shall be not less than 3 percent and 6 percent, respectively, of impeller diameter. The ratio of liquid channel widths (diffuser or volute/impeller) shall be not less than 1.4 nor more than 1.5 for volute-type pumps. The pump shall be designed so that internal geometry shall not cause uneven flow distribution at impeller vane inlets.

G.3.4 Component Design Criteria

Combined stresses in steel frames and supports shall not exceed those permitted by the AISC Manual of Practice. Combined stresses in cast, forged, rolled, or fabricated pressure retaining components, frames and supports shall not exceed that allowed for the given material in Section VIII, Division 1 of the ASME Code. Design pressures for pressure-retaining parts shall be not less than twice the pump's shutoff head at the manufacturer's listed maximum operating speed. Pump casing strain at any head on the full speed operating curve (including allowances for increases caused by specified multi-stage applications) shall not result in distortions at the bearing housings greater than the maximum allowable by the bearing manufacturer to provide the specified bearing life.

The term "combined stresses" in this section shall mean the sum of all operating stresses, including stresses induced by dynamic and static forces as developed via the analysis procedures stipulated in this section. Static forces (x, y, z, and moments in all planes) shall include the relevant maximum nozzle loads specified in ANSI/HI 9.6.2 or as stipulated by the pump manufacturer. Dynamic forces shall include both steady state and transient stresses induced by operating conditions within the zone of operation established by the specified operating conditions.

G.3.5 Torsional and Combined Shaft Stresses

Shaft stresses shall be calculated using the following equation and the stress concentration factors in Table G-2 below.

Where:

S = stress, psi

Scf = stress concentration factor, dimensionless

D = minimum shaft diameter at point of concentration, inches

$\Delta\Theta$ = twist in shaft between adjacent masses, radians

L = effective length between masses, inches

G = shear modulus of shaft material, PSF

The Scf, to be applied at all the roots of all keyways and changes in shaft diameter shall be as follows:

Table G-2. Stress Concentration Factors

S_{cf}	Ratio of fillet radius to shaft diameter
4.3	0.0025
3.7	0.01
3.05	0.02
2.75	0.03
2.6	0.04
2.55	0.05 and greater

Values of Scf between data points in the table above shall be based upon a straight line interpolation.

G.3.5.1 Shaft Deflection

Pump shafts on volute type pumps shall be designed to provide sufficient stiffness to operate without distortion or damaging vibration throughout the range of service specified. Shaft deflection at the face (impeller side) of the shaft seal shall be limited to no more than 1.5 mils at any operating condition within the zone described by the specified continuous duty operating conditions. Calculation of radial thrust loads shall be performed in accordance with the methodology set forth in ANSI/HI 1.3, paragraph 1.3.5.1. Shaft deflection calculations shall be performed in accordance with ANSI/HI 1.3.5.4. Shaft deflection criteria and limits shall be as required by API 610 (ISO 13709).

G.3.5.2 Bearings

Anti-friction bearings for pumps shall be selected for a minimum L–10 life of 50,000 hours in accordance with ABMA 9 or 11. Bearings shall be heavy-duty, oil lubricated or permanently greased lubricated anti-friction type double shielded and factory sealed. Bearings for other elements in the rotating system such as motors shall be selected using the same criteria as specified for the pump. Bearing selection shall be based upon the worst combination of continuous duty operating conditions specified and shall include both steady state and transient loads.

G.3.6 Net Positive Suction Head Margin Limitations

Net Positive Suction Head Required - 3 Percent Reduction (NPSH3) characteristics for the candidate pump shall be based upon documented test data not more than five years old, performed on a pump not more than two nominal pump diameters larger or smaller than the proposed pump with an impeller of the same geometry as that proposed for the pump to be used for the subject application, and operating at the same speed as the pump for the proposed application.

The Net Positive Suction Head Available (NPSHA) information for anticipated operating conditions for each application shall be generally referenced to a specific elevation, stated in terms of project datum. The pump manufacturer shall adjust the NPSHA information to the elevation of the pump impeller eye for the specific pump model and size proposed for the application. NPSH3, as used in the following paragraphs, shall mean the NPSH3 at the impeller eye, determined in accordance with ANSI/HI 11.6 or 14.6, as applicable for the proposed pump.

Pumps classified as centrifugal pumps under ANSI/HI 1.1 – 1.2 with suction specific speeds less than 8500 with cast duplex stainless steel impellers, a minimum NPSHA/NPSH3 margin ratio of 1.1 shall apply to pumps at any operating condition within 85 percent and 115 percent of best efficiency capacity. The minimum acceptable NPSH margin ratio at any other location on the pump's head/capacity curve shall be 1.2.

Pumps with suction specific speeds greater than the above limitations shall have NPSH margins of 1.5 and 2 applicable to the capacity envelope limitations defined previously. Under no circumstances shall the absolute value of the margin above NPSH3 be less than 3.5 feet.

Pumps with suction specific speeds greater than the above limitations and pumps with impeller materials that do not meet the requirement for duplex cast stainless steel set forth in this section, and all pumps with suction specific speeds greater than 10,000 shall have NPSH margins not less than 2.5 at operating conditions within ±15 percent of best efficiency capacity and not less than 3.5 for all operating conditions falling outside the ±15 percent of best efficiency capacity envelope. Under no circumstances shall the absolute value of the margin for pumps qualifying with the foregoing restrictions, be less than 3.5 feet greater than NPSH3.

G.3.7 Casing

The volute casing shall be a one-piece casting with a tangential or center discharge nozzle. The cutwater shall be specifically designed for use in fluids with stringy solids and rags. The volute casting shall be specifically designed to bear the loads associated with removal and placement of the pump when submerged or exposed and to withstand the loads imposed. The discharge nozzle shall be reinforced for the loads imposed by the specified conditions of service. The nozzle flange face shall be designed to mate with the discharge fitting. The volute casing shall be drilled and tapped or otherwise fitted with an inlet nozzle.

G.3.8 Shaft

The pump shaft shall be turned, ground and polished, of proportions suitable for use in the specified application. The shaft shall be of sufficient section to limit deflection at the shaft seal to not more than 1.5 mils when the pump is operating at any continuous-duty point. Additionally, under no circumstances shall the distance from the lower bearing and the hub of the impeller exceed two times the diameter of the shaft.

G.3.9 Bearings

Bearings shall be heavy-duty, oil lubricated or permanently greased lubricated anti-friction type double shielded and factory sealed. Bearings shall be designed for an L-10 rating life of at least 50,000 hours at Operating Conditions A, B, or C.

G.3.10 Impeller

The impeller shall be dynamically balanced after trimming to the diameter required by the specified operating conditions, and have a nonclog design capable of passing solids, fibrous materials, heavy sludge, and other matter found in wastewater applications through to the discharge nozzle. Impellers for pumps with discharges 8 inches in diameter and greater shall be not less than two-vane design. Fit between the impeller and the shaft shall be a sliding fit with a taper-lock bushing pressed by a screw, which is threaded into the end of the shaft, or a slip fit onto the shaft and drive key and fastened to the shaft by an impeller nut having cover for protection from pumped fluid. A wearing ring system designed for abrasion resistance shall provide efficient sealing between the volute and impeller.

G.3.11 Mechanical Seals

The pump shall be provided with a tandem double mechanical seal running in an oil reservoir, composed of two separate lapped face seals. The lower seal unit, between the pump and oil chamber, shall consist of one stationary and one positively driven, rotating tungsten-carbide or ring, with each pair of rings held in contact by a separate spring. The upper seal unit, between the oil sump and the motor housing, shall consist of one stationary tungsten-carbide or silicon-carbide ring and one positively driven silicon-carbide or rotating carbon ring. Ceramic seals will not be acceptable. The seals shall require neither maintenance nor adjustment and shall be easily replaceable. Conventional double mechanical seals with a single or a double spring between the rotating faces, or that require constant differential pressure to effect sealing and are subject to opening and penetration by pumping forces, will not be acceptable. The pump shall be capable of continuous submergence without loss of watertight integrity to a depth of 65 feet.

Each pump shall be provided with a seal lubricant chamber for the shaft sealing system. The seal lubricant chamber shall be designed to assure that an air pocket is provided in the seal lubricant chamber, to absorb the expansion of the seal lubricant due to temperature variations. The drain and inspection plug with positive anti-leak seal shall be easily accessible from the outside.

G.3.12 Motors

The pump motor shall be a squirrel-cage induction, shell type design, housed in an air-filled or an oil-filled, watertight chamber, NEMA B type Inverter Duty with a service factor of 1.15 based upon nameplate rating. The stator winding and stator leads shall be insulated with moisture resistant Class H insulation, which shall be rated at a temperature of 155 degrees C. The motor shall be designed for continuous duty, capable of sustaining a minimum of 12 starts per hour. The temperature rise of the motor shall not be in excess of that specified in NEMA MG-1 for class B insulating materials when operating continuously under load. Motors shall be Factory Mutual or UL listed in accordance with UL 674 and 1207 for Class I, Group D hazardous atmospheres. The junction chamber, containing the terminal board, shall be hermetically sealed from the motor. Connection between the cable conductors and stator leads shall be made with threaded compressed type binding post permanently affixed to a terminal board. The submersible electrical cable shall be of sufficient length to reach the junction box indicated.

The cooling system may be of the oil filled or air filled motor housing type. Thermal sensors shall be provided to monitor stator temperatures. The stator shall be equipped with three thermal sensors, embedded in the end coils of the stator winding (one sensor in each stator phase). These shall be used in conjunction with external motor overload protection and wired to the control panel. The design shall be suitable for continuous motor operation at listed motor rating in 95 degree F water.

The cooling system may rely on radiation of excess heat energy to the fluid in the wet well or, alternatively, the pumped fluid via a closed circuit circulating system utilizing either oil or glycol, or a combination of these. It is specifically required that the cooling system must be compatible with the contemplated control schedule, which may require that the motor case to be exposed continuously or intermittently. Cooling systems shall not employ the pumped fluid to directly cool the motor through wastewater passageways incorporated into the motor shell. It is preferred that the motor be cooled by the wastewater via fins incorporated into the motor shell. If an internal liquid circulation system is employed for cooling purposes, the liquid shall be glycol or heat transfer oil, which shall in turn circulate a heat exchanger incorporated into the cavity behind the pump impeller.

If the motor is an oil-filled type, it shall be positively cooled by circulating non-toxic oil through the windings to passages within the pump designed as a heat exchanger to transfer heat to the pumped fluid. Vanes cast into the rear impeller shroud shall be provided to circulate pumped flow past a heat exchanger in the shaft seal area to provide the required cooling. Cooling water passages in the motor's shell designed to convey the pumped fluid for cooling purposes are specifically prohibited. The system shall be designed to prevent clogging by virtue of dimensions and configuration and shall be specifically configured to maintain motor temperatures within conservative limits when the pump is operating at variable speed under the operating conditions specified.

Motor bearings shall be protected with bearing isolators. Spacer shafts shall be placed between pumps and motors to allow for the quick and easy removal of backheads and rotors of end suction pumps.

G.3.13 Moisture Detectors

Air-filled motors 10 horsepower and larger and all oil-filled motors shall be provided with an electronic moisture detection system. A primary moisture detector shall be provided between the tandem mechanical seals. A secondary leakage sensor shall be located in the motor housing and shall be specifically designed to detect the presence of water in the motor housing. In addition, motors 15 horsepower and larger shall be fitted with moisture detectors in the cable junction box. All moisture detectors shall be wired to the junction box for connection to the specified monitoring system.

G.3.14 Variable Speed Drive

Each Pump shall be furnished with a variable speed drive. The variable speed drive shall be fully compatible with the characteristics and requirements of the pump motor and vice-versa and shall be furnished by the pump manufacturer.

G.3.15 Cables

1. CABLE: The pump cable(s) provided by the pump manufacturer shall include seven conductors: three conductors for power, two conductors for control, and two ground conductors. The cable design shall be suitable for installation in a municipal wastewater pumping station. The cable length shall not exceed the product manufacturer's recommended length. A cable rack shall be provided and installed in the wet well to neatly store the cable slack when the pumps are in service. The cabling shall be direct connections without the use of any junction boxes.
2. CABLE SEAL: The cable entry water seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall be comprised of individual cylindrical elastomer clamps having a close tolerance fit against the cable conductor insulation and the entry inside diameter and compressed by the entry body containing a strain relief function, separate from the function of sealing the cable. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland, potting chamber or terminal board, which shall isolate the motor interior from foreign material gaining access through the pump top. If a potting chamber is used, the potting procedure shall employ an epoxy-potting compound combined with a procedure that insures

penetration of the compound into the individual cable conductor strands to prevent development of wicking pathways for entrance of water into the motor.

3. CABLE DISCONNECTION: The pump shall be designed such that power/ control cable can be removed from the pump motor without breaking the cable seal. The power/ control cable shall be sealed to a removable motor chamber cap that shall be universally mateable to the same manufacturer's pump series. The pump shall be able to be removed from the wet well and disconnected from the cable by removing the motor chamber cap. A spare removable chamber cap with 15 feet of cable shall be provided.

G.3.16 Junction Boxes

NEMA 7X (stainless steel) junction boxes shall be provided for both motor power and system monitors. Sensor leads shall be provided for termination of the thermal sensor and moisture detectors for connection to the monitoring system indicated. The sensor junction box shall be separate from that shown for motor power.

G.3.17 Inlet Nozzle

The wet well design has been developed on the basis of a limiting velocity at the pump inlet of 4 feet per second and a confined inlet designed for cleaning by operating the pump until it breaks suction. Inlet nozzles are required for all pumps with entrance velocities exceeding this limitation. If a nozzle is required, the pump casing shall be drilled and tapped to receive an inlet nozzle and bell fitting to extend the pump inlet connection into the confines of the wet well or sump to achieve the floor separation required by the Hydraulic Institute Intake Standard (ANSI/HI 9.8). The inlet nozzle may be of commercially available forged steel fittings or cast iron and shall have a smooth, flared transition from a bell fitting at the entrance to the nozzle and a smooth, direct entry to the connection at the impeller inlet. The final configuration of the inlet bell and nozzle shall be selected to efficiently convey the pumped fluid into the impeller eye.

G.3.18 Pump Discharge Connection Seal

The connection between the pump discharge connections shall be fitted with a replaceable dynamic sealing feature to affect a complete closure between the pump discharge flange and the mating connection on the anchor fitting. The dynamic seal shall function to effect a water tight connection as further defined in this paragraph. Leakage through the seal shall not exceed 1.5 percent of the flow specified for Condition Point A when operating at pump shutoff head and not more than 1 percent of total pump flow at Condition Point B.

The dynamic seal shall affect a seal meeting the requirements of this paragraph using the head developed by the pump when in operation to expand the sealing device, which may be of metallic or elastomeric construction, against the inner contours of the discharge fitting. The design of the seal shall incorporate features to protect the integrity of the seal during the pump removal/setting process. The seal shall be attached to the pump side of the pump/anchor connection and shall be easily replaceable.

G.3.19 Pump Anchorage, Guide System and Access Cover

The pump shall be provided with a guide system to allow easy removal of the pump without entering the wet well. The dry weather pump guide rail system may be of either the single or dual rail type. The wet weather pump guide rail system shall be of the dual rail type. The discharge connection shall be bolted to the structure as indicated and shall serve as a lower attachment for the guide rails. The discharge connection shall be either horizontal or elbow discharge type, as indicated.

The pump and guide rail system shall be designed to automatically connect the pump to the discharge piping when lowered into place on the discharge connection. The design shall be non-sparking and shall conform to UL requirements for installation in a location classified in accordance with NFPA 70, Article 500 for Class 1, Group D, Division 1 locations. The pump shall be easily removable for inspection or service, requiring no bolts, nuts, or other fastenings to be removed for this purpose, and no need for personnel to enter the pump wet well or sump. Sealing of the pumping unit to the discharge connection shall be accomplished by a simple linear downward motion of the pump with the entire weight of the pumping unit guided to and pressing tightly against the discharge connections. No portion of the pump shall bear directly on the floor of the sump and no rotary motion of the pump shall be required for sealing. Guide bars provided for directing the pump into position or for removing the pump for maintenance shall steer the pump into proper contact with the discharge elbow. Once the pump has been positioned on its support fitting at the discharge fitting, the guide bar system shall not be required for pump support.

Unless otherwise specified, pumps installed in structures located out of doors shall be provided with a hinged access cover with frame cast into the top slab. Cover shall be aluminum with a skidproof design, furnished with a flush locking mechanism and shall be designed to support a uniform live load of 125 pounds per square foot with a safety factor of three. The doors shall be provided with stainless steel hinges and lifting handle shall open to 90 degrees and lock automatically in that position. The frame shall include upper attachments for the guide rails and attachments for the lifting chain and power cable. Access frames and covers shall be sized as specified. Hardware and miscellaneous attachments shall all be constructed out of ASTM A276, Type 316 stainless steel. Dielectric isolation shall be provided between dissimilar metals.

G.3.20 Spare Parts

At a minimum, the following spare parts shall be provided for each pump:

- 2 sets--all gaskets
- 2 sets--all bearings
- 1 set--mechanical seals
- 2 sets—discharge connection sealing devices

Additional spare parts shall be provided as recommended by the pump manufacturer. Spare parts shall be tagged by project equipment number and identified by part number, equipment manufacturer, and subassembly component (if appropriate).

G.4 Mechanical Equipment

The following describes the general requirements for mechanical equipment.

G.4.1 General

Each item of driven equipment and each motor weighing more than 50 pounds shall be fitted with a minimum of one lifting eye.

G.4.2 Bearings

Equipment bearings shall be oil or grease lubricated ball or roller type designed to withstand the stresses of the service specified.

Oil lubricated bearings shall be equipped with either a pressure lubricating system or a separate oil reservoir type system. Each oil lubrication system shall be of sufficient size to safely absorb the heat energy normally generated in the bearing under a maximum ambient temperature of 60 decrees C and shall be equipped with a filler pipe and an external level indicator gage.

Grease lubricated bearings (except factory sealed and lubricated bearings) shall be fitted with easily accessible grease supply, flush, drain, and relief fittings. Extension tubes shall be used when necessary. Grease supply fittings shall be standard hydraulic alemite type.

Bearings shall be rated in accordance with the latest revisions of American Bearing Manufacturers Association (ABMA) Methods of Evaluation Load Ratings of Ball and Roller Bearings for a minimum L-10 rating life of 50,000 hours as determined using the maximum equipment operating speed.

All bearings accessible to touch and located within 7 feet measured vertically from floor or working level or within 15 inches measured horizontally from stairways, ramps, fixed ladders or other access structures shall either incorporate bearing housings with sufficient cooling to maintain surface temperature at 65 degrees C or less for continuous operation at bearing rated load and a 50 degrees C ambient temperature or appropriate shielding shall be provided that shall prevent inadvertent human contact.

G.4.3 Guards

Guards shall be provided for exposed moving parts which meet OSHA requirements.

Guards shall be fabricated of 14-gage Type 316 stainless steel, 1/2-13-15 expanded metal screen.

Guards shall be modified to meet all equipment manufacturer’s specified maintenance requirements (such as preventative or routing maintenance tasks) without disassembly of guards. Lube fittings, for example, shall be extended through guards for easy personnel access.

Piping, manifolds, heaters, and other surfaces having a surface temperature sufficient to burn human tissue (140 degrees F or greater) shall be covered with thermal insulation or guarded. Thermal insulation shall be as described elsewhere in this appendix.

G.4.4 Lubricants

Lubricants shall be of the type recommended by the equipment manufacturer from products of SVCW’s current lubricant supplier.

G.4.5 Miscellaneous Items

Caution signs shall be provided for equipment with guarded moving parts which operate automatically or by remote control.

Pressure taps shall be provided on the suction and discharge side of pumps, blowers, and compressors.

Equipment nameplates shall have the equipment name and number engraved or stamped on stainless steel material. All equipment, including valves, shall be provided with nameplates.

A fall prevention system adjacent to the wet wells shall be installed for maintenance technicians to anchor their safety lines during maintenance activities. The fall prevention system shall prevent technicians from falling into open hatches, especially during installation or removal of pumps.

G.4.6 Equipment Mounting

All supports, anchorage, and mounting of all equipment shall be in accordance with the manufacturer's recommendations, the CBC, and industry standard requirements.

All floor-mounted equipment shall be installed on minimum 6-inch reinforced concrete pads. The concrete pads shall be at least 4 inches larger than the equipment base, or as required by the equipment anchor bolt calculations, and shall enclose all conduits, drains, and piping connections.

Equipment baseplate for floor mounted equipment shall be fabricated steel or cast iron, hot-dipped galvanized after fabrication.

Anchor bolts shall be designed for lateral forces for both pullout and shear in accordance with CBC and ASCE 7; the component importance factor (I_P) for all equipment shall be 1.50. Minimum diameter of anchor bolts shall be 1/2 inch. Material for equipment anchor bolts shall be Type 316 stainless steel.

Equipment bases for horizontal pumps shall conform to ANSI/HI 1.3.4, API 610 (paragraph 3.3) and shall provide common support for the pump and motor (and flywheel, if one is specified). Eight positioning jackscrews shall be provided for all drivers and flywheels (if specified) for all horizontal pump baseplates. All bases for horizontal pumps shall be equipped with jackscrews for positioning and leveling the base prior to grouting.

Mounting holes for anchor bolts in the bases shall be drilled (not burned) out and shall not be open slots. All mounting studs shall be Type 316 stainless steel. Anchor bolts shall be Type 316 stainless steel. An anti-seize or anti-galling compound shall be used on all threads.

Equipment bases for vertical volute-type pumps weighing more than 2000 pounds shall be soleplates or leveling boxes under individual feet or support brackets integral with the volute casting. Direct mounting of the volute on housekeeping pads shall not be permitted.

Pumps shall be installed in accordance with ANSI/HI 1.4 and ANSI/HI 2.4. Grouting of equipment bases shall take place prior to connecting any field piping or electrical and instrumentation systems.

Equipment that is not mounted on vibration isolators shall be anchored directly to the supporting floor system. In addition to the anchorage, all such equipment shall be internally designed so that all static and moving parts are anchored to the supporting framework to resist all imposed forces. All forces shall be transmitted to the base in order to be anchored as required.

Connecting piping with flexible connections and/or expansion joints shall be anchored such that the intended uses of these joints are maintained in the piping system without imposing strain on the equipment connections.

All machinery shall be mounted and leveled by millwrights. All equipment bases and equipment shall be leveled against steel surfaces. For equipment with drivers 20 horsepower and greater, periodic special inspection of epoxy grout installation for equipment mounts in accordance with CBC, Section 1705.5.6 shall be performed.

G.4.7 Electric Motors

All motors shall be required to be supplied by the driven equipment supplier.

Electric motors less than 0.5 horsepower (HP) used to drive nonprocess-related equipment shall be specified as open, drip-proof, 1.0 service factor, 115 volts, single-phase, with Class B or F insulation.

Electric motors less than 0.5 HP used to drive process-related equipment or located in an area where washdown occurs or is required shall be specified as totally enclosed, fan-cooled, nonventilated, 1.0 service factor, 115 volts, single-phase, with Class B or F insulation.

Electric motors 0.5 HP through 250 HP used to drive nonprocess-related equipment shall be specified as open, drip-proof, 1.0 service factor, 460 volts, 3 phase, with Class B or F insulation.

Electric motors 0.5 HP through 250 HP used to drive process-related equipment or located in an area where washdown occurs or is required shall be specified as totally enclosed, fan-cooled, 1.15 service factor, 460 volts, 3 phase, Class F insulation with a maximum of 80 degrees C temperature rise. Motors 60 HP and larger shall be specified with overtemperature protection.

Electric motors greater than 250 HP used to drive process-related equipment or located in an area where washdown occurs or is required shall be specified as weather-protected II enclosures, 1.15 service factor, 4000 volts, 3 phase, Class F insulation with a maximum of 80 degrees C temperature rise. Motors shall be specified with resistance temperature detectors.

All electric motors shall be specified with bearings rated for an L-10 life of 100,000 hours.

Electric motors specified for use with variable frequency drives shall be totally enclosed, air-over, blower-cooled with 1.00 service factor, voltage as appropriate, Class F insulation, inverter duty rated and specified with resistance temperature detectors.

Electric motors 15 HP and larger shall be specified with space heater.

Motors weighing more than 50 pounds shall be fitted with at least one lifting eye.

G.4.8 Vibration Isolation

Curb mounted equipment, principally rooftop ventilating equipment, shall be mounted on vibration isolation bases that fit over the curb and under the isolated equipment.

Structural steel bases shall be rectangular in shape for all equipment other than centrifugal pump bases, which may be "T" or "L" shaped. Typical application is centrifugal fans.

Double-deflection neoprene mountings shall have a minimum static deflection of 0.35 inch. All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Typical applications are blowers and floor mounted air handling units (AHU).

Steel members used to cradle machines having legs or bases that do not require a complete supplementary base shall be sufficiently rigid to prevent strains on the equipment. Typical applications are cooling towers and condensing units.

Freestanding, spring-type mountings without housings shall be laterally stable and have neoprene friction pads between the base and support. Typical applications are refrigeration reciprocating compressors and slow speed compressors.

Freestanding, spring-type mountings shall have housings and vertical limit stops when used for equipment exposed to the wind or with operating weight different from installed weight. Typical applications are chillers, boilers, and air cooling towers.

Steel hanger mountings shall contain steel spring and a 0.3-inch deflection neoprene element in series. Principal application is suspended air handling equipment.

Double-deflection sandwich pad mountings shall consist of a high density cork layer permanently bonded to top and bottom layers of corrugated oil-resistant synthetic rubber. Typical applications are centrifugal compressors and vacuum pumps.

Seismic restraints shall meet the requirements of the CBC and ASCE 7; the component importance factor (I_P) for all vibration isolated equipment shall be 1.50.

G.4.9 Noise

The maximum permissible noise levels for a complete piece of mechanical equipment located within or outside a structure shall be coordinated with the local agencies during final design. A complete piece of mechanical equipment is defined as the driver and driven equipment, plus any intermediate couplings, gears, and auxiliaries.

Noise reduction measures such as sound reduction enclosures, acoustical equipment mountings, acoustical wall or ceiling panels, and acoustical insulation on equipment shall be provided where necessary following installed equipment field noise testing.

G.4.10 GATES

Non-rising stems shall be used on gates located beneath roads or drivable surfaces.

G.4.10.1 Sluice Gates

1. Sluice gates shall be heavy-duty, flat-back frame type meeting the requirements of AWWA C501.
2. Materials of construction shall be as follows:

Component	Material
Gate, guide, and frame	ASTM A126, Class B, cast iron
Seating faces	ASTM B103 or B 139, bronze
Wall thimbles	ASTM A126, Class B, cast iron
Stems	ASTM A276, stainless steel, Type 316
Wedges, thrust nut, stem couplings	ASTM B584, bronze, CA872
Fasteners and adjusting hardware	ASTM A276, stainless steel, Type 316, or ASTM F593 and F94, stainless steel, group 1 or group 2
Yoke	ASTM A126, Class B, cast iron
Flush bottom seal	Neoprene
Flush bottom retainer bar	ASTM A276, stainless steel, Type 316

G.4.10.2 Slide Gates

1. Materials of construction shall be as follows:

Component	Material
Frames and slides	ASTM A276, stainless steel, Type 316
Rails and yokes	ASTM A276, stainless steel, Type 316
Fasteners and anchor bolts	ASTM A276, stainless steel, Type 316
Stems	ASTM A276, stainless steel, Type 316
Flush bottom and "J" bulb seals	ASTM D2000, Buna-N or neoprene rubber

G.4.11 Washer Compactor

This section includes design criteria for the equipment used to wash and dewater screenings collected from the municipal wastewater. The units shall vigorously wash, compact, and dewater screenings.

G.4.11.1 Performance Guidelines

Washer compactor systems shall be suitable for installation under the conditions in Table G-3.

Table G-3 . Washer Compactor Criteria

Capacity, FT^3/unit/hr	11
Water supply for Wash Water	Reclaimed for PS2 and PS3 City Potable for PS1
Materials:	
Screenings washer/compactor components and component housing, plates and sheets	Stainless steel, ASTM A240/A240M, Type 304 ASTM A480/A480M, No. 1 finish for sheets and hot-rolled or cold-rolled, and Annealed or Heat Treated, and Blast Cleaners or Pickled" finish for plates
Support bars, angles, and shapes	Stainless steel, ASTM A276, Type 316 ASTM A484/A484M, Class A finish for shapes

Each unit shall be designed to handle screenings volume based on peak daily flow and maximum screenings quantities. The maximum screenings quantity can be determined using Figure 9.7 from the Design of Municipal Wastewater Treatment Plants, Fourth Edition, Volume 2. The red vertical line indicates screenings quantities based on the bar screen design criteria.

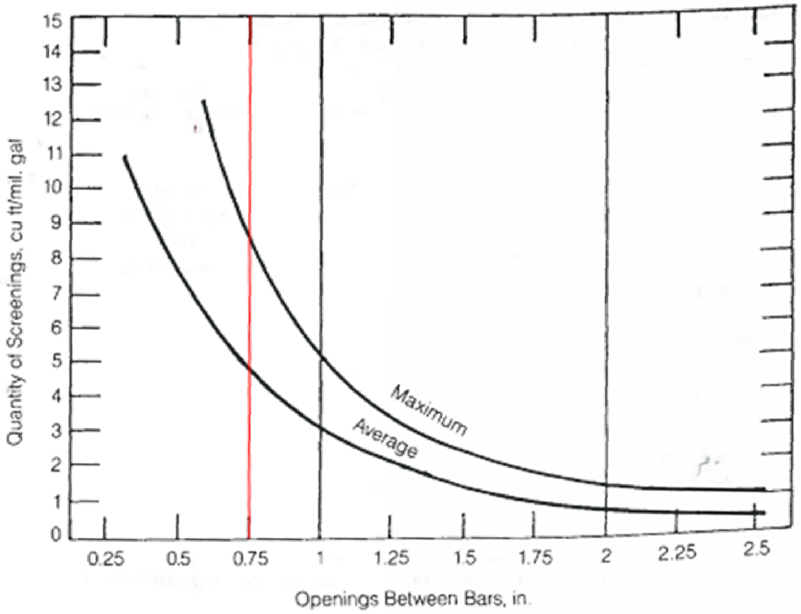


Figure 9.7 Average and maximum volumes of coarse screenings as a function of openings between bars (cu ft/mil. gal × 0.007 5 = L/m³; in. × 25.4 × mm).

G.4.11.2 Screening Disposal

Screenings from the washer compactor will fall directly into a roll-off container sized for a minimum of 2 days of peak screening yield. The washer compactor will reduce the volume of screenings by approximately 50 percent, so this factor should be taken into consideration when sizing the roll-off container.

REFERENCES

Grant, D. M., & Dawson, B. D. (2001). Isco Open Channel Flow Measurement Handbook Fifth Edition. Lincoln, NE: Isco, Inc.

(1998). *Design of Municipal Wastewater Treatment Plants: WEF Manual of Practice No. 8 ASCE Manuals and Reports on Engineering Practice No. 76.* (4th ed., Vol. 2). McGraw-Hill Education.

G.5 Equipment Designation and Numbering

A unique tag number should be assigned to any item at the three facilities that requires automation or monitored for a particular parameter (e.g., level). SVCW standard equipment and valve identification naming convention shall be used for assigning names to equipment, valves, and instrumentation on this project. The equipment designation and numbering consists of four parts: (1) Process Area, (2) Process Function, (3) Equipment Designator, and (4) a five digit sequential number. The following sections describe the components of the naming convention.

G.5.1 Process Area

The following process area designations shall be used at each of the pump stations. An example of the types of facilities and equipment that shall be assigned to each process area is also displayed below.

Table G-4. Process Area Designations

Abbreviator	Process Area	Types of Facilities/Equipment
EGN	Emergency Generator	• Fuel Storage Tanks • Standby Generator
HDW	Headworks	• Screens • Washer Compactor • Screening Sluice • Associated Screen Channel Gates and Level Sensors
HVA	Heating and Ventilation Air Conditioning	• Supply Air Fans • Exhaust Fans • Odor Control Unit
INF	Influent	• Junction Structure • Flow Meters and Sampling Equipment for Incoming Flow at PS3
SRG	Surge Control	• Surge Control Tanks • Recirculation Pumps
WW	Wet Well	• Pumps • Valve Vault • Flow Meters

Additional process area designations are located in the latest version of the SVCW Standard Equipment and Valve Identification Naming Convention.

G.5.2 Process Function Designations

The following process function designations shall be used for this project:

Table G-5. Process Function Designations

Abbreviation	Process Function
ANA	Analyzer
CNT	Control
DET	Detector
DRN	Drain
DIS	Discharge
EXH	Exhaust
FIL	Fill
GS	General Service
INJ	Injection
INL	Inlet

Table G-5. Process Function Designations

Abbreviation	Process Function
INT	Instrument
ISL	Isolation
MET	Metering
MIX	Mixing
MOD	Modulating
MON	Monitor
OUT	Outlet
PLY	Polymer Related Function
RET	Return
REC	Recirculation (added)
SCR	Screen
SDW	Sludge Dewatering
SUP	Supply
SW	Seal Water
SUC	Suction
SUM	Sump
TRA	Transmitter
TRS	Transfer

This list of process function designations may be expanded subject to review and approval by SVCW.

G.5.3 Equipment Designations

Equipment includes mechanical, electrical , and instrumentation equipment. The following equipment designations shall be used:

Table G-6. Equipment Designations

Abbreviation	Equipment
AC	Air Conditioning Unit
ACD	Analyzer Conductivity
AD	Auto Dialer
AHU	Air Handling Unit
AI	Analog Input
ALM	Alarm
AO	Analog Output

Table G-6. Equipment Designations	
Abbreviation	Equipment
ATS	Automatic Transfer Switch
AUD	Audible Alarm
BAT	Battery
BDV	Blow Down Valve
BFS	Burner Flame Sensor (Cadmium Eye)
BI	Analyzer Blanket Indicating
BLR	Boiler
BLT	Blanket Depth Sensor
BLW	Blower
BUB	Bubbler
C2	Analyzer Carbon Dioxide
CEN	Centrifuge
CH	Chiller
CHG	Battery Charger
CL	Analyzer Chlorine
CLK	Clock
CNV	Conveyor
CO	Analyzer Carbon Monoxide
COL	Collector
CP	Control Panel
DI	Discrete Input
DIS	Distributor Arm (added)
DO	Discrete Output
DO	Analyzer Dissolved Oxygen
DOP	Doppler
DU	Drive Unit
FAN	Fan
FE	Flow Sensing Element
FIT	Flow Indicating Transmitter
FLC	Flocculator
FLT	Float Switch

Table G-6. Equipment Designations	
Abbreviation	Equipment
FQT	Flow Totalizing Transmitter
FS	Flow Switch
FT	Flow Transmitter
GDR	Grinder
GEN	Generator
GLS	Gate Limit Switch (Open/Closed)
HEX	Heat Exchanger
HS	Hand Switch
IE	Current Element (Amp Meter)
IIT	Current Indicating Transmitter (Amp Meter)
IT	Current Transmitter (Amp Meter)
JE	Power Sensing Element
JIT	Power Indicating Transmitter
JT	Power Transmitter
LE	Level Sensing Element
LGT	Alarm Light
LIT	Level Indicating Transmitter
LS	Level Switch
LT	Level Transmitter
MBS	Mechanical Bar Screen
MCC	Motor Controller Center
MME	Miscellaneous Mechanical
MTR	Motor
MXR	Mixer
NT	Analyzer Turbidity
PCV	Pressure Control Valve
PDT	Pressure Differential Indicating Transmitter
PE	Pressure Sensing Element
Ph	Analyzer pH
PIT	Pressure Indicating Transmitter
PLC	Programmable Logic Controller

Table G-6. Equipment Designations	
Abbreviation	Equipment
PMP	Pump
PNL	Panel
PRX	Proximity Sensor
PSW	Pressure Switch
PT	Pressure Transmitter
PT	Pressure Transducer
PWR	Power Supply
RDR	Radar LIT
RFP	Rotary Fan Press
RTU	Remote Terminal Unit
SE	Speed Element
SG	Slide Gate
SI	Analyzer Sulfite Ion
SIT	Speed Indicating Transmitter
SS	Analyzer Suspended Solids
ST	Speed Transmitter
SV	Solenoid Valve (added)
SWB	Switchboard
SWR	Switchgear
T	Transmitter
TE	Temperature Sensing Element
TFR	Transformer
TG	Analyzer Gas
TIT	Temperature Indicating Transmitter
TS	Temperature Switch
TS	Analyzer Total Solids
TT	Temperature Transmitter
TTG	Analyzer Triple Gas
TTL	Totalizer
TTM	Transit Time
UPS	Un-interruptible Power Supply

Table G-6. Equipment Designations

Abbreviation	Equipment
USD	Ultra Sound
VE	Voltage Element
VE	Vibration Element
VFD	Variable Frequency Drive
VIT	Voltage Indicating Transmitter
VIT	Vibration Indicting Transmitter
VLV	Valve
VNT	Venturi
VPS	Valve Position Sensor (% open)
VT	Voltage Transmitter
VT	Vibration Transmitter
WC	Washer Compactor Unit
WE	Torque Element
WGB	Waste Gas Burner
WIT	Torque Indicating Transmitter
WS	Torque Switch
WSK	Whisker Switch
WT	Torque Transmitter
ZC	Position Closed Switch/Indicator
ZO	Position Open Switch/Indicator

The equipment list designations may be expanded subject to review and approval by SVCW.

G.5.4 Sequential Number

A five digit sequential number shall be applied to each panel, equipment, valve, or instrument. Per SVCW's naming convention, the five digit number does not need to be unique if the preceding process area, process function designation, and equipment designation within the name is unique. For example, a submersible pump in Wet Well 1 at Pump Station 1 and the influent slide gate to Wet Well 1 at Pump Station 1 shall have the same five digit sequential number but the overall names shall be unique (WW_TRS_PMP_51101 vs. WW_INL_SG_51101). Subsequent pumps or slide gates shall have five digit sequential numbers of 01102, 01103, etc.

The five digit sequential number following the process area designation, process function designation, and equipment designation for each piece of equipment is comprised of three parts. The first two digits represent the SVCW location code. For this project, the following location code designations shall be used:

- 51 for Pump Station 1 (West Bay S.D.)
- 52 for Pump Station 2 (Redwood City)
- 53 for Pump Station 3 (San Carlos)

The third digit in the sequential number is assigned based on the major areas it is related to as follows:

- 0 for items common to multiple process units, such as the influent junction structure and screens
- 01 for Wet Well 1
- 02 for Wet Well 2

The fourth and fifth digits are sequential numbers assigned based on order in the process line. Lower numbers are in the beginning of the process line and higher numbers are further along the process line.

G.5.5 Equipment and Instrument Naming

The resulting equipment and instrument numbers shall include the four components separated by an underscore as follows: “Process Area_Process Function_Equipment Designator_Sequential Number.” A few examples are presented below.

Table G-7. Equipment and Instrument Designation and Number Examples

Example of Mechanical Bar Screen at PS2	
Process Area =	HDW
Process Function =	SCR (Screen)
Equipment Designator =	MBS (Mechanical Bar Screen)
Digit 1 and 2	52 (Redwood City)
Digit 3	0 (general use, not tied to a wet well)
Digit 4 and 5	01
Mechanical Bar Screen number one =	HDW_SCR_MBS_52001
Example of First Pump in Wet Well 1 at PS1	
Process Area =	WW
Process Function =	TRS (Transfer)
Equipment Designator =	PMP (Pump)
Digit 1 and 2	51 (West Bay S.D.)
Digit 3	1 (Wet Well 1)
Digit 4 and 5	01
Pump 1 in Wet Well 1 =	WW_TRS_PUMP_51101
Example of Inlet Slide Gate in Wet Well 2 at PS3	
Process Area =	WW
Process Function =	INL (Inlet)
Equipment Designator =	SG (Slide Gate)

Table G-7. Equipment and Instrument Designation and Number Examples

Digit 1 and 2	53 (San Carlos)
Digit 3	2 (Wet Well 2)
Digit 4 and 5	01
Inlet Slide Gate in Wet Well 2 =	WW_INL_SG_53201

G.5.6 Additional Naming Considerations

The following is a list of additional naming considerations that shall be used during the pump station design:

- Hand switches are considered to be equipment control; therefore, the process function designation shall be “CNT” for control.
- Other switches (flow switches, motor temp switches, valve open/close status, etc) are used for detecting “events.” These switches shall be assigned a process function designation of “DET” for detect (e.g., WW_DET_TS_52104 and WW_DET_WS_52104).
- Pressure elements (PE) are considered to be instruments; therefore, they shall be assigned a process function designation of “INT.”
  - Pressure gages (dial style) shall be named after the piping process designation (e.g., “DIS” for discharge if the dial style pressure gage is located on the discharge end of a pump).
- Pressure-Indicating Transmitters (PIT) shall be assigned a process function of “MON” since they output an analog signal.
- Isolation valves shall be assigned a process function named using the piping process function (e.g., "DIS" for discharge).
- For example, Plug Valve on Pump 1 Discharge Line: WW_DIS_VLV_52101.
- All valves on supply fans or exhaust fans will have the process function "SUP" or "EXH." "SUC" or "DIS" process functions will not be used for HVAC and will mainly be used for pumps. For example,
  - Butterfly Valve on 1 on Supply Fan 1 Line: HVA_SUP_VLV_52001.
  - Butterlfy Valve 2 on Exhaust Fan 4 Line: HVA_EXH_VLV_52106.

G.6 Piping, Valves, and Accessories

The following describes the general requirements for piping, fittings, valves, and accessories. Piping, fittings, and valves shall be as designated in the piping specification sheets (PIPESPEC) are included in Attachment H.

G.6.1 Flanges and Pipe Threads

Flanges on equipment and appurtenances shall conform in dimensions and drilling to ANSI B16.1, Class 125. Pipe threads shall conform in dimension and limits of size to ANSI B1.1, coarse thread series, Class 2 fit.

Threaded flanges shall have a standard taper pipe thread conforming to ANSI B1.20.1. Flanges shall be flat-faced whenever practical.

Flange assembly bolts shall be heavy pattern, hexagonal head, carbon steel machine bolts with heavy pattern, hot-pressed, hexagonal nuts conforming to ANSI B18.2.1 and B18.2.2. Threads shall be Uniform Screw Threads, Standard Coarse Thread Series, Class 2A and 2B, ANSI B1.1.

G.6.2 General Valve Requirements

All valves, except those which are equipped with power operators or those designed for automatic operation, shall be provided with manual operators.

Unless specifically required to be equipped with other types of operators, all valves with centerlines more than 7 feet 6 inches above the floor shall be provided with chain wheels and operating chains.

Wrench nuts shall be provided on all buried valves, on all valves which are to be operated through floor boxes, and where otherwise required.

Valve types shall be as designated in the attached piping specification sheets. Valves of the same size and service shall be provided by a single valve manufacturer.

G.6.3 Butterfly Valves

Butterfly valves shall be of the stub or through shaft design, flanged or equipped for grooved end mechanical-type (Victaulic) pipe couplings.

Butterfly valve bodies shall be cast iron, ASTM A126, Grade B. Valve bearings shall be reinforced Teflon or chemically inert nylon.

Butterfly valve shafts shall be stainless steel, ASTM A276, Type 304 or ASTM A582, Type 416. Seat mating surfaces shall be stainless steel, ASTM A276, Type 304. Seat sealing surface shall be neoprene or Buna-N.

Discs shall be ductile iron, ASTM A536 or cast iron, ASTM A48, Class 40 or ASTM A126, Class B.

Butterfly valves shall be used for isolating service on water, air, and gas service applications.

G.6.4 Ball Valves

Ball valves 2 inches and smaller shall be threaded, full bore, shall have bronze or brass bodies, balls and stems, and Teflon seats at both ends. Valves shall be rated at 300 psi and shall be so constructed as to make positive shutoff with flow in either direction.

Ball valves larger than 2 inches shall be flanged, full bore, shall have carbon steel or ductile iron bodies, balls and stems, and Teflon seats at both ends. Valves shall be rated at 275 psi and shall be so constructed as to make positive shutoff with flow in either direction.

Ball valves shall be used for isolating service on air and water service applications.

G.6.5 Gate Valves

Gate valves 3 inches and larger in size shall comply with ANSI/AWWA C500, including hydrostatic testing requirements. Gate valves smaller than 3 inches shall be subject to system test pressure hydrostatic testing.

Materials of construction shall be as follows:

Component	Material
Body:	
3 inches and smaller	Bronze
Larger than 3 inches	Cast iron, ASTM A126, Class B
Wedge:	
3 inches and smaller	Bronze
Larger than 3 inches	Cast Iron, ASTM A126, Class B
Mounting	Bronze
Stem	Bronze, ANSI/AWWA C500 (Section 3.12)
Seat rings	Bronze, Grade A, ANSI/AWWA C500 (Section 3.8)

All exposed gate valves shall be rising stem type. All buried or submerged gate valves shall be nonrising stem type.

G.6.6 Globe Valves

Globe and angle valves shall have all bronze bodies.

Valves shall have union bonnets and renewable composition or plug discs. Valves shall be repackable when open.

Globe and angle valves shall be rated at 200 psig.

Globe valves shall be used for throttling service on air and water service applications.

G.6.7 Eccentric Plug Valves

Eccentric plug valves shall be straight-flow, nonlubricated, resilient plug type suitable for driptight, bi-directional shutoff.

Valve upper and lower journal bearings shall be replaceable, sleeve-type, corrosion-resistant, and permanently lubricated.

Materials of construction shall be as follows:

Component	Material
Body	Cast iron, ASTM A126, Class B
Plug	Cast iron, ASTM A126, Class B; cast iron, ASTM A436 (No-resist); or ductile iron, ASTM A536
Plug facing	Neoprene or Buna-N
Body seats:	
Less than 3 inches	Cast iron, ASTM A126, Class B
3 inches and larger	Stainless steel, ASTM A276, Type 316 or nickel
Packing	Buna V-flex or TFE

Eccentric plug valves 3 inches and smaller shall be threaded. Valves larger than 3 inches shall be flanged or equipped for grooved-end, mechanical-type (Victaulic) couplings match pipe ends.

G.6.8 Pressure Regulating Valves

Pressure regulating valves for air, water, and gas service shall be of the direct acting type.

Valves used for water service shall have bronze bodies and stainless steel seats. Diaphragms shall be Buna-N with nylon inserts.

Valves used for air service shall have bronze bodies and stainless steel or monel seat rings.

Valves used for gas service shall have cast iron bodies, and trim shall be stainless steel, Type 316.

G.6.9 Solenoid Valves

Solenoid valves shall be encapsulated coil, direct operated, suitable for two-, three-, or four-way service.

Solenoid valve bodies shall be brass or Type 316 stainless steel. Seats shall be Teflon or Buna-N.

Solenoid valve coils shall be the tube, core or shell type.

G.6.10 Piping Accessories

The piping accessories criteria is discussed below.

G.6.10.1 Strainers

a. Pipeline strainers for air, gas, and water shall be of the Y-pattern in-line type or basket type.

b. Air and gas strainers shall have monel screens, brass blowoff cocks, and stainless steel bodies. The filter material shall be Everdur wool.

c. Water strainers shall have stainless steel or monel screens and bronze or Type 316 stainless steel bodies.

G.6.10.2 Vacuum Breakers

Vacuum breakers shall have carbon steel bonnets, springs and bodies with stainless steel stems, discs, and fasteners. The vacuum breaker valves shall have grooved-end, mechanical-type (Victaulic) coupling connections and shall be rated for a 30-inch mercury vacuum.

G.6.10.3 Flexible Pipe Connectors

a. Flexible pipe connections shall be installed at the suction and discharge of all rotating equipment to minimize pipe vibration and allow easier pipe removal at equipment for maintenance.

b. Where piping passes through walls, takedown couplings shall be provided within 3 feet of the wall.

c. A screw union or flanged takedown connection shall be provided within 2 feet of each threaded end valve. For pipelines 2-1/2 inches in diameter and larger, a grooved-end, mechanical-type (Victaulic) coupling or screw union connection shall be provided on each valve end.

d. Piping 2 inches in diameter and larger passing from concrete to earth shall be provided with two pipe couplings or flexible joints within 2 feet or one pipe diameter of the structure, whichever is greater. Where required for resistance to pressure, mechanical couplings shall be restrained in accordance with AWWA M11, Figures 19.15 and 19.16 and Table 19.7.

G.6.11 Piping Insulation

Insulation shall be provided for the following piping and related vessels and appurtenances where applicable:

Potable water (in condensation sensitive locations)

Domestic hot water

Service air (between compressor and aftercooler)

Heat reservoir water

Insulation shall include insulating material, protective jackets, flashing, and other materials as required. Pre-insulated piping shall be used where applicable.

G.6.11.1 Low Temperature Insulation

Low temperature insulation shall be of the unicellular elastomeric thermal type, or premolded fiberglass.

Piping insulation shall be tubular for simple installation.

Insulation shall be applied over clean, dry surfaces with all joints butted firmly together.

Low temperature insulation shall be for chilled water piping, and potable water piping insulation for thermal and condensation control. Surfaces to be insulated include piping and related vessels and appurtenances.

The minimum insulation thicknesses shall be as shown in Table G-8:

Table G-8. Minimum Insulation Thicknesses for Low Temperature Insulation

Pipe size, inches	Minimum insulation thicknesses, inches
1/2 - 2	1
2-1/2 - 4	1-1/2
6 - 12	2
14 and larger	2-1/2

Aluminum jacket shall conform to ASTM B209, alloy 5005, temper H16. Sheet metal screws shall be 6061-T aluminum, anodized 2024 aluminum or Type 300 or 400 series stainless steel of adequate strength. Aluminum jacket shall be for piping larger than 2 inches in diameter. Laminated polyvinyl jacket shall be for piping 2 inches in diameter and smaller. Shield for the protection of nonrigid insulation at hangers and supports shall be 16-gage galvanized steel sheet.

G.6.11.2 Medium Temperature Insulation

Medium temperature insulation shall be for agitation air piping, instrument and service air piping, hot water piping, and heat reservoir water piping insulation.

Hot water piping insulation shall be suitable for an operating temperature range of 100 to 300 degrees F.

Insulation includes insulating material, protective jackets, flashing and other materials specified. Surfaces to be insulated include piping and related vessels and appurtenances.

The minimum insulation thicknesses shall be as shown in Table G-9:

Table G-9. Minimum Insulation Thicknesses for Medium Temperature Insulation

Pipe size, inches	Minimum insulation thicknesses, inches
1/2 - 2	1
2-1/2 - 4	1-1/2
6 - 12	2
14 and larger	2-1/2

Jackets shall be similar to the jackets for low temperature insulation.

G.6.12 Pipe Supports

Pipe hanger and support selection and application shall conform to the requirements of MSS SP-69, FEDSPEC WW-H-171e and governing state and local codes. In case of conflict, governing state or local codes shall be followed. Pipe hanger and support materials, design and manufacture shall conform to the requirements of MSS SP-58. Pipe hanger and support fabrication and installation shall conform to the requirements of MSS P-89. Metal framing system components and application shall conform to MFMA-2 and MFMA-101.

Pipe hangers and supports, structural attachments, fittings and accessories shall be Type 316 stainless steel. Nuts, bolts and washers shall be Type 316 stainless steel.

Hangers and supports shall be located as near as possible to concentrated loads such as valves, flanges, etc. At least one hanger or support shall be located within 2 feet from a pipe change in direction on each run of pipe from the change in direction. Hangers and supports shall be located such that connections to equipment, tanks, etc., are substantially free from loads transmitted by the piping. Where piping is connected to equipment, a valve, piping assembly, etc., that shall require removal for maintenance, the piping shall be supported in such a manner that temporary supports shall not be necessary for this procedure. Pipe shall be installed in straight and true runs, without sags, high points or deformation caused by loads imposed on the pipe support system.

Welded and bolted attachments to building structural steel shall be in accordance with the requirements of the AISC Manual of Steel Construction. There shall be no drilling or burning of holes in building structural steel. Hanger components shall not be used for purposes other than for which they were designed. They shall not be used for rigging and erection purposes. Items to be embedded shall be installed before concrete is poured. Embedded items shall be secured to the forms to prevent movement when concrete is poured. Embedded anchor bolts shall be used instead of concrete inserts for support installations in areas below water surface or normally subject to submerging. Thermal pipe hanger shields shall be installed on insulated piping at required locations during hanger and support installation. Butt joint connections to pipe insulation shall be made at the time of insulation installation in accordance with the manufacturer's recommendations. Hanger and support components in contact with plastic pipe shall be free of burrs and sharp edges. Rollers shall roll freely without binding.

Finished floor beneath stanchion baseplate structural attachments and framing channel post bases shall be roughed prior to grouting. Grout between base plate and floor shall be free of voids and foreign material. Baseplates shall be cut and drilled to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts. Plastic or rubber end caps shall be provided at the exposed ends of all framing channels that are located up to 7 feet above the floor.

For pipes less than 8-inches in diameter, the supports shall be designed by the Contractor.

G.6.13 Seismic Restraints

The seismic restraint system shall be designed by the professional engineer retained by the construction contractor for design of the pipe support systems. Seismic restraint details shall be designed in conjunction with preparation of pipe hanger support system drawings. All drawings and calculations for the seismic restraint system shall bear the professional engineer's registration seal and signature.

Pipe restraint materials, design, manufacture, testing, installation and application shall conform to the requirements of MSS SP-58, MSS-SP-69, MSS-SP-89, MFMA-2, and MFMA-101. Restraints, including braces, and pipe and structural attachments, shall be Type 316 stainless steel. Nuts, bolts and washers shall be Type 316 stainless steel. For corrosive areas all pipe support, anchor and brace components (not just fittings and accessories) shall be made of fiberglass.

Piping systems shall not be braced to dissimilar parts of a building or to dissimilar building systems that may respond in a different mode during an earthquake. (Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.) Restraints shall be sized to fit the outside diameter of the pipe, tubing, or the outside diameter of insulation. There shall be no contact between a pipe and restraint component of dissimilar metals. When restraining copper tubing, copper-plated, rubber, plastic or vinyl coated, or stainless steel restraint components shall be used. Branch lines shall not be used to brace main lines. Seismic bracing shall not limit the expansion and contraction of the piping system.

The first seismic restraint on a piping system shall be located not more than 10 feet from the main riser, entrance to a building or piece of equipment. Cast iron pipe shall be braced on each side of a change in direction of 90 degrees or more. Joints in risers shall be braced or stabilized between floors. No-hub and bell and spigot cast iron soil pipe shall be braced longitudinally every 20 feet and laterally every 10 feet. Lateral bracing for one pipe section may also act as longitudinal bracing for the pipe section connected perpendicular to it, if the bracing is installed with 24 inches of the elbow or tee of the same size.

Rod stiffener assemblies shall be used at seismic restraints for hanger rods over 6 inches in length. A minimum of two-rod stiffener clamps shall be used on any rod stiffener assembly. Lateral and longitudinal bracing shall be installed between 45 degrees above and 45 degrees below horizontal, inclusive, relative to the horizontal centerline of the pipe. Welded and bolted attachments to building structural steel shall be in accordance with the requirements of the AISC Manual of Steel Construction. There shall be no drilling or burning of holes in the building structural steel unless otherwise specified. Embedded anchor bolts shall be used instead of concrete inserts for seismic brace installations in areas below water surface or normally subject to submergence. Thermal pipe hanger shields shall be installed on insulated piping at required locations during restraint installation. Butt joint connections to pipe insulation shall be made at the time of insulation installation in accordance with the manufacturer's recommendations. Restraint components in contact with plastic pipe shall be free of burrs and sharp edges. Rollers shall roll freely without binding. Plastic or rubber end caps shall be provided at the exposed ends of all framing channels that are located up to 7 feet above the floor.

G.6.14 Expansion Control

The expansion control system shall be designed by the professional engineer retained by the construction contractor for design of the pipe support systems. Expansion control details shall be designed in conjunction with preparation of pipe hanger support system and seismic restraint systems drawings. All drawings and calculations for the expansion control system shall bear the professional engineer's registration seal and signature.

Anchors and guides shall be manufactured or iron or steel, including braces, pipe and structural attachments, and shall be hot-dip galvanized after fabrication. Supports cast integrally with cast iron fittings shall be specifically prohibited for use in any application where shear forces may be imposed on the support. Nuts, bolts and washers may be zinc-plated except for those subject to moisture or corrosive atmosphere which shall be Type 316 stainless steel. For corrosive areas all pipe support, anchor and brace components (not just fittings and accessories) shall be made of fiberglass.

The expansion control system shall be designed for maximum reliability. "L", "U", or "Z" bends shall be employed to control expansion in preference over expansion joints. Expansion control systems using pipe bends shall be designed to limit bending stress in the pipe associated with deflection at the worst case temperature difference. The maximum allowable bending stress shall be 1/3 of the yield stress for the pipe material. If loading conditions or uncertainties warrant, a lower allowable stress value shall be used. Expansion control design for expansion joints shall conform to the guidelines given in the Standards of the Expansion Joint Manufacturers Association, Inc. (EJMA). The test pressures listed in the PIPESPEC sheets shall be used when calculating pressure forces. Pipe guides or planar pipe guides shall be provided to control the movement of pipes when "L", "U", or "Z" bends are used for expansion control. The guides shall be located as indicated in EJMA standards. Recommended main anchor locations shall be shown on the drawings. Intermediate anchors shall be provided as needed. Maximum forces that the structure can withstand at the main anchor points shall be noted on the drawings. Anchors shall be designed to attach to the structure and solidly to the pipe. Pipe clamps or U-bolts shall not be allowed unless they are designed to withstand the forces imposed upon the anchor and have stops welded to the pipe so that the pipe cannot slip in the anchor. Anchors and guides shall be coordinated with the pipe support systems and seismic restraints. The design of the expansion control, pipe support and seismic restraints for the piping systems shall be integrated to provide maximum flexibility for maintenance access to equipment, appurtenances such as valves etc., and to the pipe itself. There shall be no metal-to-metal contact between a pipe and restraint component of dissimilar metals. Branch lines shall not be used to anchor main lines. For elevated pipe sections, fabricated support frames or other appropriate structures shall be designed to withstand the specified loads plus gravity and seismic loads. The support shall be designed to provide access to equipment, walkways, gates, and other piping.

Welded and bolted attachments to building structural steel shall be in accordance with the requirements of the AISC Manual of Steel Construction. There shall be no drilling or burning of holes in the building structural steel unless otherwise specified. Embedded anchor bolts shall be used instead of concrete inserts, wedge anchors, expansion anchors, adhesive, or other non-embedded type of anchor for expansion control installations in areas below water surface or normally subject to submerging. Thermal pipe hanger shields shall be installed on insulated piping at required locations during guide installation. Butt joint connections to pipe insulation shall be made at the time of insulation installation in accordance with the manufacturer's recommendations. Anchors shall be directly connected to the pipe by welding or another acceptable, positive means. Components in contact with plastic pipe shall be free of burrs and sharp edges. Rollers shall roll freely without binding. Plastic or rubber end caps shall be provided at the exposed ends of all framing channels that are located up to 7 feet above the floor.

G.6.15 Miscellaneous

Exposed piping, interior and exterior, and piping in ceiling spaces, pipe trenches, pipe chases, and valve boxes shall be identified with plastic legend markers and directional arrows located at each side of the walls, floorings, and ceilings, at one side of each piece of equipment, at piping intersections, and at approximately 50 foot centers.

Connection of ferrous to nonferrous metal piping shall be with an insulating section of rubber or plastic pipe having a minimum length of 12 pipe diameters or with a dielectric union.

Buried ferrous piping shall be corrosion protected by coating with liquid epoxy conforming to ANSI/AWWA C210, polyethylene tape coating conforming to ANSI/AWWA C214, or fusion epoxy as specified in the piping system specification sheets.

Buried ductile iron piping shall be corrosion protected by coating with asphaltic coating conforming to ANSI/AWWA C151/A21.11 and wrapped with polyethylene film conforming to ANSI/AWWA C1051A21.5.

G.7 Piping Services Index and Specifications

Table G-10, which follows, provides a list of pipe services to be used in this project. Each pipe service is given a symbol which shall be used on the drawings. The system number indicates which pipe system specification applies to this service. Color coding and fluid category provide a quick reference of a pipe service. The piping specifications in accordance to their system number are included in Attachment H.

Table G-10. Piping Services

Symbol	Service	System	Fluid category	Pipe marker background color
CD	Chemical Drain	25	Drain/Vent	Yellow
CSO	Caustic Soda	19	Chemical	Yellow
D	Drain	24	Drain/Vent	Green
DSF	Diesel Fuel	18	Petroleum	White
FA	Foul Air	22	Foul Air	Yellow
FM	Force Main	12A	Wastewater	Green
HOCl	Sodium Hypochlorite	19	Chemical	Yellow
HW	Potable Hot Water	7	Water	Blue
LOR	Lube Oil Return	18	Petroleum	White
LOS	Lube Oil Supply	18	Petroleum	White
LOW	Lube Oil Waste	18	Petroleum	White
PD	Pumped Drainage	12	Wastewater	Green
RS	Raw Sewage (Gravity)	12	Wastewater	Green

Table G-10. Piping Services

Symbol	Service	System	Fluid category	Pipe marker background color
RWR	Reclaimed Water	9	Water	Green
SA	Service Air	2	Air	Orange
SD	Sanitary Drain	24	Drain/Vent	Green
STD	Storm Drain	24	Drain/Vent	Green
V	Vent	24	Drain/Vent	Yellow
VC	Chemical Vent	25	Drain/Vent	Yellow
1W	Potable Water (City water)	7	Water	Blue
3WS	No. 3 Spray Water	10	Water	Green

Note: System numbers 1, 3-6, 8, 11, 13-17, 20-21, 23 and 26-30 not included.

G.8 Standard Details

Standard details are included in Attachment N.

H. ATTACHMENT

Piping Specifications

The purpose of this document is to guide the pump station final design teams and to ensure consistent quality and similar facilities for ease of operation and maintenance. This document is meant to be a working document for the design teams such that during the design, changes can be made based on design team review and consensus.

PIPING SPECIFICATION SHEETS–PIPESPEC

Piping Symbol/Service: SA--Service Air System--2

Test Requirements:
- Medium: Water
- Pressure: 20 inches water column
- Duration: 60 minutes

Gasket Requirements:
- Flange: Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder
- Push-on/Mech Cpl: N/A

<u>Exposed Pipe and Valves</u>:

(24" and smaller)
- Pipe: <u>Fiberglass Reinforced Plastic</u>; ASTM D883, filament wound construction.
  <u>Conn</u>; butt or mitered weld, flanged for valves.
  <u>Ftgs</u>; molded or fabricated as the same material as the pipe.
- Valves: <u>Ball</u>; Jamesbury 5150-31-2200TT, Nibco F-510, or equal.
  <u>Check</u>; Ported plate style designed for use with pulsating flow; Hoerbiger Depend-A-Check or Compact-A-Check, Dienes Type DL-RF, or equal.

<u>Buried and Encased Pipe and Valves</u>:

(24" and smaller)
- Pipe: <u>HDPE</u>; AWWA C906. Provide magnetic tracer tape.
  <u>Conn</u>; thermal butt-fusion welded with flanged adapters for valves.
  <u>Ftgs</u>; HDPE AWWA C906, fabricated; ends and SDR to match pipe
- Valves: <u>Ball</u>; same as exposed with extension stem and valve box.

Remarks:

1. Pipe materials for immersed service air piping shall be:

(2" and smaller)

Pipe:	Stainless steel; ASTM A312, Schedule 40S. Conn; threaded, ANSI B1.20.1. Ftgs; ASTM A403, material, ends and wall thickness to match pipe.

2. Encased pipes shall not be coated.

PIPING SPECIFICATION SHEETS–PIPESPEC

Piping Symbol/Service: 1W--Potable Water System--7

Test Requirements:
Medium: Water
Pressure: 150 psig
Duration: 60 minutes

Gasket Requirements:
Flange: Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder
Push-on/Mech Cpl: EPDM

Exposed Pipe and Valves:

(3" and smaller)
Pipe: Copper tube; ASTM B88, Type L, drawn.
Conn; solder type with threaded or flanged adapters for valves.
Ftgs; wrought copper or bronze, ANSI B16.22.

(2" and smaller)
Valves: Ball; Jamesbury Fig. 351, Nibco T-580, or equal.
Globe; Crane 7TF or 17TF, Lunkenheimer 123 or 214, or equal.
Swing check; Crane 137, Lunkenheimer 230, or equal.

(4" and larger)
Pipe: Steel; ASTM A53, seamless, Grade B, black, with cement mortar lining.
Conn; grooved mechanical pipe coupling or flanged.
Ftgs; malleable iron, ductile iron, or steel ends and lining to match pipe.

(2 1/2" and larger)
Valves: Butterfly. Substitute Type B on 2-1/2-inch lines.
Swing check; spring loaded.

Buried and Encased Pipe and Valves:

(3" and smaller)
Pipe: Copper tube; ASTM B88, Type K, annealed or drawn.
Conn; solder type, with threaded or flanged adapters for valves.
Ftgs; wrought copper or bronze, ANSI B16.22.

Valves: Gate; ref. spec Section 15101, with extension stem and valve box. Coating shall be petrolatum based mastic and wrapping tape.

(4" and larger)

PIPING SPECIFICATION SHEETS–PIPESPEC

Piping System:	7 (continued)
Pipe:	Ductile iron; AWWA C151 with cement mortar lining. Outside shall be coated with 100-percent solids polyurethane, fusion bonded epoxy, or tap wrap conforming to AWWA C209. Conn; grooved end or restrained push-on rubber gasket joint. Flanged adapters for valves. Ftgs; ductile iron per spec Section 15062; coating, lining, and ends to match pipe.
Valves:	Butterfly; same as exposed with extension stem and valve box. Coating shall be petrolatum based mastic and wrapping tape.

Remarks:

1. Manual air vents shall be provided at the high points and drains provided at the low points of each reach of pipeline.
2. Lug or flanged butterfly valves are required for dead end or isolation service.
3. Encased pipe shall not be coated.

PIPING SPECIFICATION SHEETS–PIPESPEC

Piping Symbol/Service:	RWR Reclaimed Water	System–9
Test Requirements:		
Medium:	Water	
Pressure:	125 psig	
Duration:	60 minutes	
Gasket Requirements:		
Flange:	Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder	
Push-on/Mech Cpl:	Nitrile or Neoprene	
Exposed Pipe and Valves:		
(3" and smaller)		
Pipe:	Steel; ASTM A53, galvanized. Ref. spec Section 15061. Conn; taper threaded, ANSI B1.20.1. Flanged adapters for 2-1/2 inch, 3 inch valves. Ftgs; malleable iron, ASTM A197, ANSI B16.3, Class 150, galvanized.	
(2" and smaller)		
Valves:	Ball; Jamesbury Fig. 351, Nibco T-580, or equal. Globe; Crane 7TF or 17TF, Lunkenheimer 123 or 214, or equal. Swing check; Crane 137, Lunkenheimer 230, or equal.	
(4" thru 8")		
Pipe:	Steel; ASTM A53, ERW, Grade B, black, with cement mortar lining. Conn; grooved mech pipe coupling or flanged. Ftgs; malleable iron, ductile iron, or steel; ends and lining to match pipe.	
(2 1/2" thru 8")		
Valves:	Butterfly; Substitute Type B on 2-1/2-inch lines. Swing check; spring loaded.	
(10" thru 24")		
Pipe:	Steel; same as 8 inch or AWWA C200, 3/16 inch thick, with cement mortar lining. Conn; same as 8 inch. See Remarks. Ftgs; steel, ASTM A234, or fabricated steel, AWWA C208. Lining and ends to match pipe.	
Valves:	Butterfly. Swing check; spring loaded.	

PIPING SPECIFICATION SHEETS–PIPESPEC

Piping System: 9 (continued)

Buried and Encased Pipe and Valves:

(3" and smaller)

Pipe: PVC; ASTM D1784, Class 12454-B, NSF certified, ASTM D1785, Sch. 80. Provide magnetic tracer tape.
Conn; plain end; solvent weld with threaded or flanged adapters for valves.
Ftgs; PVC, Sch. 80, socket weld.

Valves: Gate; with extension stem and valve box. Coating shall be petrolatum based mastic and wrapping tapes.

(4" to 12")

Pipe: Ductile iron; AWWA C151 with cement mortar lining. Outer coating shall be 100-percent solids polyurethane, fusion bonded epoxy, or tape wrap conforming to AWWA C209.
Conn; grooved end or restrained push-on rubber gasket joint. Flanged adapters for valves.
Ftgs; ductile iron; coating, lining and ends to match pipe.

Valves: Butterfly; same as exposed with extension stem and valve box. Coating shall be petrolatum based mastic and wrapping tapes.

(14" and larger)

Pipe: Ductile iron; same as 12 inch for pipe, conn and ftgs

Valves: Butterfly; same as exposed with extension stem and valve box.

Remarks:

1. Manual air vents shall be provided at the high points and drains provided at the low points of each reach of pipeline.
2. Provide lug or flanged butterfly valves for dead end or isolation service.

3.06 PIPING SPECIFICATION SHEETS–PIPESPEC

Piping Symbol/Service:	3WS No. 3 Spray Water	System--10

Test Requirements:	
Medium:	Water
Pressure:	125 psig
Duration:	120 minutes
Gasket Requirements:	
Flange:	Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder
Push-on/Mech Cpl:	Nitrile or Neoprene

Exposed Pipe and Valves:

(2" and smaller)	
Pipe:	Steel; ASTM A53, galvanized. Conn; taper threaded, ANSI B1.20.1. Ftgs; malleable iron, ASTM A197, ANSI B16.3, Class 150, galvanized.
Valves:	Ball; Jamesbury Fig. 351, Nibco T-580, or equal. Globe; Crane 7TF or 17TF, Lunkenheimer 123 or 214, or equal. Swing check; Crane 137, Lunkenheimer 230, or equal.
(2 1/2" thru 8")	
Pipe:	Steel; ASTM A53, ERW, Grade B, black, no lining. Conn; butt weld, grooved mech pipe coupling or flanged. Ftgs; malleable iron, ductile iron, or steel; ends to match pipe.
Valves:	Butterfly; Substitute Type B on 2-1/2-inch lines. Swing check; spring loaded.
(10" and larger)	
Pipe:	Steel; same as 8 inch or AWWA C200, 3/16 inch thick, w/lining. Conn; butt weld, mech pipe coupling, or flanged. Ftgs; steel, ASTM A234, or fabricated steel, AWWA C208; lining and ends to match pipe.
Valves:	Butterfly. Swing check; spring loaded.

Buried and Encased Pipe and Valves:

(3" and smaller)

3.06 PIPING SPECIFICATION SHEETS–PIPESPEC

Piping System:	10 (continued)
Pipe:	PVC; ASTM D1784, Class 12454-B, ASTM D1785, Sch. 80. Provide magnetic tracer tape. Conn; plain end; solvent weld with threaded or flanged adapters for valves. Ftgs; PVC, Sch. 80, socket weld.
Valves:	Gate; with extension stem and valve box. Coating shall be petrolatum based mastic and wrapping tapes.
(4" thru 12")	
Pipe:	Ductile iron; AWWA C151. Outer coating shall be 100-percent solids polyurethane, fusion bonded epoxy, or tape wrap conforming to AWWA C209. Conn; grooved end or restrained push-on rubber gasket joint. Flanged adapters for valves. Ftgs; ductile iron; coating, lining and ends to match pipe.
Valves:	Butterfly; same as exposed with extension stem and valve box. Coating shall be petrolatum based mastic and wrapping tapes.
(14" and larger)	
Pipe:	Ductile iron; same as 12 inch for pipe and ftgs. Conn; restrained bell and spigot with O-ring rubber gasket joint. Flanged adapters for valves. Ftgs; fabricated steel, mortar lined and coated.
Valves:	Butterfly; same as exposed with extension stem and valve box. Coating shall be petrolatum based mastic and wrapping tapes.

Remarks:

1. Manual air vents shall be provided at the high points and drains provided at the low points of each reach of pipeline.
2. Provide lug or flanged butterfly valves for dead end or isolation service.

PIPING SPECIFICATION SHEETS–PIPESPEC

Piping Symbol/Service: RS--Raw Sewage System--12

Test Requirements:

- Medium: Water.
- Pressure: 125 psig
- Duration: 120 minutes

Gasket Requirements:

- Flange: Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder
- Push-on/Mech Cpl: Nitrile or Neoprene

Exposed Pipe and Valves:
(Not Used)

Buried and Encased Pipe and Valves:

(3" and smaller)

Pipe: PVC; ASTM D1784, Class 12454-B, ASTM D1785, Sch. 80. Provide magnetic tracer tape.
Conn; plain end; solvent weld with threaded or flanged adapters for valves.
Ftgs; PVC, Sch. 80, socket weld.

Valves: Eccentric plug; same as exposed with extension stem and valve box. Fusion bonded epoxy lined and coated, applied in accordance with AWWA C550.

(4" thru 12")

Pipe: Ductile iron; AWWA C151. Coated with 100-percent solids polyurethane, fusion bonded epoxy, or tape wrapped conforming to AWWA C209.
Conn; grooved end or restrained push-on rubber gasket joint. Flanged adapters for valves.
Ftgs; ductile iron; coating, lining and ends to match pipe.

Valves: Eccentric plug; same as exposed with extension stem and valve box. Coating shall be petrolatum based mastic and wrapping tapes.

(14" thru 24”)

Pipe: Ductile iron; same as 12 inch for pipe and ftgs.
Conn; restrained bell and spigot with O-ring rubber gasket joint. Flanged adapters for valves.
Ftgs; ductile iron; coating, lining and ends to match pipe.

PIPING SPECIFICATION SHEETS–PIPESPEC

Piping System:	12 (continued)
Valves:	Eccentric plug; same as exposed with extension stem and valve box. Coating shall be petrolatum based mastic and wrapping tapes.
(24" or larger) Pipe:	Reinforced concrete pipe with PVC lining. Conn; bell and spigot with rubber gasket joint. Joint design shall include provisions for double rubber gasket for pipe greater than or equal to 48-inch in diameter and a single or double gasket for smaller pipe. Ftgs; fabricated from same material as pipe; lining and ends to match pipe or manholes.
Valves:	None.

Remarks:

1. Verify that wall stiffness of the concrete pipe is sufficient to withstand external loads imposed from specified trenching, bedding and backfill operations. If required, modify trenching, bedding and backfill operations and/or increase the wall stiffness to satisfy actual conditions.

3.06 PIPING SPECIFICATION SHEETS–PIPESPEC

Piping Symbol/Service: FM — Force Main System—12A
PD — Pump Drainage

Test Requirements:
Medium: Water.
Pressure: 125 psig
Duration: 120 minutes

Gasket Requirements:
Flange: Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder
Push-on/Mech Cpl: Nitrile or Neoprene

Exposed Pipe and Valves:

(2" and smaller)
Pipe:
Steel; ASTM A53, galvanized.
Conn; taper threaded, ANSI B1.20.1.
Ftgs; malleable iron, ASTM A197, ANSI B16.3, Class 150, galvanized.

Valves:
Eccentric plug; Install valve with seat upstream.
Swing check; Lunkenheimer 230, Crane 137, or equal.

(2 1/2" thru 8")
Pipe:
Steel; ASTM A53 ERW, Grade B, black, no lining.
Conn; butt weld, grooved mech pipe coupling or flanged.
Ftgs; malleable iron, ductile iron, or; ends to match pipe.

Valves:
Eccentric plug; Install valve with seat upstream.
Swing check; spring loaded.

(10" thru 12")
Pipe:
Steel; same as 8 inch or AWWA C200, 3/16 inch thick, with lining.
Conn; butt weld, mech pipe coupling, or flanged.
Ftgs; steel, ASTM A234, or fabricated steel, AWWA C208; lining and ends to match pipe.

Valves:
Eccentric plug.
Swing check; spring loaded.

(12" and larger)
Pipe:
Ductile iron; AWWA C115 with lining and 100-percent solids polyurethane or fusion bonded epoxy coating or tape wrapped conforming to AWWA C209.
Conn; Flanged.

3.06 PIPING SPECIFICATION SHEETS–PIPESPEC

Piping System: 12 (continued)

Ftgs; ductile iron; coating, lining and ends to match pipe.

Valves: Eccentric plug; Install valve with seat upstream.
Swing check; spring loaded.

Buried and Encased Pipe and Valves:

(3" and smaller)

Pipe: PVC; ASTM D1784, Class 12454-B, ASTM D1785, Sch. 80. Provide magnetic tracer tape.
Conn; plain end; solvent weld with threaded or flanged adapters for valves.
Ftgs; PVC, Sch. 80, socket weld.

Valves: Eccentric plug; same as exposed with extension stem and valve box. Coating and lining shall be fusion bonded epoxy.

(4" thru 12")

Pipe: Ductile iron; AWWA C151 with lining and 100-percent solids polyurethane or fusion bonded epoxy coating or tape wrapped conforming to AWWA C209.
Conn; grooved end or restrained push-on rubber gasket joint. Flanged adapters for valves.
Ftgs; ductile iron; coating, lining and ends to match pipe.

Valves: Eccentric plug; same as exposed with extension stem and valve box. Coating and lining shall be fusion bonded epoxy.

(14" and larger within Pump Station Site)

Pipe: Ductile iron; same as 12 inch for pipe and ftgs.
Conn; restrained bell and spigot with O-ring rubber gasket joint. Flanged adapters for valves.
Ftgs; fabricated steel, mortar lined and coated.

Valves: Eccentric plug; same as exposed with extension stem and valve box. Coating and lining shall be fusion bonded epoxy.

(14" and larger outside of Pump Station Site)

Pipe: High Density Polyethylene (HDPE), ASTM D3350, DR 21.
Conn; butt fusion. Flanged adapters for valves.
Ftgs; molded or fabricated of the same pipe material as pipe, AWWA C906. SDR no greater than pipe. Pressure rating at least equal to pipe.

3.06 PIPING SPECIFICATION SHEETS–PIPESPEC

Piping System:	12 (continued)
Valves:	Eccentric plug; same as exposed with extension stem and valve box. Coating and lining shall be fusion bonded epoxy.

3.06 PIPING SPECIFICATION SHEETS–PIPESPEC

Piping Symbol/Service: DSF--Diesel Fuel System--18
LOR--Lube Oil Return
LOS--Lube Oil Supply
LOW–Lube Oil Waste

Test Requirements:
Medium: Fuel oil.
Pressure: 150 psig (pressure piping)
5 psig (nonpressure piping)
Duration: 60 minutes

Gasket Requirements:
Flange: Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder
Push-On/Mech Cpl: N/A

Exposed Pipe and Valves:

(2" and smaller)

Pipe: Steel; ASTM A106, seamless, Grade B, black, pickled.
Conn; threaded or socket weld with threaded adapters for valves.
Ftgs; forged steel, ASTM A105, ANSI B16.11, pressure Class 3000, pickled.

Valves: Lubricated plug; cast iron, PTFE coated plug, Nordstrom Fig. 142, Walworth Fig. 1796, or equal.
Lift check; Crane 27TF, Lunkenheimer 231, or equal.

(2 1/2" thru 12")

Pipe: Steel; ASTM A53, seamless, Grade B, black, pickled.
Conn; butt weld, flanged for valves.
Ftgs; steel, ASTM A234, seamless, ANSI B16.9, pickled; ends shall match pipe.

Valves: Lubricated plug; cast iron with PTFE or molydisulfide coated plug, Nordstrom Fig. 143, Walworth Fig. 1797F, or equal, thru 5 inch; worm gear operator Rockwell Fig. 149, Walworth Fig. 1727F, or equal, 6 to 12 inches.

Swing check; cast iron, flanged, Jenkins 1025-B2, Walworth 5344F, or equal.

Buried and Encased Pipe and Valves:

(2" and larger)

3.06 PIPING SPECIFICATION SHEETS–PIPESPEC

Piping System:	18 (continued)
Pipe:	Reinforced thermosetting resin (RTRP); Type 1. Double containment unless otherwise specified. Provide magnetic tracer tape. Conn; bonded bell and spigot or flanged. Ftgs; RTRP to match pipe.
Valves:	Lubricated plug; same as exposed with extension stem and valve box.

Remarks:

1. The cleaning (pickling) solution used shall comply with Mil-H-13528B. Immediately following pickling and rinsing procedures, steel pipe and fittings shall be coated inside and outside with a rust and corrosion preventative system, and the ends sealed to prevent the entry of dirt.
2. Provide double contained piping for all piping. Carrier and secondary piping shall be hydrostatically tested as specified in this section.
3. Low pressure air testing of approximately 5 psig is allowable for secondary containment piping and is the preferred method of testing. A 5 psig test will attest to the integrity of the system. If secondary containment piping is specified, add the following remark: “Low pressure air testing of approximately 5 psig is allowed for testing the secondary containment piping.”

3.06 PIPING SPECIFICATION SHEETS–PIPESPEC

Piping Symbol/Service: CSO--Caustic Soda System--19
HOCL--Sodium Hypochlorite

Test Requirements:
Medium: Water.
Pressure: 150 psig
Duration: 120 minutes

Gasket Requirements:
Flange: PTFE bonded EPDM, full-face gaskets, ANSI B16.1.
Push-on/Mech Cpl: N/A

Exposed Pipe and Valves:
(See drawings for pipe size and valve type)

(All sizes)
Pipe: PVC; ASTM D1784, Class 12454-B, NSF certified, ASTM D1785, Sch. 80. Pipe and fittings exposed to sunlight shall be painted.
Conn; plain end, solvent weld, flanged for valves 3 inch and larger.
Ftgs; PVC, Sch. 80, solvent weld.

(4" and less)
Valves: Ball; PVC Chemtrol Tru Bloc TU Series, Asahi/America Duo Bloc TU Series, GSR TU Series, or equal, with PTFE seats and EPDM O-rings.
Diaphragm; PVC body, Chemtrol Series PD, Posacon 677, Asahi/America, or equal with EPDM or PTFE diaphragm.
Ball check; PVC body, Chemtrol Series BC, Asahi/America, or equal with EPDM or PTFE seats/seals.

(5" and larger)
Valves: Diaphragm; ITT Dia-Flo 2558-2-M, Hills-McCanna 0649-1-38, or equal.
Swing or ball check; fully lined valve body; fully coated swing check flapper or ball check ball; lining and coating shall be Hypalon or fluorinated ethylene propylene. Valve and Primer Co. APCO Series 100R, Peabody Dore Model 770, or equal.

Buried and Encased Pipe and Valves:

(All sizes)
Pipe: PVC; same as exposed. Provide magnetic tracer tape.
Conn; same as exposed.
Ftgs; same as exposed.

3.06 PIPING SPECIFICATION SHEETS–PIPESPEC

Piping System:	19 (continued)
(2" and less) Valves:	Ball; same as exposed with extension stem and valve box.
(2 1/2" and larger) Valves:	Diaphragm; same as exposed with extension stem and valve box.

Remarks:

1. Ball valves and threaded fittings are not permitted on chemical service.

2. Diaphragm valves shall be provided with PVDF limits with EPDM Teflon Diaphragm.

3. Diaphragm valves 4 inches and smaller shall be provided with PTFE diaphragms; valves 5 inches and larger shall be provided with Hypalon or PDVF linings with PTFE diaphragms.

4. The procedure for making solvent-cemented joints with schedule 80 PVC pipe and fittings shall strictly conform to ASTM D2855. The solvent weld cement for joints shall only be IPS WELD-ON® 724 glue. The glue is labeled for CPVC, but is also rated for PVC. A representative of the PVC pipe company shall provide training to certify the plumbers.

5. Closer spacing of pipe supports shall be provided for plastic pipe operating with chemical solutions. For high temperature caustic soda service, add the following remark: "Pipe supports for caustic soda piping shall be 60 percent closer than maximum spacing specified for plastic piping."

6. Piping outside of containment areas shall be double contained. Carrier and secondary piping shall be hydrostatically tested as specified in this section.

7. Joints shall be true union for all PVC valves.

1.06 PIPING SPECIFICATION SHEETS—PIPESPEC

Piping Symbol/Service:	FA--Foul Air	System--22

Test Requirements:

Medium:	Air
Pressure:	20 inches water column
Duration:	60 minutes

Gasket Requirements, 16” and smaller:

Flange:	Gylon gasketing, Garlock style 3504
Push-on/Mech Cpl:	PTFE

Exposed Pipe and Valves:

(24" and smaller)

Pipe:	Fiberglass Reinforced Plastic; ASTM D883, filament wound construction. Conn; butt or mitered weld, flanged for valves. Ftgs; molded or fabricated as the same material as the pipe.
Valves:	Butterfly

Buried and Encased Pipe and Valves:

(24" and smaller)

Pipe:	HDPE; AWWA C906. Conn; thermal butt-fusion welded with flanged adapters for valves. Ftgs; HDPE AWWA C906, fabricated; ends and SDR to match pipe
Valves:	Butterfly; same as exposed with extension stem and valve box. Coating shall be petrolatum based mastic and wrapping tapes.

Remarks:

1. All piping shall be sloped to drain into wet well.

3.06 PIPING SPECIFICATION SHEETS–PIPESPEC

Piping Symbol/Service: D--Drain System–24
SD--Sanitary Drain
STD--Storm Drain
V--Vent

Test Requirements:

Medium: In accordance with Section 712, Uniform Plumbing Code.

Pressure: In accordance with Section 712, Uniform Plumbing Code.

Duration: In accordance with Section 712, Uniform Plumbing Code.

Gasket Requirements:

Flange: Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder

Push-on/Mech Cpl: Nitrile or neoprene

Exposed Pipe and Valves:

(3" and smaller)

Pipe:
Steel; ASTM A53, galvanized.
Conn; taper threaded, ANSI B1.20.1.
Ftgs; cast iron, threaded drainage fittings, ASTM A126, ANSI B16.12, galvanized.

Valves: None

(4" thru 12")

Pipe:
Cast iron soil pipe (CISP); ASTM A74.
Conn; service hub and spigot compression type or hubless cast iron sanitary system per CISPI 301.
Ftgs; CISP, ASTM A74, joint options to match pipe.

Valves: None

(14" and larger)

Pipe:
Ductile iron; AWWA C151.
Conn; flanged or mechanical.
Ftgs; ductile iron; ends to match pipe.

Valves: None

Buried and Encased Pipe and Valves Under and 5 Feet Outside Building

(12" and smaller)

Pipe: Cast iron soil pipe (CISP); same as exposed.

3.06 PIPING SPECIFICATION SHEETS–PIPESPEC

Piping System: 24 (continued)

Valves: None

(14" and larger)
Pipe: Ductile iron; same as exposed.

Valves: None

Buried and Encased Pipe and Valves Beyond 5 Feet Outside Building

(8" and smaller)
Pipe: PVC; ASTM D1784, Class 12454-B, ASTM D2665, Sch. 40.
Provide magnetic tracer tape.
Conn; plain end, solvent weld.
Ftgs; PVC, socket type, DWV, ASTM D2665.

Valves: None

(10" and 12")
Pipe: PVC; ASTM D3034, SDR 35. Provide magnetic tracer tape.
Conn; Push-on with nitrile gasket.
Ftgs; PVC or IPS cast iron; ends to match pipe.

Valves: None

(14" and larger)
Pipe: Reinforced concrete pipe (RCP).
Conn; ASTM C443, rubber gasket type.
Ftgs; concrete manhole as specified on the drawings.

Valves: None

Remarks:

1. PVC pipe, 12 inches and smaller, is specified for buried service beyond five feet outside buildings. Governing local building and plumbing codes must be reviewed for compliance, and client preference must be determined before using this PIPESPEC.

2. Pipe slope requirements and direction of flow shall be shown on the drawings. For building drainage, piping should be provided with a minimum downward slope of 1/4 inch per foot in the direction of flow.

3. Copper condensate drains shall be specified on the drawings for HVAC equipment. If HVAC equipment condensate drains are required, add the following specification to remarks:

3.06 PIPING SPECIFICATION SHEETS–PIPESPEC

Piping System: 24 (continued)

"HVAC equipment condensate drains shall be copper tube; ASTM B88, Type M, drawn. Fittings shall be wrought copper or bronze, ANSI B16.22. Connections shall be solder type with threaded adapters for equipment connections where required."

3.06 PIPING SPECIFICATION SHEETS–PIPESPEC

Piping Symbol/Service:	CD--Chemical Drain VC--Chemical Vent	System--25

Test Requirements:

Medium:	In accordance with Section 712, Uniform Plumbing Code.
Pressure:	In accordance with Section 712, Uniform Plumbing Code.
Duration:	In accordance with Section 712, Uniform Plumbing Code.

Gasket Requirements:

Flange:	N/A
Push-on/Mech Cpl:	N/A

<u>Exposed Pipe and Valves</u>:
(See drawings for pipe size and valve type)

(All sizes)

Pipe:	<u>PP</u>; ASTM D4101, Sch. 40, flame retardant. <u>Conn</u>; electrical fusion coils energized by a variable low-voltage power supply to completely fuse the interface between the pipe and socket to form a completely homogenous structure. Mechanical joint fittings may be used under bench or in exposed locations where future disassembly is desired. <u>Ftgs</u>; PP, socket type coil fused DWV.
Valves:	None

<u>Buried and Encased Pipe and Valves</u>:

Pipe:	<u>PP</u>; same as exposed. Provide magnetic tracer tape. <u>Conn</u>; same as exposed. <u>Ftgs</u>; same as exposed.
Valves:	None.

<u>Remarks</u>: None.

3.06 PIPING SPECIFICATION SHEETS–PIPESPEC

Piping Symbol/Service:	2WL--Landscape Irrigation	System–29

Test Requirements:

Medium:	Water.
Pressure:	125 psig
Duration:	120 minutes

Gasket Requirements:

Flange:	Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder
Flush-on/Mech Cpl:	Nitrile or Neoprene

Exposed Pipe and Valves:
(See drawings for pipe size and valve type)

(2" and smaller)

Pipe:	PVC; ASTM D1784, Class 12454-B, NSF certified, ASTM D1785, Sch. 80. Pipe and fittings exposed to sunlight shall be painted. Conn; plain end; solvent weld with threaded adapters for valves. Ftgs; PVC, Sch. 80, socket type.
Valves:	Ball; Jamesbury Fig. 351, Nibco T-580, or equal. Globe; Crane 7TF or 17TF, Lunkenheimer 123 or 214, or equal. Swing check; Crane 137, Lunkenheimer 230, or equal.

(2 1/2" thru 8")

Pipe:	Steel; ASTM A53, ERW, Grade B, black, no lining. Conn; butt weld, grooved mech pipe coupling or flanged. Ftgs; malleable iron, ductile iron, or steel; ends to match pipe.
Valves:	Butterfly; ref. spec Section 15103. Substitute Type B on 2-1/2-inch lines. Swing check; spring loaded.

(10" and larger)

Pipe:	Steel; same as 8 inch or AWWA C200, 3/16 inch thick with lining. Conn; butt weld or flanged. Ftgs; steel, ASTM A234, or fabricated steel, AWWA C208; lining and ends to match pipe.
Valves:	Butterfly. Swing check; spring loaded.

Buried and Encased Pipe and Valves:

(6" and smaller)

3.06 PIPING SPECIFICATION SHEETS–PIPESPEC

Piping System:	29 (continued)
Pipe:	PVC; ASTM D1784, Class 12454-B, NSF certified, ASTM D2241, SDR 21. Conn; plain end; solvent weld with threaded or flanged adapters for valves. Ftgs; PVC, Sch. 80, socket type.
(All sizes) Valves:	Butterfly. Swing check; spring loaded.
(8" thru 12") Pipe:	PVC; same as 6 inch. Conn; push-on gasketed joint with flanged adapters for valves. Ftgs; steel or ductile iron, IPS, push-on or mechanical joint with standard lining and coating.

Remarks: None.

3.06 PIPING SPECIFICATION SHEETS–PIPESPEC

Piping Symbol/Service	EE--Engine Exhaust	System--31

Test Requirements:

Medium:	None
Pressure:	None
Duration:	None

Gasket Requirements:

Flange:	See Remarks
Push-on/Mech Cpl:	N/A

Exposed Pipe and Valves:
(See drawings for pipe size)

All Pipe:	Stainless Steel; ASTM A312, Type 321 or 316L seamless, Schedule 10S, welded. Conn; butt weld, flanged for equipment connections. Ftgs; ASTM A403, material, thickness, and end connections to match pipe.

Remarks:

1. Pipe and fittings shall be insulated as specified with removable blanket type insulation.

2. Flange gasket shall be flat, full-face, graphoil suitable for temperatures to 1200 degrees F.

3. Engine exhaust piping shall be provided with stainless steel formed metal bellows type expansion joints.

4. Provide plugged sample ports as required for testing.

I. ATTACHMENT

HVAC Design

I.1 Purpose

The purpose of this document is to guide the pump station final design teams and to ensure consistent quality and similar facilities for ease of operation and maintenance. This document is meant to be a working document for the design teams such that during the design, changes can be made based on design team review and consensus.

I.2 Codes and Standards

Ventilating, and air conditioning (HVAC) design for the pump stations shall comply with the California Building Code (CBC), the California Mechanical Code (CMC), the California Energy Code (CEC), the American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE), and the National Fire Protection Association (NFPA).

HVAC construction shall be performed in accordance with the most current version of the following codes and standards:

- American National Standards Institute (ANSI) standards.
- National Fire Protection Association: Standard for Fire Protection in Wastewater Treatment and Collection Facilities (NFPA 820)
- California Building Code (California Code of Regulations, Title 24, Part 2)
- California Mechanical Code (California Code of Regulations, Title 24, Part 4)
- California Energy Code (California Code of Regulations, Title 24, Part 6)
- Sheet Metal and Air Conditioner Contractor’s National Association (SMACNA) standards.

I.3 Definitions

1. Conditioned Space – A space that is directly or indirectly conditioned with mechanical heating or cooling, unless it is a process space.
2. Process Space – A space that is thermostatically controlled to maintain a process environment heating temperature less than 55 degrees Fahrenheit, or to maintain a process environment cooling temperature greater than 90 degrees Fahrenheit for the whole space that the system serves. The space conditioning is not for human comfort but for equipment protection. Process spaces are not considered conditioned spaces by definition.
3. Physical Separation - A gas-tight partition between two adjacent spaces, or two nonadjacent spaces, with no means of gas communication between the spaces. Personnel entry to the separate spaces is by individual, grade-level exterior access ports with no physical connection between the two entrances.
4. Ventilation Rate – a value based on the number of air changes per hour, and calculated using 100 percent outside air for the supply air that is exhausted. The number of air changes per hour is calculated on the basis of the maximum aggregate volume of the space to be ventilated.

I.4 Design Criteria

HVAC systems shall be designed to provide ventilation for air quality, personnel safety, and equipment protection. All ventilated spaces shall be served by both supply and exhaust fans. All of the spaces shall be designed as process or unconditioned spaces. Materials and coatings will be selected for corrosion resistance in marine environments. Powered equipment shall be selected for quiet operation, but noise attenuation measures will not be incorporated.

Dedicated electrical rooms with VFDs shall be served with a dedicated HVAC system for equipment cooling, including mechanical filtration, chemical filtration, and positive pressure to maintain a clean, noncorrosive atmosphere.

I.5 Design Conditions

The HVAC systems will be designed for the following outdoor temperature conditions listed in Table I-1 based on the ASHRAE climatic data for the San Francisco International Airport:

Table I-1. HVAC Outdoor Temperature Design Conditions

Table I-1. HVAC Outdoor Temperature Design Conditions

Winter design dry bulb temperature	39 degrees F (ASHRAE 99.6% heating design condition)
Summer design dry bulb temperature	83 degrees F (ASHRAE 0.4% cooling design condition)
Summer mean coincident wet bulb temperature	63 degrees F (ASHRAE 0.4% wet bulb design condition)

The pump stations will be designed as unconditioned spaces. The indoor temperature design criteria are listed below in Table I-2.

Table I-2. HVAC Indoor Temperature Design Conditions

Wet well	
Heating	None, ventilation only
Cooling	None, ventilation only
Valve vault	
Heating	None
Cooling	None
Electrical building	
Heating	None
Cooling	90 degrees F

I.6 Ventilation Rates

Wet well spaces will be ventilated at 12 air changes or more per hour, and valve vault spaces will not be ventilated. These ventilation rates will allow all spaces in the pump stations to have an electrical hazard classification of "Class I, Division 2". Physical separation shall be provided between each wet well and between the wet well and associated valve vault.

I.7 HVAC Equipment

Roof Fans. Roof fans will be direct drive if possible to minimize maintenance. Roof fans will be specified with manufacturer-supplied mounting curbs. Fans equipped with ducting will be centrifugal type. Supply fans will be specified with disposable particulate filters.

Air Conditioners. Air conditioners,if required may be packaged, split system, or wall-mounted.

Ducting. All ductwork and duct accessories will be specified as aluminum for corrosion resistance. Ductwork will be fabricated according to SMACNA. Access doors will be provided adjacent to all pieces of duct-mounted equipment or instrumentation. Ductwork insulation is not an anticipated requirement.

Louvers. Intake and exhaust louvers will be provided with bird screens or insect screens. Louvers will be sized for a face velocity of 500 to 750 feet per minute, less than 0.10 inch water column pressure drop, and no water penetration. Louvers will be of aluminum construction with an anti-corrosion coating.

Grilles, Registers, and Diffusers. Grilles, registers, and diffusers shall be of aluminum construction and shall be sized in accordance with the manufacturer's recommendations for noise level, air velocity, pressure drop, and throw.

I.8 HVAC Controls

Ventilation systems shall run continuously. Cooling functions will be controlled by local thermostats. Ventilation systems used to downgrade the electrical classification of a space will be provided with ventilation failure alarms.

I.9 Standard Details

Standard details for each pump station are located in Attachment N.

J. ATTACHMENT

Electrical and Power

This section describes the electrical design criteria and construction standards for the design of the Silicon Valley Clean Water (SVCW) Pump Stations as noted herein. Included in the design criteria are the electrical distribution system, the standby generator system and automatic transfer switch, switchboards, motor control centers, motor starters, variable frequency drives (VFDs), conduit and wiring, etc.

The project consists of three existing pump stations,

1. Menlo Park S.D. Pump Station (PS1)
2. Redwood City Pump Station (PS2)
3. San Carlos Pump Station (PS3)

These three pump stations will require electrical equipment upgrades and replacement to meet the increased pumping capacity and reliability requirements. Additionally, the upgraded pump stations will have larger pump motors than the existing and will require a new standby generator to replace the existing.

It is assumed that the existing PG&E electrical service does not have the capacity for the increased pumping loads. Therefore, each pump station may require replacement of the existing utility transformer with a larger unit. During final design the size of the service requirements for the new pump station loads should be verified with the existing utility transformer capacity and coordinated with PG&E.

If this document overlaps or conflicts with governing codes, standards or manufacturer’s directions and instructions, the more restrictive interpretation or requirements shall be followed.

Where required the removal of existing power distribution equipment should be indicated on the drawings. Contractor should disconnect and remove in an orderly, planned, approved manner to facilitate continuous operation of the existing pump station. Electrical work shall be coordinated with mechanical work to minimize outages, downtime, altered plant operations, etc. All existing electrical equipment to be removed under this project shall be presented to SVCW for right of refusal. If SVCW elects to salvage the contractor shall remove and place the equipment at a location on the pump station site. If SVCW elects to refuse, the contractor shall remove and dispose of said equipment.

J.1 Purpose

The purpose of this document is to guide the pump station final design teams and to ensure consistent quality and similar facilities for ease of operation and maintenance. This document is meant to be a working document for the design teams such that during the design, changes can be made based on design team review and consensus.

J.2 Standard Definitions and Abbreviations

1. Authority Having Jurisdiction (AHJ) – An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.
2. Corrosive Location – An area normally subject to corrosive gasses or liquids. Material types for enclosures, conduit and conduit supports shall be compatible with corrosive gasses or liquids and not subject to premature failure.
3. Damp Location - Locations protected from weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture. Examples of such locations include partially protected locations under canopies, marquees, roofed open porches, and like locations, and interior locations subject to moderate degrees of moisture, such as some basements, some barns and some cold-storage warehouses.
4. Dry Location – A location not normally subject to dampness or wetness. A location classified as dry may be temporarily subject to dampness or wetness, as in the case of a building under construction.
5. GRS-PVC (conduit) – Galvanized Rigid Steel with Polyvinyl Chloride coating.
6. RAC-PVC (conduit) – Rigid Aluminum Conduit with Polyvinyl Chloride coating.
7. Hazardous (Classified) Location – A location that is classified based on the properties of the flammable vapors, or gases, combustible dusts, or fibers that might be present and the likelihood that a flammable or combustible concentration or quantity is present. The following NFPA 820 hazardous location classifications are as follows:

    a. Class I, Division 1 Location: A location (1) in which ignitable concentrations of flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors can exist under normal operating conditions; or (2) in which ignitable concentrations of such flammable gases, flammable liquid-produced vapors, or combustible liquids above their flash points may exist frequently because of repair or maintenance operations or because of leakage; or (3) in which breakdown of faulty operation of equipment or processes might also cause simultaneous failure of electrical equipment to become a source of ignition. Classification subject to NFPA 820.

    b. Class I, Division 2 Location: A location (1) in which volatile flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors are handled, processed, or used, but in which the liquids, vapors or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems, or in case of abnormal operation of equipment; (2) in which ignitable concentrations of flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors are normally prevented by positive mechanical ventilation and which might become hazardous through failure or abnormal operation of the ventilation equipment; or (3) that is adjacent to a Class I, Division 1 location and to which ignitable concentrations of flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors above their flash point might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air and effective safeguards against ventilation failure are provided. Classification subject to NFPA 820.

   c. Electrical conduits and their associated enclosures separated from process fluids or gasses by a single seal or barrier are classified as a Class I, Division 2 location if the outside of the conduit and enclosures is a nonhazardous (unclassified) location. Classification subject to NFPA 820.

8. I/O – Input and Output – Used to describe any program, operation or device that transfers data to or from a computer and to or from a peripheral device. Every transfer is an output from one device and an input into another.
9. Intrinsic Safety – A type of protection in which a portion of the electrical system contains only intrinsically safe equipment (apparatus, circuits, and wiring) that is incapable of causing ignition in the surrounding atmosphere. No single device or wiring is intrinsically safe by itself (except for battery-operated self-contained apparatus such as portable pagers, transceivers, gas detectors, etc., which are specifically designed as intrinsically safe self-contained devices) but is intrinsically safe only when employed in a properly designed intrinsically safe system.

   a. Intrinsic Safety Barrier: A component containing a network designed to limit the energy (voltage and current) available to the protected circuit in the hazardous (classified) location under specified fault conditions.
   b. Intrinsically Safe Circuit: A circuit in which any spark or thermal effect, produced either normally or in specified fault conditions, is incapable of releasing sufficient electrical or thermal energy to cause ignition of a specific hazardous atmospheric mixture in its most easily ignitable concentration.
   c. Intrinsically Safe Equipment (apparatus, circuits, and wiring): Equipment and wiring that, under normal or abnormal conditions, are incapable of releasing sufficient electrical or thermal energy to cause ignition of a specific hazardous atmospheric mixture in its most easily ignitable concentration.

10.
11. Labeled Equipment – Equipment or materials, to which has been attached a label, symbol, or other identifying mark of an organization concerned with product evaluation, that may maintain periodic inspection of the production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
12. LED – Light Emitting Diode
13. Listed – Equipment, materials or services included in a list published by an organization acceptable to the AHJ that is concerned with evaluation of products, that conducts periodic inspection of the production of the listed equipment or materials, and whose listing states either that the equipment, material or service meets appropriate designated standards, or has been tested and found suitable for a specified purpose.
14. MCC – Motor control center – A means to provide a convenient method for grouping motor control, as well as associated distribution equipment.
15. PLC – Programmable Logic Controller – A digital computer used for automation of electromechanical processes.
16. PPE – Personal Protective Equipment – Refers to protective clothing, helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury.

17. Qualified Person – One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved.

18. SCADA – Supervisory Control and Data Acquisition – Type of industrial control system, computer controlled system that monitor and control industrial processes that exist in the physical world.
19. Short Circuit Rating – The prospective symmetrical fault current at a nominal voltage to which an apparatus or system can be connected without sustaining damage exceeding defined acceptance criteria.
20. THD – Total Harmonic Distortion.
21. UPS – Uninterruptable Power Supply.
22. VFD – Variable Frequency Drive.
23. Wet Location – Installations under ground or in concrete slabs in direct contact with the earth; in locations subject to saturation with water or other liquids such as vehicle washing areas or areas requiring wash down by operations staff; or in unprotected locations exposed to weather.

J.3 Codes and Standards

1. Electrical design and construction shall comply with the National Electrical Code, the California Electrical Code, the Occupational Safety and Health Act, and the requirements of local codes in effect at the project site. All electrical construction shall be performed in the accordance with the most current version of the following codes and standards:
   - American National Standards Institute (ANSI) standards.
   - Insulated Cable Engineers Association (ICEA) standards.
   - Institute of Electrical and Electron Engineers Association (IEEE) standards.
   - Instrument Society of America (ISA) standards.
   - California Electrical Code (CEC), 2013, based on the 2011 National Electrical Code (NEC)
   - National Fire Protection Agency (NFPA 70E) Standard for Electrical Safety in the Workplace.
   - National Fire Protection Agency (NFPA 820) Fire Protection in Wastewater Treatment and Collection Facilities.
   - National Electrical Manufacturers Association (NEMA) standards.
   - Occupational Safety and Health Administration (OSHA) standards.
   - Acceptance Testing Specifications of Electrical Power Distribution Equipment and Systems, International Electrical Testing Association (NETA).
   - Underwriters Laboratories, Inc.
   - Insulated Power Cable Engineers Association (IPCEA)

2. In instances where two or more codes are at variance, the most restrictive requirements shall apply. Codes and standards referenced shall be considered minimum acceptable work.
3. All work shall also be performed in accordance with SVCW, State, County or Owner standards and local Utility codes.

J.4 ELECTRICAL DESIGN AND CONSTRUCTION STANDARDS

J.4.1 General

Electrical systems shall be heavy-duty industrial type with design emphasis placed on safety, reliability, maintainability and economics.

A new operationally reliable and cost effective electrical power system will be required to safely distribute power for the highest projected electrical demand at the modified pump station facility.

The equipment providing electrical power distribution must provide the safest conditions possible for normal electrical operation, for maintenance procedures and for pump station operation during a primary source power outage. This includes providing ample working clearances, ability to isolate equipment, spare parts storage and strict adherence to the latest published requirements and recommendations of NFPA 70E, Electrical Safety in the Workplace.

It is the intent to secure the highest quality in all materials and equipment in order to facilitate operation and maintenance of the pump stations. All equipment and materials shall be new and the products of reputable suppliers with adequate experience in the manufacture of these particular items. For uniformity and standardization, only one manufacturer will be accepted for the motor control centers and power distribution equipment: Eaton provide the manufacturer’s latest design conforming to these standards. All electrical equipment shall be UL listed.

All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection and continuous or intermittent operation. All equipment shall be adequately stayed, braced and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details. All components and devices installed shall be standard items of industrial grade and shall be of sturdy and durable construction suitable for long, trouble-free service. Light duty, fragile, or competitive grade devices are not acceptable for use.

Electrical and instrument modifications and additions will be made at an operational pump station which is continuously pumping wastewater. Contractor shall schedule all required work with SVCW, including all shutdown periods. Each shutdown shall be scheduled to minimize disruption of pump station operations. Shutdowns may have to be scheduled outside of normal working hours when pump station flow is at a minimum. The work shall not disrupt any existing operations without prior approval by SVCW.

J.4.2 Safety

Design shall include Contractor requirements to provide services for Short Circuit, Coordination and Arc Flash Analysis for all new power distribution equipment. Design shall meet the requirements of the NEC and NFPA 70E, however design of the power distribution system should consider reduction of the Category level to the extent possible. Design features shall provide the inclusion of infrared (IR) options such as IR view ports that would allow Thermo graphic Imaging to be done with Category 0 PPE for critical areas of power distribution switchboards, and other points of distribution.

Classified areas shall be identified and designed to meet the requirements of NFPA 820.

J.4.3 Reliability

Design shall include reliability of the power distribution system. Reliability is defined as a measurement of the ability of a component or system to perform its designated function without failure. When designing the electrical system the following elements shall be incorporated:

- Standby Generator - A standby generator provides capacity (sufficient to power the pump stations vital components) in case of failure of normal plant power.
- Redundancy - The redundancy of vital components within a system ensures reliability of the power supply to the vital component loads by providing alternate paths for the electrical power supply. MCC loads will be split between two MCC's to provide 50 percent redundancy to the system upon failure of one MCC.
- Sizing - Correct sizing of vital components of the electrical distribution system prevent premature component failure and maintain reliability of the system.
- Coordination - Electrical protective devices need to be sized and set to provide fast isolation of electrical faults and minimum interference with the remaining healthy system. Poor coordination between protective devices reduces the reliability of the system.
- Protection - Judicious placement of equipment or physical protection of vital components of the electrical system prevent possible physical damage.

Where power feeder circuits can be transferred from one power source to another, a transfer switch will be provided to assure that the two power sources cannot be cross-connected, if unsynchronized. Automatic transfer should be provided to ensure minimal interruption for pumping performance. The control panel power source and pump power source should both be transferred to the standby power source. The actuation of an automatic transfer switch should be alarmed and annunciated, with these signals passed to the SCADA system.

J.5 DESIGN GUIDELINES

J.5.1 Power Distribution Design

J.5.1.1 Pump Station Load Capacity

The existing load capacity at the pump stations will not be suitable for the new equipment loads being proposed for this project. A detailed load analysis and calculations will be required in order to determine the size of the new service and rating of the power distribution system at each pump station. The load analysis will be based on the NEC requirements and operational requirements of the pump station.

A minimum of 20 percent space and 20 percent spare circuit breakers shall be provided in each switchboard, motor control center and panelboard.

On all transformers, 25 percent spare loading shall be provided. The following will be included in the load analysis:

- Perform calculations for connected load (amp), maximum demand load (amp) and standby power loads (amp).
- Utility service size (amp) and voltage minimum requirements.

J.5.1.2 Short Circuit Calculations

Short circuit calculations using the simplified “infinite bus” formula shall be completed and provided to determine the available interrupting circuit (AIC) for determining the AIC rating of the power distribution equipment

Results are conservative since the Power Utility systems do not have infinite short circuit current.

J.5.1.3 Distribution

Provide 600V class service entrance rated switchboard to accept ±480V power from the utility company. Service entrance switchboard and service equipment from the utility shall be in strict conformance with the utility company requirements for incoming cables, metering and main overcurrent protection type, and coordination. The distribution equipment will be located indoors.

J.5.1.4 Utilization Voltage

Utilization voltage shall be as follows:

- 480V, three phase (3Ø), 60Hz for all motors 1 HP to 500 HP.
- 120/240V for controls, receptacles and lighting circuits.
- 24VDC for low voltage control and signals.

J.5.1.5 Power Quality

Voltage Regulation shall include the following criteria:

- Maintain voltage regulation to ±3 percent under normal conditions
- Limit starting voltage drop to less than 10 percent
- Limit running voltage drop to less than 3 percent for branch circuitry and not exceeding 5 percent for total at subject operating voltage

Harmonics shall include the following criteria:

- Mitigate harmonic interference with sensitive equipment as necessary
- Limit individual current harmonics to not greater than the values listed in Table 10.3 of IEEE 519 for the ratio of short circuit to load current that is applicable to each point of common coupling. Limit total voltage harmonic distortion to not greater than 5 percent at this point.
- Surge Protection Device shall include the following criteria:
- Properly size surge protective device for the equipment within the design.
- Provide surge protective device at all switchboards. Surge protection devices shall be UL Listed with class/category ratings as required to meet the Lightning Protection Institute certifications.
- The surge protection device shall be rated for use on and above 480V, three phase Wye systems. The nominal line voltage of the surge suppressor shall be 277V with a maximum continuous line voltage of 320V.

- Provide a circuit breaker with each surge device. Locate surge protective device so that the indicating lights are viewable without removing panels.

J.5.1.6 Voltage Drop

Voltage drop calculations confirm available voltage at equipment during motor start and run conditions. Calculations shall be done for conductor runs over 250 feet.

J.5.2 Utility Coordination

The Design engineer shall take the lead role in coordination with the Utility during final design.

J.5.3 Power Monitoring

Utility and standby power shall be continuously monitored by a microprocessor-based power monitoring instrument, networked to the pump station control system and monitored via the pump station control system.

The power monitor display unit shall be door mounted with the meter module mounted inside a transition section. The meter module shall transmit all data via Ethernet to the pump station control system for monitoring all parameters.

The units shall be self-powered excluding power monitors that have the features of power quality and harmonic analysis. Power monitors shall be Rockwell 1426 PowerMonitor 5000,or Approved Equal.

J.5.4 Standby Power

A new generator shall be provided at each pump station to provide emergency standby power to essential equipment when normal power (utility power) is not available. The generator will be located indoors and be a skid mounted unit. A separate fuel storage tank with provision for fuel transfer during periods of generator operation will be located outdoors and provide 24 hours of fuel capacity at 100 percent generator loading.

The designer shall coordinate with the City Fire Marshal in regards to any applicable fire codes and required monitoring for the standby power generator and fuel storage tank.

The fuel storage tank shall be located on the property such that it meets the requirements of NFPA 30 (Flammable and Combustible Liquids Code) for minimum distances from the property line and buildings.

Transfer of standby power shall be done using an automatic transfer switch, open transition with non-paralleling capabilities.

The standby power generator shall be sized based on the load analysis for standby power loads and the stepping sequence for starting essential loads. The size will be determined in kilowatts (kW) / kilovolt-amps (kVA). In addition to the standby power load analysis the following will be used to size the generator:

- Maximum voltage dip of 20 percent.
- Engine generator sets shall be sized at a load capacity not to exceed 75 percent of nameplate rating.
- Generator shall be sized for motor starting requirements and harmonic content of the load (variable frequency drives).
- Ambient temperature conditions.

The standby power system (generator, transfer equipment, schemes, etc.) shall meet the requirements of NEC Article 701, Legally Required Standby Systems. Standby system shall be a Class rating in accordance with Chapter 2 specified run time, Type 10, Level 1.

The system shall meet the requirements of NFPA 704 Hazard Identification System. Diamond indicating the hazards associated with the fuel being stored.

Generator shall be EPA Certified and meet expected emissions tier requirements at the time of installation for the local air quality management district.

Best available control technology shall be used as it pertains to emissions systems.

The engine shall utilize only No. 2 diesel fuel approved by local air quality authorities.

An Ethernet communication link from the generator control panel to the pump station control system for monitoring all operating parameters and alarms shall be included. SCADA screens shall be developed for status, trends, alarms etc. Dry contacts shall be provided for critical alarms and basic running conditions.

The major equipment emergency standby power requirements for each pump station are listed in Table J-1.

Table J-1. Major Equipment Emergency Standby Power Requirements

Pump Station	Model	Power Required per Pump (HP)	Pump Motor Nominal Power (HP)	Worst case power required (HP)	Type	Max Pumps on Duty
PS1 – Menlo Park	Vaughan SE10R (13.7")	75	75	Same	Dry weather	3
	Flygt N3356	215	250	Same	Wet Weather	3
PS2 – Redwood City	Vaughan SE10R (14")	100	100	Same	Dry weather	3
	Flygt C3531 (840)	330	350	Same	Wet Weather	3
PS3 – San Carlos	Vaughan HE10R12 (15")	40	40	Same	Dry weather	0
	Flygt 3531 (1040)	250	250	300 (approx 257 needed)[1]	Wet Weather	3

[1] *Based on model run pressure head of 71.5 feet at PS3 with 42.9 mgd from PS3 and 38.0 mgd from PS2 going to WWTP.*

The generator package shall be specified to be a complete operation package consisting of the engine, alternator, controls, support frame, exhaust system including muffler and the fuel system including the main storage tank as well as a day tank if required.

The generator system shall include provision for automatic scheduled exercise operation of the engine and alternator, with load bank sized to allow loading the alternator to a minimum of 30 percent of its rated capacity.

Current regulatory agencies have established air quality standards for the engine exhaust from emergency generators and the generator system will be specified to be EPA certified for stationary emergency applications. Further consideration shall be made for the local permitting requirements for new installation within specified distances of public education facilities. Final design will require the investigation of each pump station location with regard to its proximity to these facilities.

Diesel Generator Fuel Storage Tank

A dedicated diesel fuel storage tank shall be provided at each pump station. The fuel tank shall be provided with the following:

- The generator fuel tank shall be UL 2085 listed.
- Fuel tank sized for 24hrs at 100 percent load
- Analog level of fuel tank for monitoring locally and at the pump station control system
- High fuel level alarm
- Fuel pipe leak detection alarm
- Fuel pump
- Fuel pump control panel
- Unit shipped as a finished assembly
- Primary and secondary containment

A day tank shall be provided for the generator. Generator day tank shall be provided with the following:

- Diesel fuel tank with double wall containment

- Leak detection alarm
- Diesel transfer pumps
- Diesel tank return pump
- Filters
- Level switches (LSHH, LSH, LSL, LSLL)
- Control panel

Approximate fuel tank dimensions are 135” x 96” x 66”H. Storage tank capacity varies between each pump station site depending on the size of the generator. Fuel storage tank and transfer pumps shall be coordinated with the generator manufacturer during final design.

Load Bank

A permanently installed load bank shall be provided for generators. The load bank shall be installed on the duct or the radiator of the generator. The Load bank shall be sized per manufacturer’s recommendations. Load bank will be required for use when only the dry weather (smaller HP pumps) are used. The size difference in wet weather and dry weather pumps will require the load bank to prevent “wet stacking” of the generator.

Load banks shall be utilized to exercise the generator once a month.

A local 240/120v distribution panelboard shall be provided at the generator skid or in the same room as the generator. Distribution panel shall provide local power for battery charger, block heater, lights, receptacles, etc.

J.5.5 Uninterruptable Power Supply (UPS)

Provide an industrial rated uninterruptable power supply (with maintenance bypass switch to allow transfer to utility power in the event of a UPS fail) for all pump station SCADA panels. UPS runtime shall be a minimum of 20 minutes, refer to the Automation Standards.

J.6 SITE DESIGN GUIDELINES

J.6.1 Underground Conduits and Ductbanks

All equipment and instrumentation located below grade fed by conduits from above grade shall have conduit drain boxes. Conduit interiors shall be plugged with sealant to keep water from traveling down conduits into equipment or instrumentation. Drain boxes will not be located over or on top of electrical panels.

Underground conduits outside of structures, excluding utility conduits, shall have a minimum cover of 24 inches. Utility power and telephone conduits shall have a minimum cover of 36 inches or as required by the utility company.

Signal conduits shall be separated from power and control conduits by a minimum of 12 inches.

Detectable warning tape shall be buried approximately 12 inches above all underground ductbanks and other conduits runs over 10 feet in length. Detectable warning tape shall be aligned parallel to and within 3 inches of the centerline of the conduit or ductbank. Use red tape for “Electric” service and orange tape for “Communication” service.

Labels shall be provided for all pullboxes and at end of parallel runs and tees.

A minimum of 20 percent spare conduits shall be provided in main ductbanks, minimum size 1”.

All ductbanks that are installed under regularly used roadway or motor vehicle pathways, shall be concrete reinforced to protect the conduits.

J.6.2 Grounding System

The grounding system shall consist of a perimeter ground grid, #4/0 bare copper wire, with ground test wells for each new structure of the pump station with interconnections between each ground electrode and also the existing grounding system.

The ground grid shall have copper-clad ground rods driven to a depth of 10 feet.

Building steel, pumping equipment, all electrical equipment and enclosures, and exposed metal that might become a current carrying conductor shall be connected to the ground grid to limit touch potential.

An equipment grounding conductor sized per applicable codes shall be run in all raceways.

Ground connections that are buried or embedded shall be made by the compression method.

J.6.3 Equipment Layout

The following shall be required for equipment layout:

- Provide the minimum clear working space in front of electrical equipment as required by the NEC.
- Rooms shall be climate controlled for efficient cooling and heating for the new equipment and to maintain ambient temperature rating of equipment.
- Provide housekeeping pads for all pad mounted equipment. Housekeeping pads shall be 3-1/2 inches above surrounding finished floor or grade unless otherwise shown and shall be 4 inches larger in width on all sides of equipment. Concrete shall be precisely leveled so that equipment set in place will not require shimming.
- Maximize use of concealed conduits where possible. However, conduits embedded in concrete slabs shall not exceed the limit at which the concrete slab integrity becomes compromised. The Designer will coordinate with structural design regarding location of concrete embedded conduits.
- Utility metering and enclosure shall be mounted remotely on the exterior wall of the building.

J.7 ELECTRICAL EQUIPMENT

J.7.1 Switchboards

The following shall be required for switchboards:

1. Confirm to IEEE, ICEA, NEC, ANSI, UL and NEMA standards.
2. Low voltage power circuit breakers shall comply with the following specific standards:
   - ANSI Std. C37.16 – Preferred Ratings
   - ANSI Std. C37.17 – Trip Devices for LVPCB
   - ANSI Std. C37.50 – Test Procedures
   - IEEE Std. C37.13 – LVPCB Used in Enclosures
   - UL 1066 - LVPCB

3. Heavy gauge steel with NEMA 1 rating for indoor location.
4. Busses shall be tin plated copper.
5. Power bus shall have continuous amperage rating at least equal to the main circuit or the power source and shall be braced to withstand stresses resulting from the maximum short circuit current available. Minimum bracing shall be 65,000 amperes symmetrical unless deemed too low by results of the available fault current from the serving utility company.
6. Ground bus shall be rated per NEC relative to the power bus amperage rating.
7. Main circuit breakers shall be 100 percent rated and indicating type with adjustable ground fault (G), Long (L), Short (S), and Instantaneous (I) trip functions. Specify digital trip units on all circuit breakers with L/S, L/S/I, or L/S/I/G trip functions.
8. 8. Main circuit breakers and feeder breakers shall be low voltage power circuit breaker type. Breakers shall be selected with adjustable trip functions for select coordination.

J.7.2 Automatic Transfer Switch (ATS)

The following shall be required for ATS:

1. The ATS will be of the open transition type using power circuit breakers for transferring power between the generator and utility power. A solid state controller will be specified with the ATS for the automatic transfer scheme.
2. ATS shall conform to IEEE, ICEA, NEC, ANSI, UL 1008 and NEMA standards.
3. Heavy gauge steel with NEMA 1 rating for indoor location.
4. ATS shall be positively interlocked mechanically and electronically to ensure only one of two possible positions, normal or standby power.
5. A position indicator shall be visible from the front of the switch to show to which source the load is connected to.
6. Breakers shall be rated for continuous duty, repetitive switching of all types of loads or transfer between two active power sources and be 100 percent rated.
7. Ground bus shall be rated per NEC relative to the power bus amperage rating. All busses shall be tin plated copper.
8. Circuit breakers shall be indicating type with ground fault (G), Long (L), Short (S) and Instantaneous (I) adjustable trip functions.
9. Provide microprocessor based ATS control panel with programmable generator exercise time.
10. Provide Auto/Test switch to test operation of the ATS by simulation a loss of the Normal Power Source.
11. At a minimum, the ATS shall include the following dry contacts:
    - Switch Closure to Utility
    - Switch Closure to Alternate Source
    - Pre-Transfer Delay
    - Engine Start

J.7.3 Motor Control Centers

The following shall be required for motor control centers:

1. Motor control centers shall conform to the standards for NEMA Class II, Type B diagrams and wiring.
2. UL 845, 600v, 65,000 amperes interrupting current (AIC) minimum unless deemed too low by results of a power systems study and available fault current from serving utility company.
3. Circuit breaker operator extensions or similar for a breakers over 70 inches in height.
4. MCC shall be designed to minimize fault propagation between and in front of MCC sections.
5. MCC shall have removable draw-out buckets for all cubicles labeled “SPACE”.
6. MCCs shall be located indoors, in climate controlled rooms or buildings.
7. MCCs shall be manufactured by Eaton, Freedom 2100 to standardize on one manufacturer as required by SVCW.

J.7.4 Variable Frequency Drives (VFDs)

The following shall be required for VFDs:

1. The VFD shall be of the latest technology used to control and maintain a process variable (level, flow, pressure, speed, etc.) by varying the motor speed.
2. VFD shall constantly monitor the load current with an electronic thermal overload relay and trip the drive on motor overload. The electronic overload relay shall be adjustable and compensate for the reduced cooling of the motor at reduced speeds.
3. For each programmed warning and fault protection function, the drive shall display a message in complete English words or Standard English abbreviations. The three (3) most recent fault messages along with time, current, speed, voltage, frequency and digital input status shall be stored in the drives fault history. The last ten (10) fault names shall be stored in the drive memory.
4. Transient and surge voltage power line input and out protection shall be provided for each VFD through use of metal oxide varistors (MOVs), phase-to-ground filter capacitors, or other approved equal methods.
5. Provide 18 pulse VFDs for all motors 50 HP and greater.
6. VFDs shall be located indoors, in climate controlled rooms.
7. VFDs shall be located in electrical rooms or enclosures that include environmental controls to maintain internal temperature not greater than 40 Degrees Celsius.
8. VFDs shall be configured to be re-enabled automatically after a power fail (no manual reset required) for automatic operation by the pump station control system.
9. Provide 120v control panel interface which provides power to VFD input and output control circuits as well as external devices, such as pilot lights, meters, relays, and other miscellaneous equipment.
10. Provide VFDs with a door mounted alpha-numeric human interface module (HIM) digital display with keypad to view and adjust the setpoints, parameters, diagnostic, and status indicators.
11. All VFDs shall be provided with Ethernet communications for non-essential data.

12. Provide VFDs with the following protection:
    - Inrush current limit
    - Ground fault
    - Over-temperature heat sink thermal switch to protect against excessive ambient temperature or loss of cooling
    - DC bus protection
    - Under voltage
    - Over frequency
    - Input or output phase loss
    - Speed compensated electronic motor overload current
13. VFDs shall comply with the latest edition of IEEE 519 for total harmonic voltage, current distortion calculation and measurement.
14. Voltage Harmonics: Operation of the VFD shall not add more than 3 percent total harmonic voltage distortion while operating from the utility source, or more than 5 percent while operating from the standby generator.
15. Current Harmonics: Maximum allowable total harmonic current distortion limits for each VFD shall not exceed 5 percent as calculated and measured at the point of common coupling.
16. Maximum allowable audible noise from the VFD system shall be 85 A-weighted decibels (dBA) at a distance of one (1) meter (3.3 feet) at any speed or load condition.
17. The Point of Common Coupling (PCC) for all harmonic calculations and field measurements for both the voltage and current distortion shall be defined as the closest feed electrical distribution equipment (i.e., MCC, or distribution switchboard where VFDs are fed directly from the switchboard.)
18. Provide VFD with output dv/dt filters when the motor load exceeds the manufacture’s recommended distance to avoid long lead voltage distortion at the motor.
19. VFD’s shall be Eaton SVX9000 series (50HP and less) and Eaton CPX9000 series (greater than 50 HP), Allen-Bradley/Rockwell PowerFlex 755 series or approved equal.

J.7.5 Electronic Reduced Voltage Solid State (ERVSS) Motor Starters

The following shall be required for ERVSS Motor Starters:

1. For all motors above 50 HP and not using a variable frequency drive, provide ERVSS motor controllers designed with adjustable time interval soft start and soft stop features. The RVSS shall be equipped with “Pump Control” mode for non-linear voltage ramp starting and stopping to smoothly accelerate and decelerate the motor.
2. Specify 120vAC control power interface.
3. The RVSS shall include an integral bypass contactor, NEMA rated.
4. The ERVSS control circuit shall have a built-in motor overcurrent and phase loss/reversal protection.
5. Front panel mounted remote interface module with two line LCD display and keypad to access ERVSS programming.
6. ERVSS motor controllers shall be networked to the pump station control system for operation and monitoring.

7. ERVSS shall be provided with isolation contactors ahead of the ERVSS to isolate against voltage or current spikes while not in operation.

J.7.6 Full Voltage Non-Reversing Motor Starters (FVNR)

The following shall be required for FVNR Motor Starters:

1. Full voltage non-reversing starters shall be provided for all motors below 30 HP not using a variable frequency drive, and be rated for a minimum of 65,000 RMS symmetrical amperes or as deemed necessary from the results of the power system study.
2. Motor starters shall be NEMA size 1 minimum, magnetic line voltage type with individual control power transformers and 120v secondary fuses with blown fuse indicators.
3. All starters and contactors shall be rated and designated in accordance with NEMA standards. Starters designated as IEC ratings or with dual IEC/NEMA ratings shall not be allowed.
4. For stand-alone FVNR motor controllers, overload relays shall utilize bi-metallic heater elements. Trip setting shall be adjustable from 85 percent to 115 percent of rating.

J.7.7 Panelboards

The following shall be required for panelboards:

1. Panelboards shall comply with the applicable sections of UL, NEC and NEMA and be manufactured by the same manufacturer for all panelboards.
2. A removable machine-typed circuit directory with clear plastic cover shall be shipped with each panelboard and mounted on the inside door in a frame. Circuit directory shall be as approved in the Submittal. Circuit directory shall be updated or replaced to show as-built breaker identification. “Sticker” type panelboard schedules are not acceptable.
3. Panelboard shall have bolt-on devices with a hinged door over all circuit breaker handles. A copper ground and neutral bus bar shall be included in panelboards with terminal screws.
4. Provide panelboard breakers with individual padlock hasps (lockable in off position) when feeding a motor.

J.7.8 Electrical Enclosures and Boxes

The following shall be required for electrical enclosures and boxes:

1. Enclosures shall be NEMA rated for installed locations with fast access door latches. Enclosure construction shall be 14 gauge minimum with continuously welded seams. Outer door shall have provisions for locking enclosure with standard padlock. Enclosures shall be per SVCW standards. Enclosure ratings are listed in Table J-2.

Table J-2. Enclosure ratings

Item	NEMA Rating	Material	Closure Type	Notes
Local Control Panels	NEMA 4X	FRP	Latch-bale type closures with hinges per vendor design.	Generally in close proximity to equipment and processes and so exposure to water, gases, sludge, etc. drive the NEMA 4X
PLC & RIO Panels	NEMA 12	Painted Steel	Full piano hinge and three point lockable door latch.	Protection from gasses, dust, water drip & dust.
Fiber Termination Panels	NEMA 12	Painted Steel	Free standing with full piano hinge and three point lockable door latch.	Protection from gasses, dust, water drip & dust.
Junction Boxes	Per design engineer with possible review by SVCW as warranted	Per design engineer with possible review by SVCW as warranted	Per design engineer with possible review by SVCW as warranted	
Pull Boxes	Per design engineer with possible review by SVCW as warranted	Per design engineer with possible review by SVCW as warranted	Per design engineer with possible review by SVCW as warranted	
VFD enclosures	NEMA 4X	FRP	Latch-bale type closures with hinges per vendor design.	Given the proximity to equipment and processes this drive potential exposure to water, gases, sludge, etc. drive the NEMA 4X
MCCs Use current Eaton MCC specification.	NEMA 12	Painted Steel	Per vendor design.	
LOS Boxes	NEMA 4X	316 SS	Lift off/screw on covers.	At the Equipment. Wall mounted or pedestal mounted.

Notes:

1.NEMA 4X panels/boxes become 3R when penetrated, but 4X is the starting basis for the panels and boxes specified to be purchased/provided by the contractor.

2. If local hazards drive a higher level of protection such as NEMA 7, the higher level of protection will be used in lieu of the designation above.

3. Panels located outside expose to sun shall be 316 stainless steel. FRP shall not be installed where subject to direct sun exposure.

2. Provide full height white back pan, thermoplastic data pocket mounted on inside door and 10 tap (min) copper ground bus.
3. Provide enclosures with accessories consisting of breaker to disconnect incoming power, pad lockable disconnect for breakers used in circuits above 120v, dead front door, heater, fan, removable metal filters, louvers and thermostats. Enclosure shall be provided with engraved phenolic nameplate.
4. Terminal boxes located at wet well area for connecting vendor pump cables to field wiring will be constructed to provide required isolation of conduit system from the hazardous area defined in the NEC Article 500 and 501. The terminal box shall be sized per NEC, 36” x 36” x 12”D minimum. The terminal box will provide hard mounted lugs for the motor conductors larger than #10 AWG as well as din rail mounted terminal blocks for the motor temperature and moisture (leak) sensors conductors. Din rail mounted terminal blocks shall be coordinated with the pump control conductors and rated 600v minimum. Power terminal blocks shall be coordinated with

the pump cables and rated 600v. The design of the enclosure and conduit penetrations shall allow for pump cable entry without requiring conduit seals on these cables. The enclosure shall be rated as non-corrosive and weatherproof, NEMA 4X 316 Stainless Steel. Terminal box shall be installed a minimum of 18" above finished grade. Provide copper ground bar 2" x 12" x ¼" with lugs to suit conductors. Provide cable supports and cable connectors. Refer to the Drawings for Standard Detail of this piece of equipment.

J.7.9 Dry-Type Transformers

The following shall be required for dry-type transformers:

1. Primary winding rating 600v and less used for power distribution.
2. Maximum size will be 30 kVA, three-phase, 80-degree C rise with 220-degree C insulation.
3. Ratings and Standards
   - 10kVA and smaller shall be single phase or as indicated
   - 15kVA and greater shall be 3 phase or as indicated
   - Voltage, frequency, number of phases and kVA as indicated.
   - Conform to ANSI/IEEE c57.12.01 and ANSI/UL 506.
4. Enclosures
   - 15kVA and smaller – weatherproof, nonventilated enclosures
   - Indoor over 15kVA – drip proof, ventilated enclosures
   - Outdoor – weatherproof enclosures.
5. Transformers 25kVA and below shall be suitable for wall mounting and include mounting brackets and hardware. Transformers over 25kVA shall be floor mounting type. Transformers shown inside the MCC shall be mounted in the MCC compartment sized for the size of transformer required.
6. Bond transformer enclosures and neutrals together and connect to the ground grid.
7. Adjust tap settings to provide proper voltage at panelboards.
8. Ground transformer in conformance with the NEC.

J.7.10 Lockout Stop Pushbutton Control Stations (LOS)

The control station shall consist of a NEMA 4X, 316 stainless steel enclosure, a 2-position Push-Pull button and a padlock attachment. The lockout stop pushbutton control station shall be as manufactured by Eaton Cat #10250TN33 enclosure, #10250T5B62 pushbutton with a #10250Ta64 padlock attachment or equal. Provide auxiliary contacts on the pushbuttons for LOS status to SCADA. No equal to match SVCW standards.

J.7.11 Wiring Devices

The following shall be required for wiring devices:

1. Three phase receptacles shall be suitable for 480 volt, 3-phase, 4-wire service, with ampere ratings as specified. Receptacles and plugs shall be designed so that the grounding pole is permanently connected to the housing. The grounding pole shall make contact before the line poles are engaged when the plug is connected to the receptacle housing. The plug sleeve shall also make contact with the receptacle housing before the line and load poles make contact. Receptacles shall be provided complete with cast back box, angle adapter, gaskets, and a gasketed screw-type, weathertight cap with chain fastener. Each receptacle shall be provided with one plug.

2. Receptacles for use in hazardous areas shall be rated in accordance with NEC for the area in which they are to be located and shall be factory sealed. Receptacles shall be designed so the plug must be inserted and turned before load is energized. Receptacles shall be provided with mounting box, sealing chamber, and compatible plug. Voltage and current ratings shall be as 120 Vac, 20-ampere.

J.8 600V CONDUCTORS

J.8.1 Low Voltage Conductors

The following shall be required for low voltage conductors:

1. Conductors shall be copper with 600V minimum rated insulation.
2. Conductors shall be Class C stranded.
3. Surface mark with manufacturers name or trademark, conductor size, insulation type and UL label.
4. Insulation type XHHW-2, rated 90 degrees Celsius in dry and wet locations, oil resistant for all power and control conductors.
5. Insulation type THHN/THWN, 19 strand, rated 90 degrees Celsius in dry locations and 75 degrees Celsius in wet locations, oil resistant for lighting and receptacles only. Seven strand is not acceptable.
6. Minimum #12 AWG for wires used in power transmission circuits or as defined on the Drawings.
7. Minimum #14 AWG for wires used in signal transmission circuits or as defined on the Drawings.
8. All conductors shall be routed in conduits per NEC conduit fill requirements.
9. Splices will be made with water-tight kits as manufactured by 3M or Raychem.
10. Motor terminations will be made with motor disconnect/boot kits.
11. Provide 1000V, VFD rated conductors for all connections from VFD to motors.

J.8.2 Equipment Internal Wiring

The following shall be required for equipment internal wiring:

1. Conductors shall be copper with 600v rated insulation – Type MTW, NFPA standard 79.
2. Minimum #16 AWG for wires used for individual conductor circuits 100v and above.
3. Minimum #18 AWG for wires used for individual conductor circuits below 100v.

J.8.3 Instrument Wiring

The following shall be required for instrument wiring:

1. Conform to UL 2250, UL 1581 and NFPA 70 Type ITC.
2. Field instrument cables shall be 600v insulation 100 percent individual and overall foil shield coverage, twisted pair #16 AWG conductors with drain wire.
3. Non-field instrument cables shall have 300v rated insulation and individual foil shielded twisted pair #18 AWG conductors with drain wire.

J.8.4 Data Cable

The following shall be required for data cable:

1. Data network cable (indoor) shall consist of 4 pair unshielded twisted pair #24 AWG solid conductors. The cable shall be rated by IEEE for service intended – plenum and dry.
2. Data network cable (outdoor) shall consist of 4 pair shielded twisted pair #24 AWG solid conductors. The cable shall be rated by IEEE for service intended – plenum, conduit, wet or dry.

J.9 CONDUIT

J.9.1 General

Conduit types shall be designed per area designations and use according to the following criteria:

- Data conduits shall be RAC-PVC, the entire length of the run
- Dry areas: Rigid Aluminum Conduit (RAC)
- Wet areas: Rigid Aluminum Conduit, Polyvinyl coated (RAS-PVC)
- Corrosive areas: Rigid Aluminum Conduit, Polyvinyl coated (RAS-PVC) or PVC -80
- Class I hazardous area: Rigid Aluminum Conduit (RAC) and Rigid Aluminum Conduit, Polyvinyl coated (RAS-PVC) when required in other designated areas.
- Stud framed walls in insulated and temperature controlled buildings: Electrical Metallic Tubing (EMT)
- Concrete block or brick walls: Polyvinyl chloride (PVC-40)
- Direct buried conduits and ductbanks: Polyvinyl chloride (PVC-80)
- Beneath floor slab-on grade: Polyvinyl chloride (PVC-40)

Twenty percent spare conduits of all types (1 inch diameter minimum) shall be provided in ductbanks between MCCs, switchboards, Electrical rooms, PLC cabinets, major process area pullboxes, handholes and manholes.

J.9.2 Conduit Requirements

The following shall be required conduits:

1. Rigid Aluminum Conduit, couplings, bends and nipples shall be in accordance with NECA 102.
2. Flexible conduit shall only be installed in exposed or accessible locations and shall be less than 36 inches (1/2 inch minimum trade size). Flex connectors shall be PVC coated when connected to RAC-PVC conduits or when located in a NEMA 4X area. Conduit between vibrating equipment and outlet boxes or conduits shall be liquid tight flexible electrical conduit.

J.9.3 Conduit Installation

The following shall be required for conduit installation:

1. Conduit transition (from below to above grade, through walls, through concrete, etc.) shall be RAC-PVC. The transition shall be made below grade at the final sweep RAC-PVC elbow or 1-foot minimum before the transition for exposed conduit. RAC-PVC conduit shall extend one (1) foot minimum beyond transition. Conduit transition has conformed to NFPA 70 requirements in classified areas.
2. The entire electrical raceway system shall be bonded and form a continuous metallic electrical conductor from service point to every box and shall be terminated with ground bushings

connected to the ground bus. Conduits entering enclosures shall be fitted with insulating grounding bushings. All grounding bushings shall be tied to the grounding system with properly sized bonding conductors per the NEC.

3. Conduits connected to boxes, cabinets, etc., outdoors, exposed to weather or in areas subject to excessive moisture shall be fitted with water tight sealing hubs.
4. Raceways for lighting, HVAC and receptacles can be surface mounted.
5. Support rigid conduits at 10 feet intervals and PVC conduits at 5 feet intervals. Support all conduits within 1 foot of boxes or changes in direction. Use riser supports with clamps for vertical conduit risers. For multiple conduit runs, group conduits together and support from the ceiling by means of trapeze hangers. Conduits installed outdoor or in NEMA 4X rated areas above grade shall be braced in place with stainless steel Unistrut stanchions and PVC coated clamps with backplates. Conduit supports with only a single hole are not acceptable.
6. Spare conduits for future use shall be mandrelled, have a pull cord installed and shall be labeled and capped with a coupling and/or plug. Provide a waterproof label on each end of pull cords in spare conduits to indicate the location of the other end.
7. Contactor to remove and recycle or waste all conduit and wire associated with removal or demolition of any equipment.
8. Conduits shall not penetrate any water bearing walls or slabs subject to flooding.
9. When a raceway passes between nonclassified and classified areas, or between noncorrosive and corrosive areas, seals will be installed.

J.9.4 Underground Boxes

1. All underground boxes located in paved areas or other areas which vehicles may travel shall be full H-20 loading rated and have traffic rated metal covers. Boxes over 2 x 3 feet shall be double leaf assemblies with end hinged, torsion spring opening assist-type covers.
2. Concrete perimeter skirts shall be poured around underground boxes in paved areas. Skirt shall extend minimum six (6) inches horizontally and twelve (12) inches vertically around the box.
3. Extension sections shall be specified to reach the depth of underground conduits with a maximum depth of forty eight (48) inches.
4. Provide eighteen (18) inches (minimum) of ¾ inch crushed rock under the lowest section of pullbox, extending eight (8) inches outside pullbox perimeter.
5. Install #4/0 bare copper ground through pullbox, in conduit ductbank. Screw-type copper ground bus shall be provided in each box.
6. Ground cover frame, cover and other exposed metal parts to bare copper ground cable.
7. Provide 10-foot long, ¾ inch diameter ground rods inside all vaults.
8. Covers shall be engraved or bead welded (minimum thickness ¼ inch) “ELECTRICAL” or “CONTROL” as applicable with specific pullbox numbers.
9. Limit the number of directional changes of the conduit to total no more than the equivalent of 270 degrees in any run between pull points. Install pullboxes for ease of pulling and as necessary to meet code. Conduit runs between two vaults, pull or junction boxes shall be limited to a maximum of 300 feet, or less 50 feet for every 90 degrees of conduit change in direction. A maximum of three equivalent 90 degree elbows are allowed in any continuous runs.

J.10 IDENTIFICATION

J.10.1 Equipment

The following shall be required for equipment identification:

1. All equipment numbering shall be as shown on the P&IDs
2. Each major piece of electrical equipment shall have a manufacturer's nameplate showing the name, model designation, part and model number, serial number and pertinent ratings such as voltage, amperage, # of phases, range, calibration etc.
3. All equipment shall have rigid laminated black phenolic plastic nameplates with beveled edges and white lettering. Provide engraved aluminum nameplates secured with stainless steel screws for outdoor equipment. No letters shall be smaller than 3/16 inch.

J.10.2 Conductors

The following shall be required for conductor identification:

1. All wires, field and interior to equipment, shall be identified with wire labels on both ends of each wire.
2. Wire labels shall be machine printed on with white heat shrinkable tubing.
3. Labels shall be shrunk to loose fit on wires.
4. Wire labels for lighting and receptacle circuits shall consist of the panel board and circuit number and a unique node number.
5. Wire color codes shall be as shown below:
   A. CONTROL CONDUCTORS:

Single-conductor control conductors shall have the following colors for the indicated voltage listed in Table J-3:

Table J-3. Single-conductor Control Conductors Color Coding

Control Conductor	120V
Power (AC)	Black
Control (AC)	Red
Neutral	White
Ground	Green
Foreign Voltage (DC)	Blue/White
Foreign Voltage (AC) Non-powered contact interface	Yellow
Power (DC)	Blue
Control (DC)	Violet

B. POWER CONDUCTORS:

Power conductors shall have the following colors for the indicated voltage listed in Table J-4:

Table J-4. Power Conductor Color Coding

Power Conductor	480V	240/120V
Phase A	Brown	Black
Phase B	Orange	Red
Phase C	Yellow	Blue
Ground	Green	Green
Neutral	Gray	White

Cables may be black with colored 3/4-inch vinyl plastic tape applied at each cable termination. Tape shall be wrapped with 25 percent overlay to provide 3 inches minimum coverage.

J.10.3 Conduits

The following shall be required for conduit identification:

1. Conduits shall be identified on the drawings.
2. Conduit shall conduit tags at both ends of each conduit run and where it enters and leaves an open transition point, junction boxes, terminal boxes, pullboxes, vaults, and manholes, etc.
3. All conduits shall have unique conduit names, including spare conduits. Conduit prefixes are as follows:

    C – Control wires

    D – Data / Communications

    H – Medium voltage (voltage > 1000v)

    P – Power wires (480v – 120V)

    S – Signal wires (low voltage analog)

    X – Spare

4. Tag material shall be aluminum with machine stamped lettering. The size of the tag shall be ½ inch high. No letters are allowed smaller than ¼ inch. The tag shall be attached to the conduit with 316 stainless steel wire of the type normally used for this purpose. Stainless steel wire must be crimp connected. Twisting ends together is not acceptable.

J.11 LIGHTING REQUIREMENTS

The following shall be required for lighting:

1. Area lighting for each site shall be from LED pole mounted lamps with utility 120v weatherproof GFI receptacles in each pole.
2. Lighting products shall minimize up-light and illuminate only the subject area.
3. All indoor areas shall be provided with switchable circuits with a minimum number of non-switched lighting fixtures for personal safety.
4. Motion activated primary lighting may be provided in infrequently visited areas such as bathrooms and storage areas to the extent that is suitable for the environmental and safety conditions of the area.
5. Battery pack type emergency lighting shall be provided for personnel safety.

6. Illumination levels will be established in compliance with California Title 24 energy levels, with illumination level goals as follows:

AREA	MAINTAINED FOOT CANDLES (FC)
a. Electrical equipment rooms	40 FC
b. Mechanical equipment rooms	30 FC
c. Outdoor areas	Compatible with existing systems. (Generally 1-2 FC)

7. Lighting circuits will be 120 volts or 277 volts as economically determined for each area except outdoor lighting system will be 120 or 240v.
8. All new lighting fixtures shall be suitable for use with LED lamps. Per SVCW standard on lights, provide BAYLED78W for all indoor lights. Refer to http://www.rabweb.com/specSheet.php?product=BAYLED78W, no equal.
9. Lighting panelboards shall be 120/40 VAC.

The following shall be required for receptacles:

1. Convenience (120v) receptacles will be provided in all new areas of the pump station.
2. Receptacles will be powered from different circuits than the lighting fixtures. Where convenient, these circuits may occupy the same raceways.
3. Receptacles located outdoors shall include ground fault interrupters and weather proof wet-in-use covers.
4. Receptacles shall use pressure lugs to accommodate 19 strand THHN or other suitable conductors.

J.12 Motor Sizing

Motor sizing will be based on hydraulic and capacity requirements for the pumps.

J.13 Utility Company (PG&E) Requirements

Based on the increased load requirements and new service equipment locations at the pump stations it is assumed that the existing utility service will have to be replaced. Replacement of the existing utility service would include the following:

- Pad mounted utility transformer
- Primary and secondary service conductors and conduit
- Utility meter and enclosure
- Primary conduit risers (at overhead poles)

Each pump station appears to have overhead poles located within 100FT of the existing utility transformers. It is assumed that the new primary service conductors will be connected to the existing overhead lines and poles near the pump station.

Final design shall include the onset of coordination and filing out the appropriate service application forms with the utility company to establish a new service and remove the existing service at the pump stations.

Design shall include transformer equipment pads, primary and secondary conduits, grounding, risers and meter enclosures per the utility company standards.

J.14 Standard Details

Standard details are included in Attachment N.

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K. ATTACHMENT

Instrumentation and Control

K.1 Purpose

The purpose of this document is to guide the pump station final design teams and to ensure consistent quality and similar facilities for ease of operation and maintenance. This document is meant to be a working document for the design teams such that during the design, changes can be made based on design team review and consensus.

K.2 Codes and Standards

1. Instrumentation and control design shall comply with the National Electrical Code, the California Electrical Code, the Occupational Safety and Health Act, and the requirements of local codes in effect at the project site. All electrical construction shall be performed in the accordance with the most current version of the following codes and standards:
   - American National Standards Institute (ANSI) standards.
   - Insulated Cable Engineers Association (ICEA) standards.
   - Institute of Electrical and Electron Engineers Association (IEEE) standards.
   - Instrument Society of America (ISA) standards.
   - California Electrical Code (CEC), 2013, based on the 2011 National Electrical Code (NEC)
   - National Fire Protection Agency (NFPA 70E) Standard for Electrical Safety in the Workplace.
   - Fire Protection in Wastewater Treatment and Collection Facilities (NFPA 820).
   - National Electrical Manufacturers Association (NEMA) standards.
   - Occupational Safety and Health Administration (OSHA) standards.
   - Acceptance Testing Specifications of Electrical Power Distribution Equipment and Systems, International Electrical Testing Association (NETA).
   - Underwriters Laboratories, Inc.
2. In instances where two or more codes are at variance, the most restrictive requirements shall apply. Codes and standards referenced shall be considered minimum acceptable work.
3. Nothing in the Procurement Documents shall be construed to permit work or materials not conforming to the preceding codes and standards.
4. All work shall also be performed in accordance with SVCW, State, County or Owner standards and local Utility codes.

K.3 Control Design Guidelines

The following information is a guideline for the final design of the pump station control system and may duplicate or be in addition to SVCW most recent version of their Automation Standards. The designer shall use this Standard as the basis for the final design of the control system at the pump station.

The existing pump stations' control systems shall be replaced in their entirety with new equipment to match SVCW's Automation Standards.

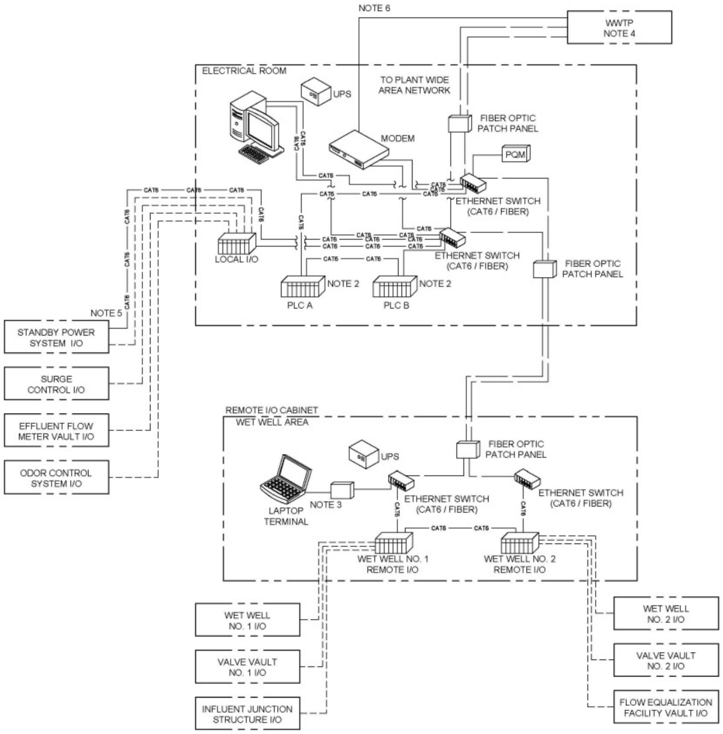
The new process equipment shown on the P&IDs shall be connected to the pump station control system. Exact I/O count for the new process equipment and instrumentation shall be determined during final design.

The existing SCADA HMI workstation at the SVCW main Waste Water Treatment Plant (WWTP) shall be configured to integrate the new process equipment at the pump stations. Graphic screen layout and reporting shall match the requirements of the Automation Standards. Each pump station shall be provided with redundant communication hardware for increased reliability for communications to the WWTP located in Redwood Shores.

The pump stations shall be remotely monitored and controlled from the SCADA HMI work station at the WWTP. Local monitoring and controls shall be available to operators via laptop connection to the pump station network or a desk top unit located in the Electrical Room.

The pump stations are considered critical process areas, therefore new SCADA hardware type and/or model shall adhere to the Automation Standards as stated herein.

Pump station control system architecture shall include redundant Allen-Bradley/Rockwell Automation ControlLogix PACs in redundant configuration consisting of (1) 1756-A7, (1) PA-75, (1) 1756-EN2T, (1) 1656-EN2TR, (1) 1756-RM, (3) 1756-N2 and (1) 1756-L73 Control Logix PAC for each chassis. Additionally, RIO cabinets will be located near the Wet Well areas to consolidate field data and send via Ethernet over fiber optic medium to the main control panel located in the Electrical Room. Refer to Figure K-1 for diagram of proposed pump station control system.



NOTES:

1. THIS DIAGRAM APPLIES TO PUMP STATION NO. 1 (MENLO PARK). ACTUAL I/O WILL VARY PER PUMP STATION.
2. PROVIDE REDUNDANT PLC, CONTROLOGIX L7x SERIES.
3. PROVIDE FOLDING SHELF WITHIN CABINET INTERIOR AND ETHERNET PORT FOR LAPTOP CONNECTION.
4. COORDINATE WITH SVCW PRIOR TO MAKING ANY CONNECTIONS TO EXISTING COMMUNICATIONS NETWORK.
5. PROVIDE ETHERNET COMMUNICATIONS LINK FROM GENERATOR CONTROL PANEL TO ETHERNET SWITCH.
6. SECONDARY COMMUNICATION LINK TYPE (RADIO, CELLULAR) TO BE DETERMINED DURING FINAL DESIGN.
7. EXISTING TELEPHONE (LANDLINE) NOT SHOWN AND PRESUMED NOT TO BE UTILIZED IN THE FUTURE

ABBREVIATIONS:

PQM	POWER QUALITY METER
UPS	UNINTERRUPTIBLE POWER SUPPLY

LEGEND:

CONTROL CABLE	- - - - - -
CATEGORY 6 CABLE	—— CAT6 ——
FIBER OPTIC CABLE	— ————
CELLULAR LINK	⌐Z_

Figure K-1. Proposed Pump Station Control System Diagram

PLCs and all critical instrumentation shall be connected to an uninterruptable power supply located in the new control panel.

The control system shall be designed to use a high level of automation consistent with safety, maintenance and operational requirements. As a rule, the control system shall control sequences of control actions, which are either event-driven or time-driven during normal operation, as well as all control that would require frequent operator action to start/stop equipment or change valve positions. The control system shall separately monitor individual interlocks, alarms and status.

All personnel or equipment safety interlocks (including Lock-Out-Stop [LOS] or Emergency Stop pushbuttons) shall be hardwired and failsafe. The safety interlocks shall function in any mode of operation. Software interlocks can be performed through the PLC.

The control system shall monitor all analog instruments, final control elements, alarms, and interlocks for equipment and process-related operations.

Redundancy shall be provided for some critical instrumentation i.e., dual ultrasonic level transducers located in the wet well. Additional requirements for redundant instruments are included in the Automation Standards.

Manufacturer-supplied packaged units may be provided and integrated with the pump station control system. The designer shall evaluate the requirements for interfacing packaged equipment to the pump station control system including implementation of PLCs and the SCADA HMI monitoring and control requirements. If the manufacturer provides an embedded PLC, it should be specified as one of the standard models used by SVCW.

K.4 Control System Hierarchy

Refer to Section 2.0 Control System Hierarchy in the Automation Standards for equipment control modes and operational status.

K.5 Device Colors

Pushbutton actuators and action-initiating icons of color graphic interface devices, indicating lights, and icons of color graphic interface devices shall be color-coded in accordance with the following table:

Table K-1. Device Colors

Color	Pilot Device	Typical Function	Examples
Red	Pushbutton	Emergency Stop, Stop, Off	Emergency Stop, Master Stop, local Stop at equipment
	Pilot Light	Stopped, Danger, Fault Condition, Alarm Closed	Equipment off or stopped. Machine ready for operation with all conditions normal or cycle complete and machine ready to be restarted. Valve or gate is closed and process is not flowing.
Yellow (Amber)	Pilot Light	Attention, caution/marginal conditions. Change or impeding change of conditions	Alarm condition, indication that a protective device has stopped the machine i.e., overload Some value (pressure, temperature) is approaching its permissible limit. Ground fault indication. Overload that is permitted for a limited time.
	Illuminated Pushbutton	Attention or caution/Start of an operation intended to avoid dangerous conditions	Reset of alarm conditions after conditions have been rectified and authorization by light.
Green	Pilot Light	Equipment running or in motion. Open	Automatic cycle or motors running Valve or gate is open and process is flowing.
	Illuminated Pushbutton	Machine or unit ready for operation/Start or On.	Start or On after authorization by light; start of one or more motors for auxiliary functions; start or energization of machine elements.
White (Clear)	Pilot Light	Normal condition confirmation	Power on; Normal pressure, temperature.
	Illuminated Pushbutton	Confirmation that a circuit has been energized or function or movement of the machine has been started/Start-On, or any pre-selection of a function.	Reset of power or normal conditions after authorization by light.

K.6 PLC Hardware and Software Standards

The following guidelines apply to new PLC/SCADA hardware and software.

K.6.1 Programmable Logic Controller (PLC)

1. Allen-Bradley ControlLogix L7x series shall be used for critical process areas. Provide redundant 100 Mbps Ethernet connectivity to the pump station control system network.
2. ControlLogix processors shall be provided with redundant monitored hot standby equipment. Each PLC system shall have dual process or chassis, dual processors, dual communications modules and dual redundancy modules. Each chassis shall be equipped with a dedicated power supply.

K.6.2 Software

1. Currently the WWTP is utilizing Wonderware 2012 R2 System Platform for their HMI and SCADA interface for monitoring the WWTP and existing pump station operations. This Shall be used for all pump stations.
2. The pump stations shall include software that allows localized HMI control via a workstation or laptop connected to the pump station network and PLC.
3. Wonderware Historian (for data storage) shall be used for recording historic data for process variables, power data, drive data, and equipment status tracking.
4. Programming software for the PLC's shall be Rockwell Softaware Studio 5000 for ControlLogix processors with the version coordinated with the WWTP version currently in use for compatibility.
5. PLC and SCADA software programming requirements are included in the Automation Standards.

K.6.3 Work Station (HMI) Hardware

1. The pump station shall include a desk top SCADA HMI work station located in the electrical room or where space permits in the pump station building. The workstation shall be connected to UPS power. Refer to the Automation Standards for hardware requirements.
2. A network connection for a laptop shall be provided at the RIO cabinet located at the wet well area for local monitoring and control of the pump station in addition to the desktop workstation located in the pump station building.
3. Pump Station control panels shall have data and power port assemblies mounted on the panel to provide 120 VAC and Ethernet access The mounting loaction on the panel is to be approved during panel design for each panel. Assemblies shall be by GracePort.

K.6.4 Remote Communications

1. Dual communication links shall be provided from the pump station to the WWTP. Primary communication link shall be over fiber optic lines. Secondary communication link shall be over a T-1, radio link or cellular systems and will be determined and coordinated with SVCW during final design. A radio study for the remote pump stations was completed by SVCW in 2013.
2. Currently the pump station uses T-1 service for communicating to the WWTP. The use of these lines will eventually be removed as SVCW updates their remote communication systems to provide increased data transfer speeds and reliability. New fiber optic cables and conduits are being installed as part of the pipeline projects and is assumed to be available when the pump stations are in construction.

K.6.5 Device Level Ring (DLR) for RIO Communications

1. All new redundant PLC's shall communicate to Remote Input/output RIO chassis via Device Level Rings. DLR's shall be use to communicate with Ethernet/IP enabled devices such as VFD's, Power Monitors, etc. Where possible when Ethernet Communication is used the designer shall attempt to specify equipment that uses the DLRs and Ethernet/IP.

K.6.6 Input & Output Circuits

1. Discrete input circuits shall be 24 VDC. 120 VAC discrete circuits shall not be implemented.
2. Discrete outputs shall be 24 VDC.
3. Analog input signals shall be scaled between 4 and 20 mA DC.
4. Input/output modules shall be as specified in section 3.2.3.6 of the Automation Standard.

K.6.7 RIO

1. RIO design shall utilize Allen-Bradley I/O module systems that are compatible with the ControlLogix L7x series . Provide dual chassis for the Wet Well RIO cabinet as shown on Figure K-1. Each chassis shall be equipped with a dedicated power supply.
2. Field connections shall only require single connections to the termination assembly.
3. The RIO chassis shall communicate to the PLC via a dual fiber optic communication system as shown on the control system diagram per the Automation Standards.
4. Provide uninterruptable power supply.
5. Provide managed switch with capability to connect laptop.
6. Enclosure requirements shall be as specified herin. In addition, provide foldable shelf for use as laptop support.

K.6.8 Panels and Enclosures

In lieu of SVCW's Automation Standards section 4.5, panel and enclosure requirements shall be as follows.

Table K-2. Panel and Enclosure Requirements

Item	NEMA Rating	Material	Closure Type	Notes
Local Control Panels	NEMA 4X	FRP	Latch-bale type closures with hinges per vendor design.	Generally in close proximity to equipment and processes and so exposure to water, gases, sludge, etc. drive the NEMA 4X
PLC & RIO Panels	NEMA 12	Painted Steel	Full piano hinge and three point lockable door latch.	Protection from gasses, dust, water drip & dust.
Fiber Termination Panels	NEMA 12	Painted Steel	Free standing with full piano hinge and three point lockable door latch.	Protection from gasses, dust, water drip & dust.

Notes:

1. NEMA 4X panels/boxes become 3R when penetrated, but 4X is the starting basis for the panels and boxes specified to be purchased/provided by the contractor.

2. If local hazards drive a higher level of protection such as NEMA 7, the higher level of protection shall be used in lieu of the designation above.

K.6.9 Ethernet Switches

Coordinate with SVCW for current Ethernet switch requirements.

K.6.10 Fiber Optic Patch Panels

Coordinate with SVCW for current fiber optic patch panel requirements.

K.6.11 Fiber Optic Cable

Coordinate with SVCW for current fiber optic cable requirements.

K.6.12Tagging and Name Convention

SCADA tag names shall match that of the latest and most current tagging standards as developed by SVCW. The Designer shall coordinate and obtain the most recent version of the tagging standards from SVCW.

Refer to SVCW's Automation Standards for additional tagging requirements.

K.7 Instrumentation Equipment

Instrument enclosures shall conform to the National Electrical Code (NEC) area classification. All instruments, to the maximum extent possible, shall be manufacturer's standard product offering shall communicate with the SCADA system and shall conform to the applicable standards for their respective process application (e.g., environmental conditions and wetted surfaces). Instrument wiring shall be electrically isolated from the instrument case. All instruments shall be industrial quality (not commercial).

All instrument transmitters shall include an integral indicator provided with the transmitter if mounted in an easily accessible location, and shall be provided with a remote indicator when the transmitter is not mounted in an easily accessible location.

Instruments shall be provided with all manuals (maintenance/programming). After installation, provide a copy or list of any and all parameters that were changed from factory settings.

The following instrument types have not been reviewed with SVCW staff and are strictly preliminary selections that shall be discussed and final selection made during the progress of the project design phase.

K.7.1 Flow Meters

1. Flowmeters shall be magnetic type for force mains and non-contact, top-mounted laser Doppler or Ultrasonic flow meter for gravity lines with integral converter/indicating transmitter.
2. Indicating transmitters shall provide full-scale flow rates of 0 to 15 fps.
3. System error shall not exceed 5 percent of flow rate between velocities of 9 to 15 fps.
4. Programmable controller analog inputs from flow meters shall be current type, 4 to 20ma.
5. Transmitters shall satisfy requirements listed within this specification.

K.7.2 Modulation Valves and Gates (Electric Actuators)

Coordinate with SVCW for current modulation valve and gate (electric actuators) requirements.

K.7.3 Transmitters

1. Two-wire type transmitters shall have operating power derived from signal transmission circuit.
2. Transmitters shall meet specified performance requirements with load variations within the range of 0 to 600 ohms with power supply at nominal 24 volts DC with the default range of 0 to 100 percent corresponding to 4 to 20 ma.
3. Transmitter output shall increase with increasing measurement.
4. Transmitter indicators, whether integral or separate, shall be calibrated in process units, and engraved on the indicator scale plate.
5. Time constant shall be adjustable from 0.5 to 5.0 seconds for transmitters used for flow, level transmitters used for flow measurement, or pressure measurement.
6. Transmitter outputs shall be galvanically isolated via electro-mechanical or optical technology.
7. Two-wire transmitters located in a facility area classified as a hazardous per NFPA and the NEC shall be made safe by means of an intrinsic safety barrier. Intrinsic Safety barriers shall be of the active, isolating, loop powered type.
8. Four-wire transmitters shall be isolated from the process and power or provided with a loop-powered signal current isolator. Signal isolators shall provide galvanic isolation of milliampere transmission signals from transmitters. Isolators shall be housed in a NEMA 250, Type 4/7 conduit body derive operating power from signal input current. Input and output signals shall be 4 to 20 milliamperes, and error shall not exceed 0.1 percent of span. Input resistance shall not exceed 550 ohms with an output load of 250 ohms.
9. Level sensors shall be ultrasonic or radar type.
    - Pump wet well level sensors shall include criteria provided in SVCW's latest "Level Instrumentation Configuration for Pump Station Wet Wells" design document.
10. Pressure transmitters shall have the following features:
    - Pressure transmitter: capacitance or piezoresistive.
    - Range: 100:1.
    - Accuracy: 0.075 percent of calibrated span.
    - Indicator: LCD display.

11. Where available as an option, transmitters shall included HART and/or Ethernet communication protocol. One HART communicator shall be added to spare parts list for each project where HART transmitters are specified.

K.7.4 Analyzers

1. Combustible gas detectors shall detect explosive and hazardous conditions.
2. Combustible gas detection systems shall consists of field mounted sensing elements and monitoring assemblies to detect the lower explosive limit (LEL) of combustible gases or vapors, oxygen levels, and hydrogen sulfide (H2S) levels.
3. Installed orientation of the indicator shall permit the operator to easily read the display from the operating floor.
4. Accuracy shall be linear and repeatability, ± 1 percent.
5. Analog signal output shall be into 600 ohm load maximum.
6. Transmitters shall satisfy requirements listed within this specification.
7. Provide minimum 3, SPST contacts rated 5A at 24 VDC or 240 VAC. In addition, provide fault relay, normally energized, deenergizes on analyzer fault.
8. Process alarms (two each) shall be individually programmable to energize above or below set point.
9. Enclosures shall be suitable for NEC Class 1, Division 1 and 2, hazardous areas.

K.7.5 Process Taps

1. Process connections shall be arranged such that instruments may be readily removed for maintenance without disruption of process units or draining of large tanks or vessels.
2. Diaphragm seals shall be the type with flushing connections, Type 316 stainless steel body and Type 316L diaphragm unless otherwise specified.
3. Annular seals shall be the in-line full stream captive sensing liquid type. Metallic wetted parts shall be Type 316 stainless steel.
4. Final connections between rigid raceway systems and instruments shall be made with jacketed flexible conduit with a maximum length of 2 feet.
5. Pressure gauges shall have the following features:
   - Gauges shall be 4-1/2- inch premium grade, glycerin filled units with bourbon tube element, glycerin filled units with bourdon tube element, 270-degree milled stainless steel movement, phenolic case, and shatterproof glass window.
   - Accuracy shall be 1 percent of span or better.
   - All exposed metal parts shall be stainless steel.
   - Taps shall be in bronze pipe saddles secured to the pipe with double bronze or stainless steel straps and shall be for screw connections of pressure gauges on both intake and discharge pipelines for pumps for portable gauges.

K.7.6 Process Switches

1. Contact outputs used for alarm actuation shall be normally-closed or normally-opened as required by the process condition.
2. Contact outputs used to control equipment shall be normally-opened and shall close to start equipment.

3. Contacts monitored by solid state equipment such as programmable controllers or annunciators shall be hermetically sealed and rate for switching currents from 20 to 100 mA at 24 volts DC.
4. Contacts, monitored by electromagnetic devices such as mechanical relays, shall be rated as NEMA ICS 5, designation B300.
5. Double barriers provided between switch elements and process fluids such that failure of one barrier shall not permit process fluids into electrical enclosures.
6. Switch electrical enclosures rated as NEMA 250, Type 4 minimum.
7. Switch contacts located in Class I, Division 1 areas and monitored by solid-state circuits shall be made safe by intrinsic safety barriers.
8. Switch range shall be selected so that the specified set point is at least 30 percent but not more than 70 percent of the span, between the upper range limit and the lower range limit.

K.8 Tags and Names

Permanent tags shall identify field-mounted instruments, such as control valves, transducers, transmitters, gages, etc. Tags shall identify, as a minimum, the instrument number. Tags shall be located so that they do not create a hazard.

Nameplates shall be furnished for panel-mounted devices and enclosures. Nameplates shall identify, as a minimum, the panel and equipment number or panel-mounted device number.

K.9 Cabling and Interconnection

All panels, consoles, enclosures or control device wiring for connection to external circuits shall be wired to terminal blocks or patch panels to facilitate installation, start-up and maintenance. In addition, the following shall apply:

1. For hardwired instrumentation, wire and cables with tinned copper 16 AWG minimum, 600 volt insulated.
2. Each shield shall be connected to a separate terminal point. Loops drawings for instruments using twisted shielded pair cables shall provide a specific location and termination depiction of the shield to be connected to the instrument level grounding system. Shield connection shall be terminated on one end only within the PLC cabinet or panel.
3. Solenoid valves and other devices not available with terminals for connections, and consequently supplied with pigtails leads, shall have these leads landed on terminals in an adjacent conduit.
4. Conductors shall be properly identified at each end with heat-shrink labels.

K.10 Instrument Tubing and Piping

All pneumatic instrument systems and impulse lines shall be designed for personnel safety and to facilitate calibration, maintenance and/or replacement. This shall be accomplished by the following, as a minimum:

1. All instrument systems shall be specified with adequate support features to ensure proper operation. Support features include strain relief on connections to mitigate the consequences of material fatigue that ultimately leads to an unsafe condition.

2. Tubing connection locations shall be specified so that adequate space is available for conducting leak tests and replacing tubing fittings without disturbing adjacent tubing connections.
3. Instrument connections shall be through root valves, isolation valves, or three-valve Type 316 stainless steel bar-stock type manifolds. Valves shall be Type 316 stainless steel, ball-type.

K.11 Grounding, Shielding and Isolation

1. Grounding. A single point ground shall be established for the instrumentation and control system equipment and components. This ground shall carry no current and shall provide the ground fault return for the AC power system and the ground return for the instrumentation and control system electrical shields. The single point ground shall be the reference for the instrumentation and control system.
2. Instrument cable shall be shielded type and shall be installed in galvanized, rigid-steel conduit. PVC-coated GRS shall be used in corrosive areas.
3. Isolation. The system shall be designed to operate within performance specifications while exposed to the ambient electromagnetic environment.

K.12 Structural and Material Requirements

All instruments shall be of material compatible with the required environmental and service conditions. For critical elements, instruments, systems and equipment, a vendor certification shall be required to ensure that the device meets the environmental and operation requirements. When stainless steel hardware is necessary it shall be 316 SS.

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L. ATTACHMENT

Noise Attenuation Requirements

Noise attenuation requirements will be completed as part of final design.

M. ATTACHMENT

CAD Standards

All drawings shall be prepared using AutoCAD Version 2013 (supplied by AutoDesk, Inc.) or latest version used by the SVCW. The final design teams shall follow SVCW's latest CAD standards in preparation of the final design drawings. The SVCW CAD standards are based on the United States National CAD Standard with some modifications.

N. ATTACHMENT

Standard Details

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Civil Design Reference Details

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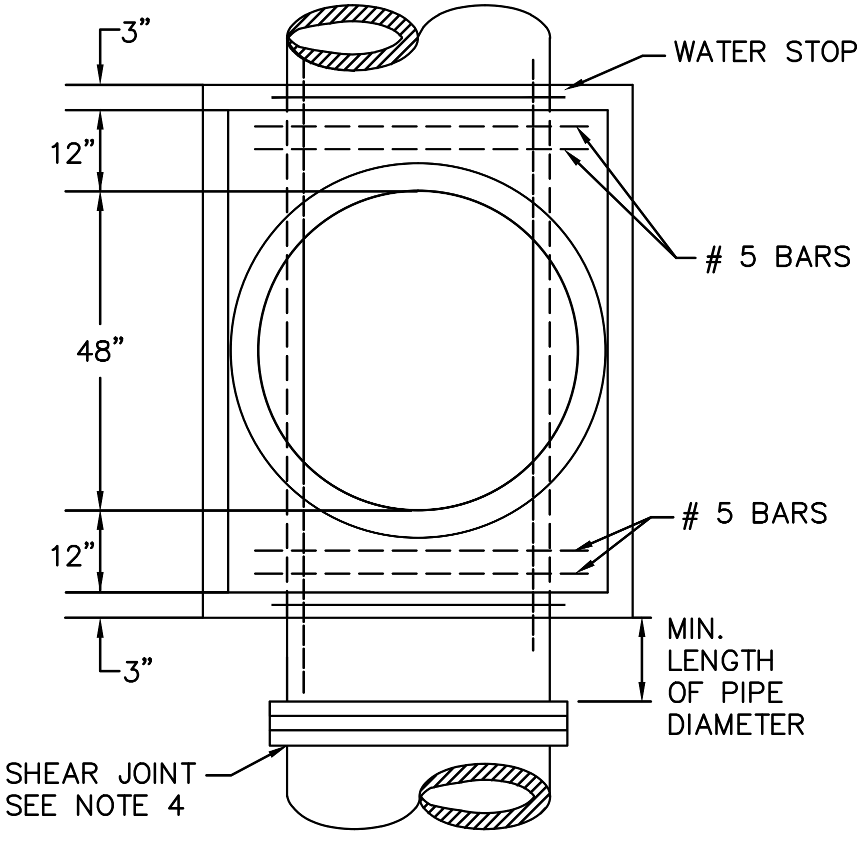
DIA.	A	B	C MIN.
24"	24"	9"	19"
27"	27"	9"	17.5"
30"	30"	9"	16"
36"	36"	9.5"	13"



SECTION A–A

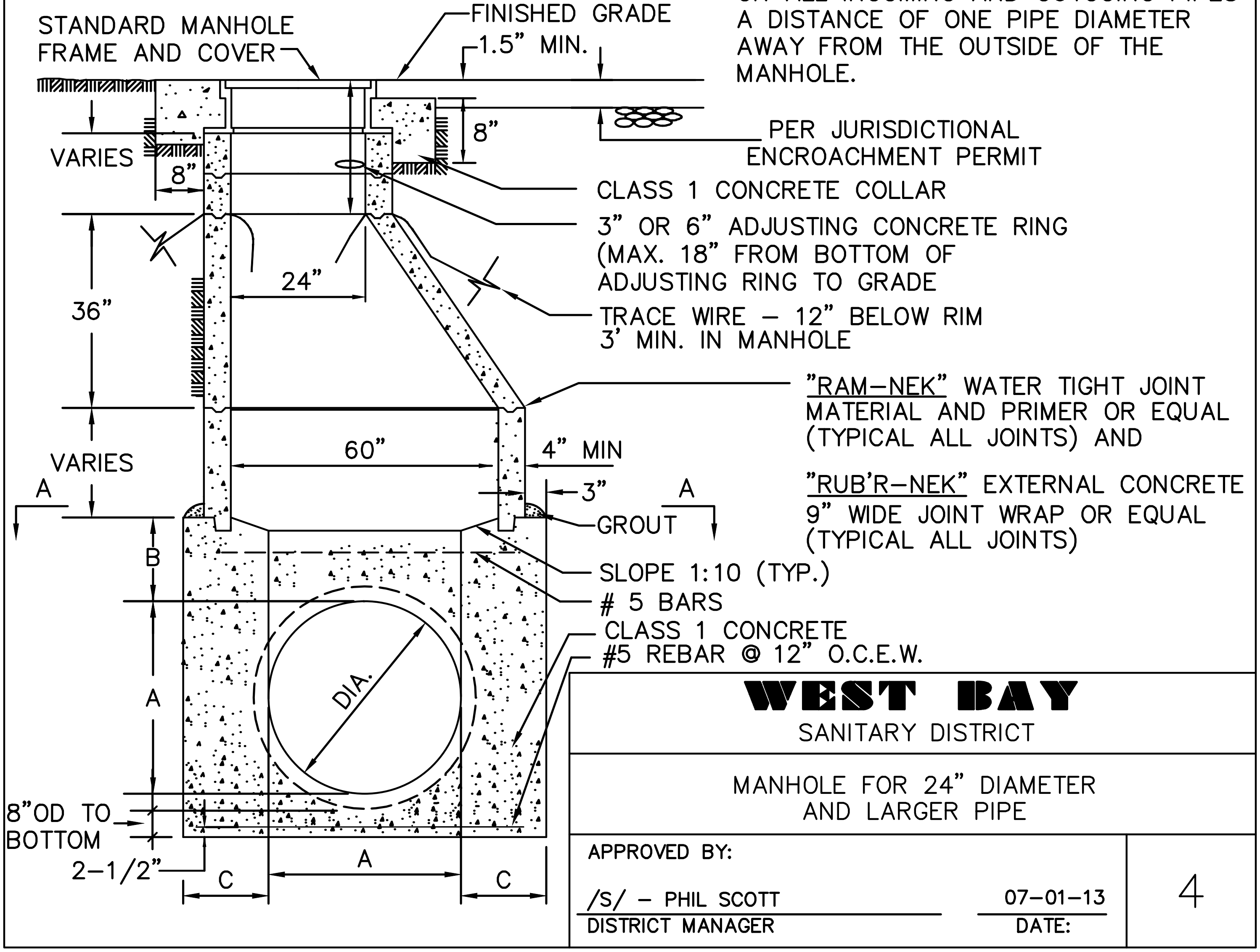
NOTES:

1) MANHOLE SHALL BE VACUUM TESTED.

2) ECCENTRIC CONE SHALL BE POSITIONED IN SUCH A MANNER OVER CENTER OF PIPE FOR INSTALLATION OF FLOW METER SENSOR BRACKET.

3) TRACE WIRE SHALL BE SOLID AND COATED 8 GAUGE COPPER WIRE PLACED 12" BELOW RIM WITH 3' COILED UP IN MANHOLE.

4) SHEAR JOINT SHALL BE INSTALLED ON ALL INCOMING AND OUTGOING PIPES A DISTANCE OF ONE PIPE DIAMETER AWAY FROM THE OUTSIDE OF THE MANHOLE.



WEST BAY
SANITARY DISTRICT

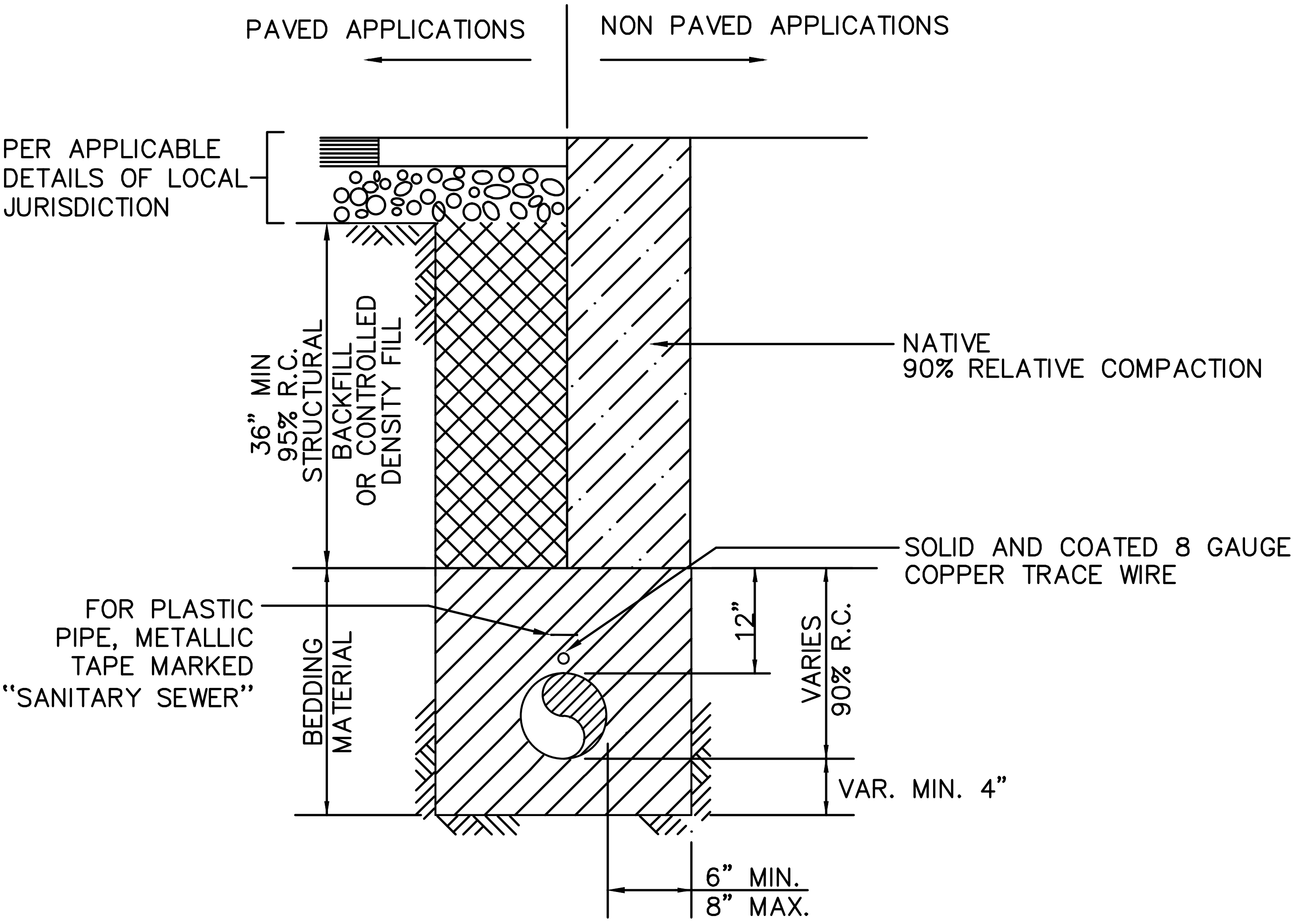
MANHOLE FOR 24" DIAMETER
AND LARGER PIPE

APPROVED BY:

/S/ – PHIL SCOTT
DISTRICT MANAGER

07–01–13
DATE:

4



TYPICAL TRENCH SECTION

BEDDING MATERIAL

ANGULAR BEDDING MATERIAL REQUIREMENTS
PERCENT PASSING (CRUSHED DRAIN ROCK)

SIEVE SIZES	PERCENTAGE PASSING
1"	100
3/4"	90–100
3/8"	20–55
#4	0–10
#8	0–5

STRUCTURAL BACKFILL

STRUCTURAL BACKFILL REQUIREMENTS
PERCENT PASSING

SIEVE SIZES	PERCENTAGE PASSING
1–1/2"	100
3/4"	80–100
#4	30–60
#30	5–35
#200	0–12

WEST BAY
SANITARY DISTRICT

EXCAVATION, BACKFILL AND
SURFACE RESTORATION

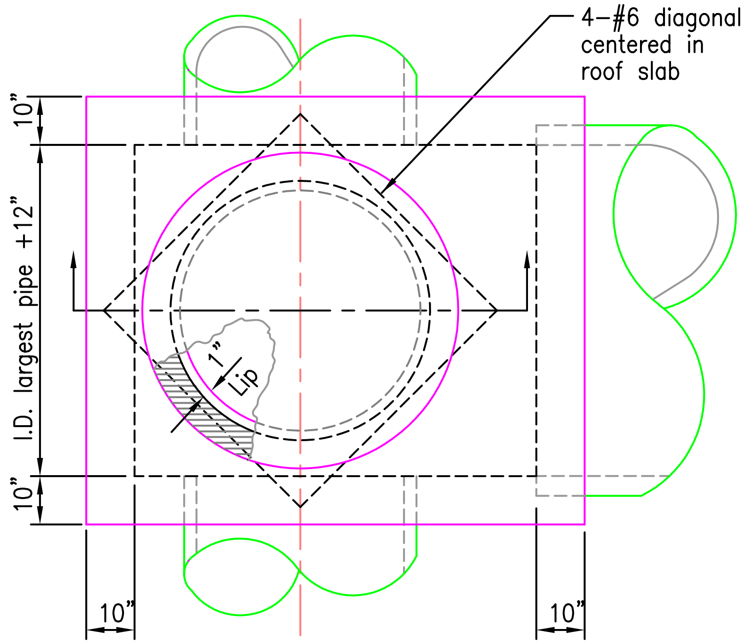
APPROVED BY:

/S/ – PHIL SCOTT 07–01–13
DISTRICT MANAGER DATE:

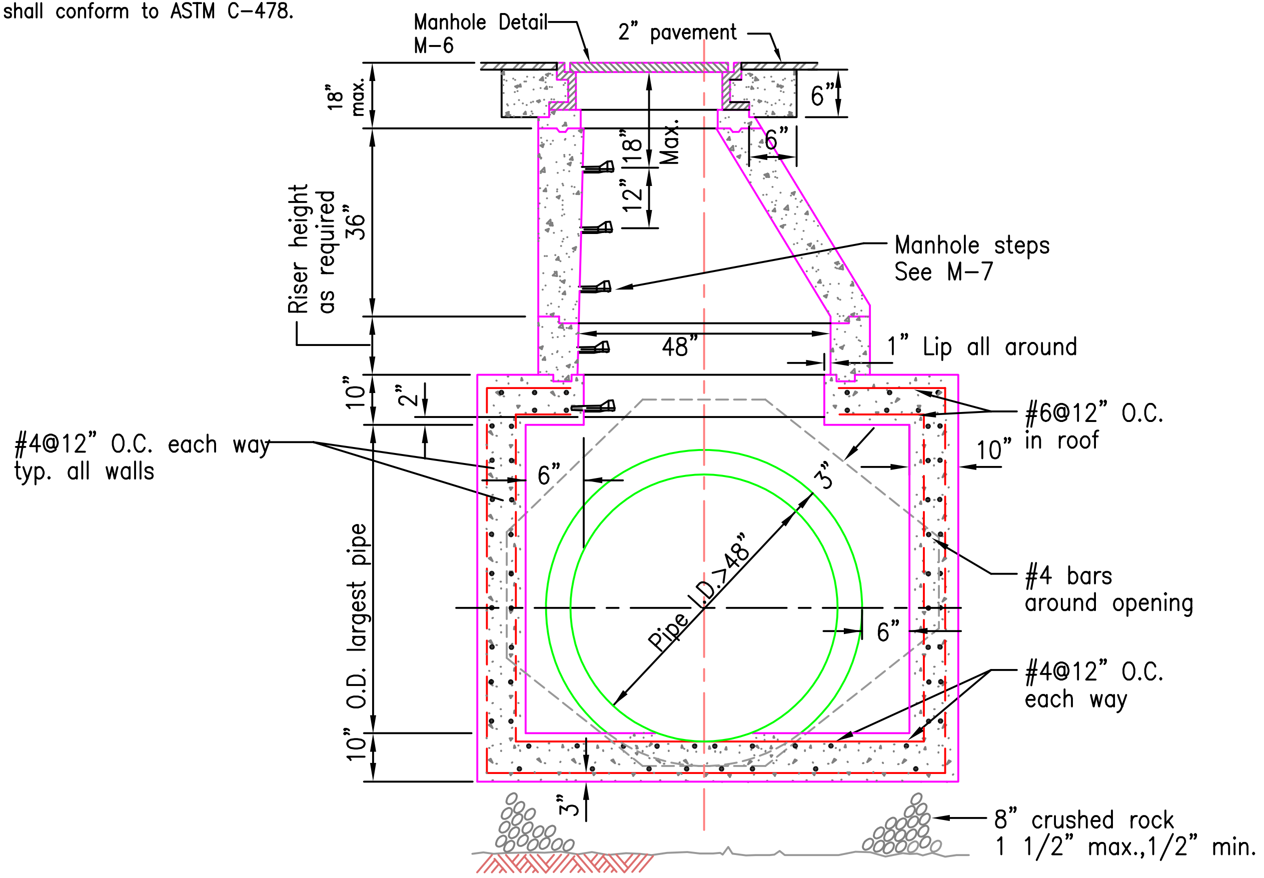
8

NOTES:

1. Provide a minimum drop of 0.10' across manhole when line bends and/or pipe diameter changes.
2. Concrete shall be Class A.
3. All joints shall be made water–tight with neoprene gaskets or Ram–neck.
4. Minimum crown elevation of smaller diameter inlet pipe shall be no less than the crown elevation of the outlet pipe without approval of City Engineer. Maximum drop from invert of inlet pipe to crown of outlet pipe shall be 1'–0".
5. Lay pipe through manhole when possible.
6. Top of pipe to be removed within manhole. Trim to neat line and finish off with grout to leave a smooth finish.
7. Provide two joints at all entry points to manholes.
8. Reinforced concrete manhole sections shall be precast, and shall conform to ASTM C–478.



PLAN



SECTION

NOT TO SCALE

STANDARD DETAIL

DATE: 12/04/06

CITY OF REDWOOD CITY

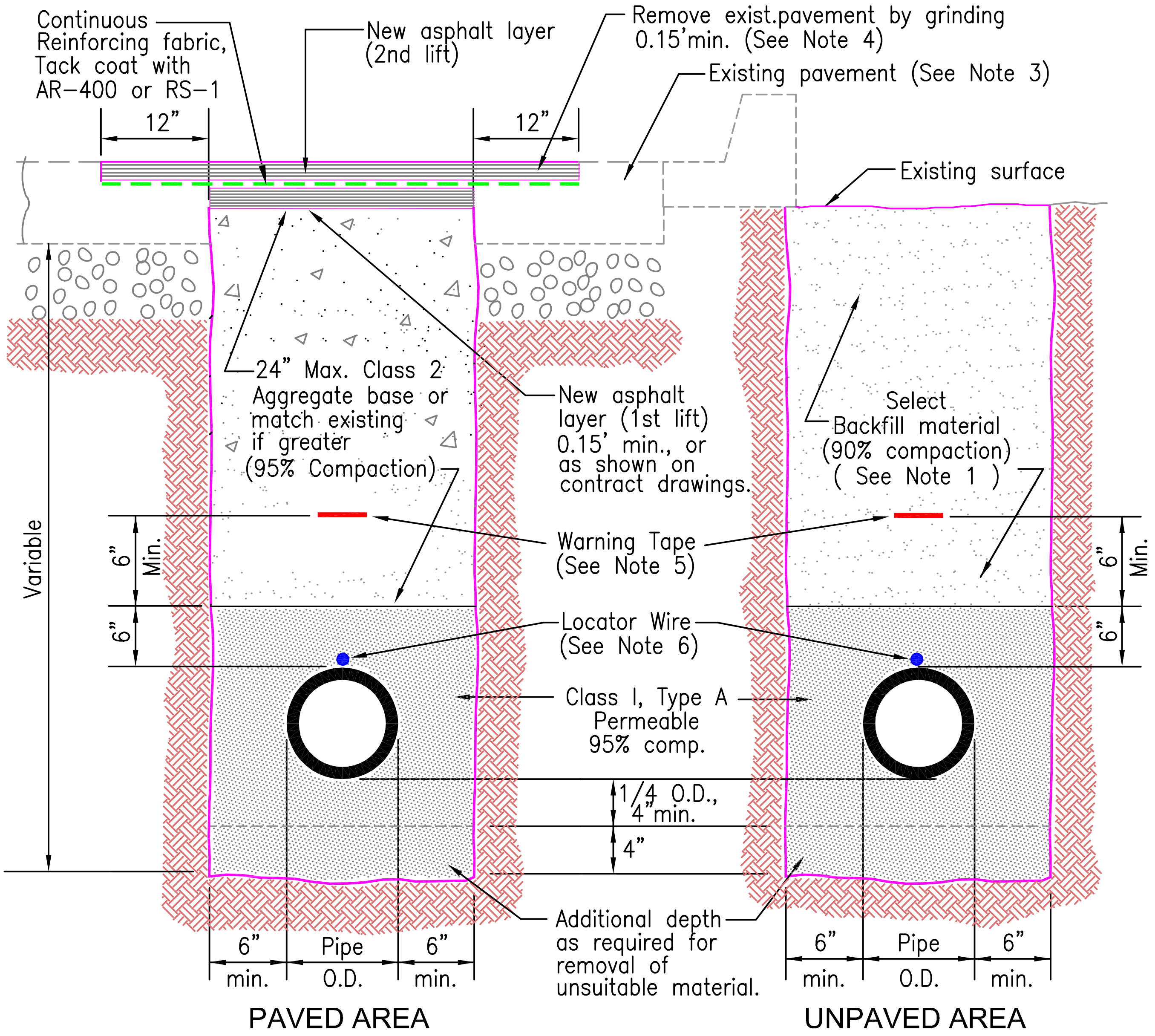
ENGINEERING AND CONSTRUCTION

TYPE III MANHOLE

(PIPES LARGER THAN 48")

M - 5

SHT 1 OF 1



NOTES:

1. Select backfill material – material from excavation, free from stones or lumps exceeding 3" in greatest dimension, vegetable matter, or unsatisfactory material. (See Specifications)
2. For new streets use design structural section as shown on plans.
3. If the edge of the trench falls within 3' of the gutter, the entire pavement shall be removed.
4. If existing pavement is less than 3" thick, pavement edge shall be sawcut to full depth in lieu of grinding.
5. Place Warning Tape 14" above pipe.
6. Place locator wire atop pipe.

NOT TO SCALE

STANDARD
DETAIL

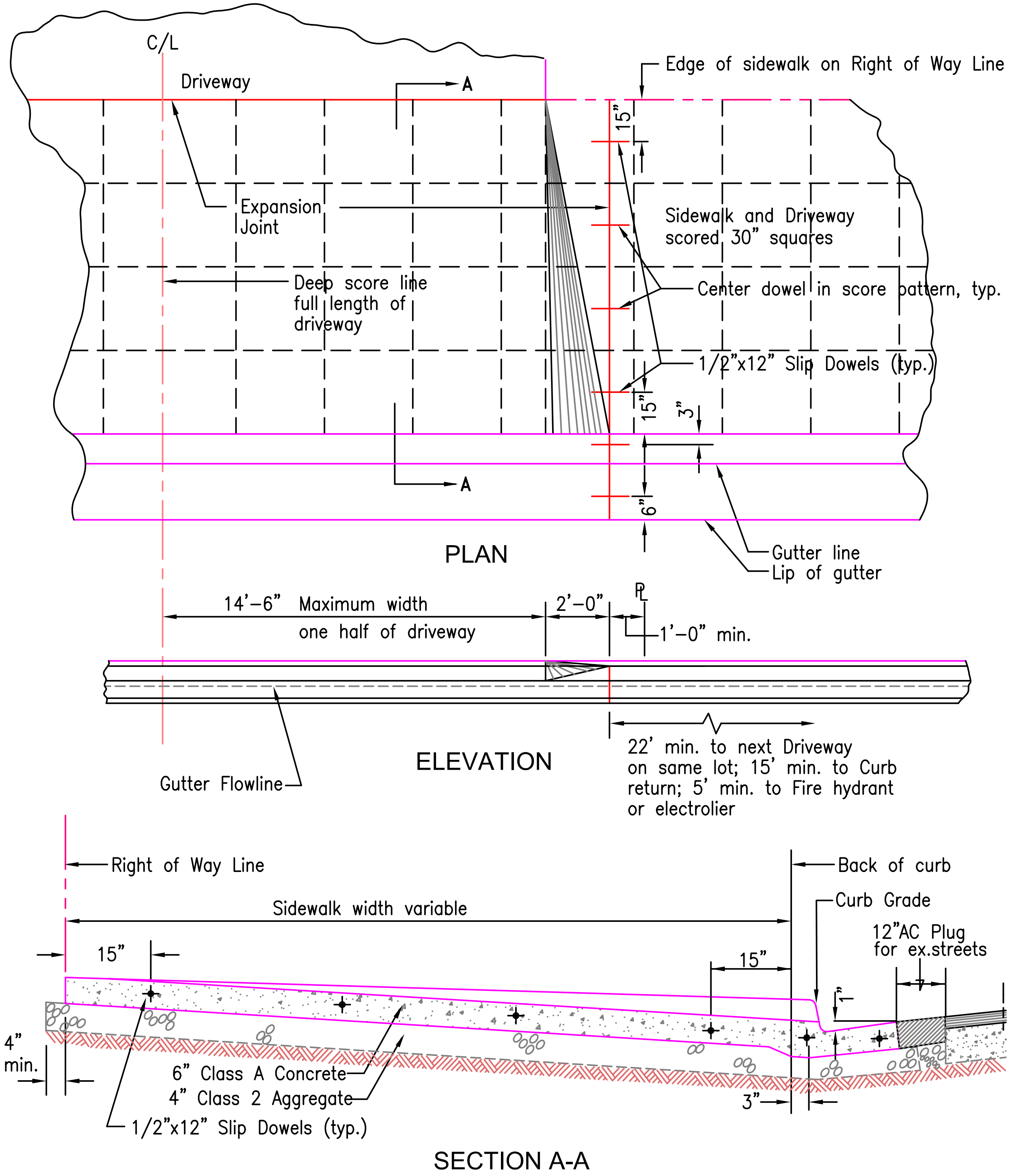
DATE: 12/04/06

CITY OF REDWOOD CITY

ENGINEERING AND CONSTRUCTION

UTILITY TRENCH DETAIL
(BAY MUD)

UT - 2
SHT 1 OF 1



NOT TO SCALE

STANDARD DETAIL

DATE: 12/04/06

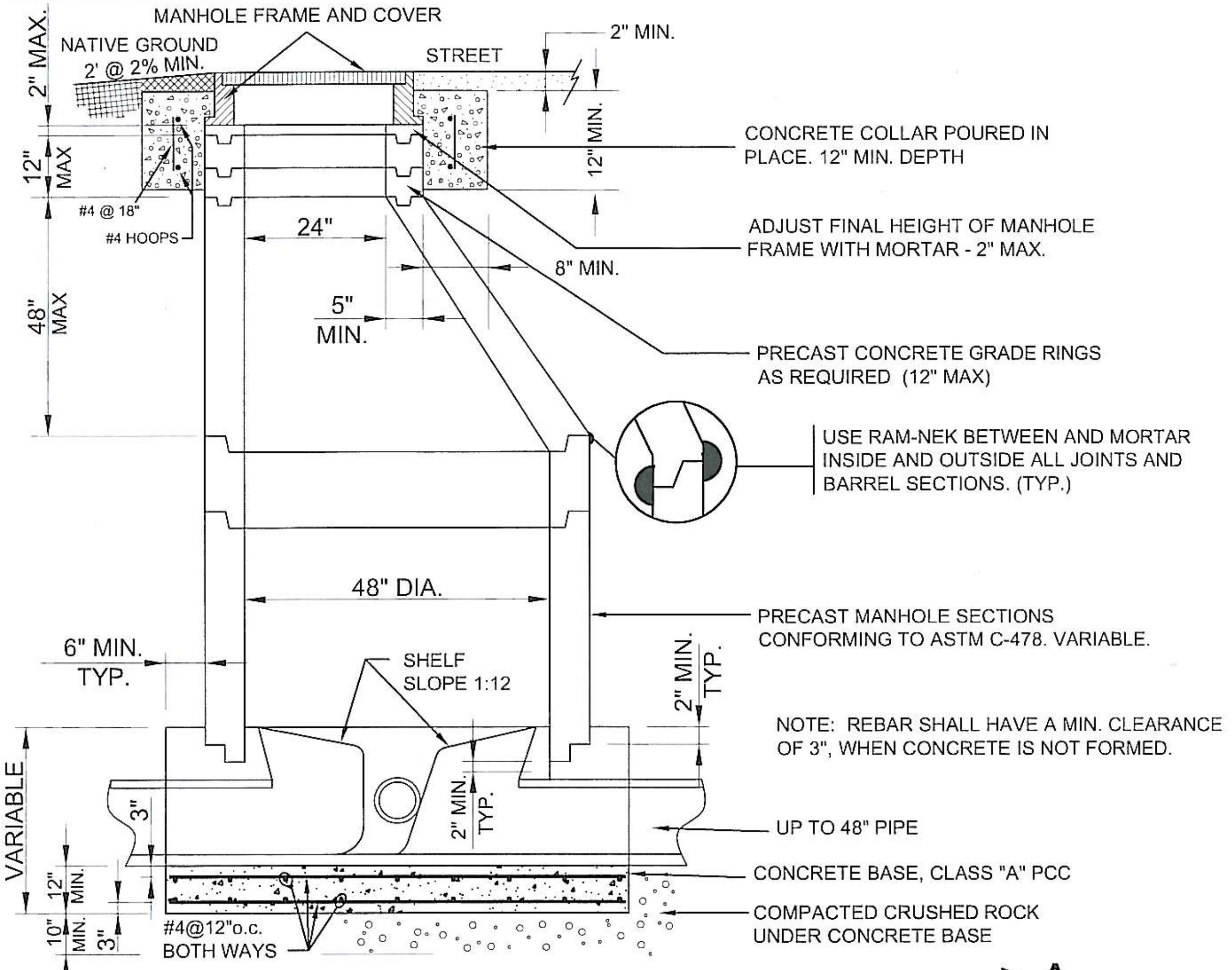
CITY OF REDWOOD CITY

ENGINEERING AND CONSTRUCTION

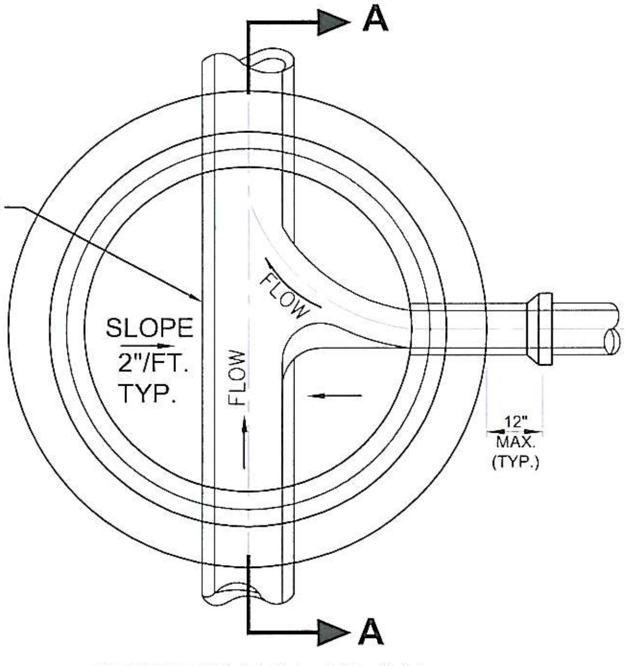
COMMERCIAL DRIVEWAY APPROACH

C - 2

SHT 1 OF 1



SECTION A-A



SECTIONAL PLAN

NOTES:

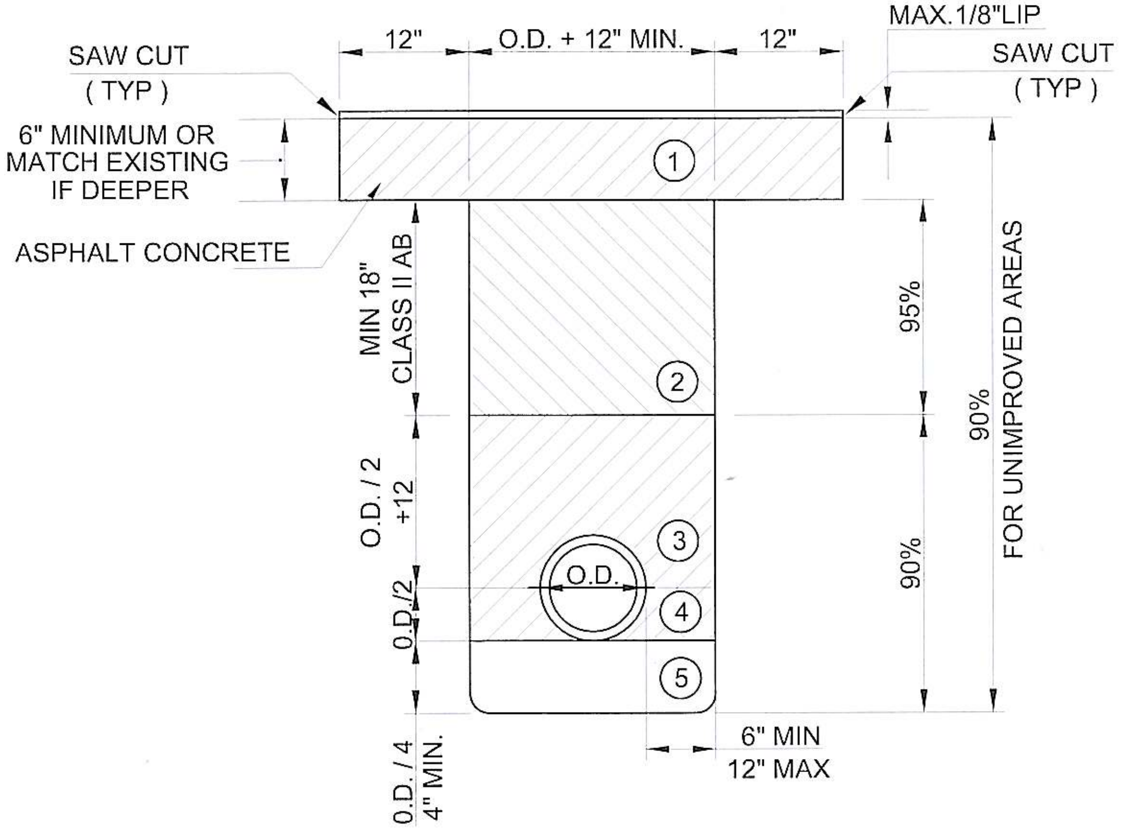
1. PRECAST MANHOLE SECTIONS SHALL CONFORM TO ASTM C478-74.
2. ALL CONCRETE JOINTS SHALL BE CLEAN & WETTED PRIOR TO SETTING NEXT SECTION. JOINTS SHALL BE OF MORTAR CONSISTING OF ONE PART OF CEMENT AND 1-1/2 PARTS OF SAND BY VOLUME. INSIDE JOINTS TO BE STRUCK FLUSH & BRUSHED SMOOTH.
3. FOUNDATION SHALL BE CLASS 'A' CONCRETE.
4. FORM CHANNEL TO MAINTAIN PIPE SECTION.

CITY OF SAN CARLOS, CALIFORNIA STANDARD DETAIL

APPROVED BY:
CITY ENGINEER
DATE: APRIL 2, 2010

STANDARD PRECAST MANHOLE

STD. DETAIL No.
11



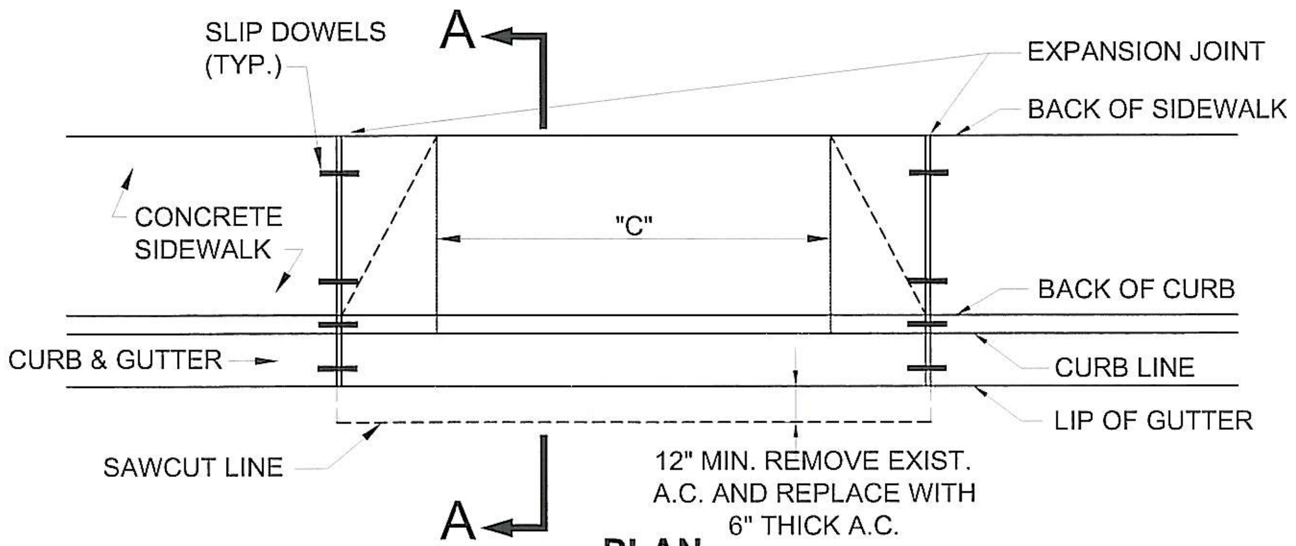
		BACKFILL MATERIALS		COMPACTION METHOD
MATERIAL LOCATION	①	STREET AREA-6" ASPHALT CONCRETE (UNIMPROVED AREAS-AGGREGATE OR NATIVE MATERIAL) AS APPROVED BY THE CITY ENGINEER.		MECHANICAL (EXCEPT UNIMPROVED AREAS MAY BE JETTED WITH ENGINEER`S APPROVED.
	②	CLASS II AGGREGATE BASE OR MATERIALS APPROVED BY THE CITY ENGINEER.		MECHANICAL COMPACTION EXCEPTION:
	③	CLASS II AGGREGATE BASE OR APPROVED NATIVE EXCEPT SAND FOR VCP OR APPROVED CDF.		
	④	SAND OR DRAIN ROCK	CRUSHED AGGREGATE BASE OR APPROVED NATIVE EXCEPT SAND FOR VCP OR APPROVED CDF.	WHEN SAND IS USED IT SHALL BE JETTED OR VIBRATED. NECESSARY FOR CDF.
	⑤	3/4" MAX. CRUSHED ROCK		MECHANICAL COMPACTION OR JETTED AS DIRECTED

CITY OF SAN CARLOS, CALIFORNIA STANDARD DETAIL

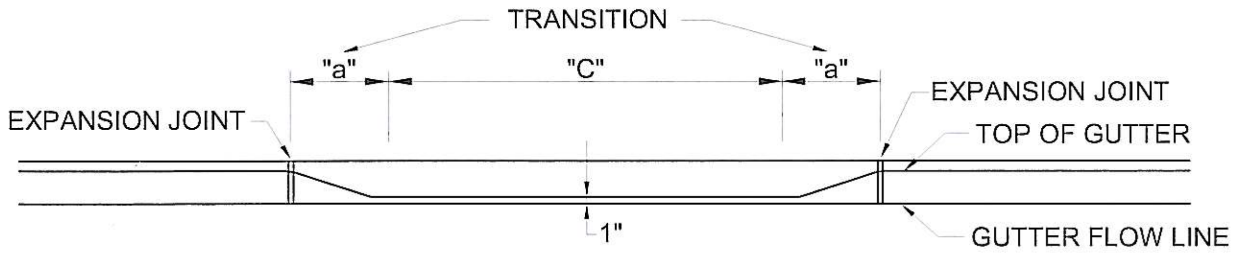
APPROVED BY:
RCWeil
CITY ENGINEER
DATE: July 31, 2009

STANDARD TRENCH DETAIL

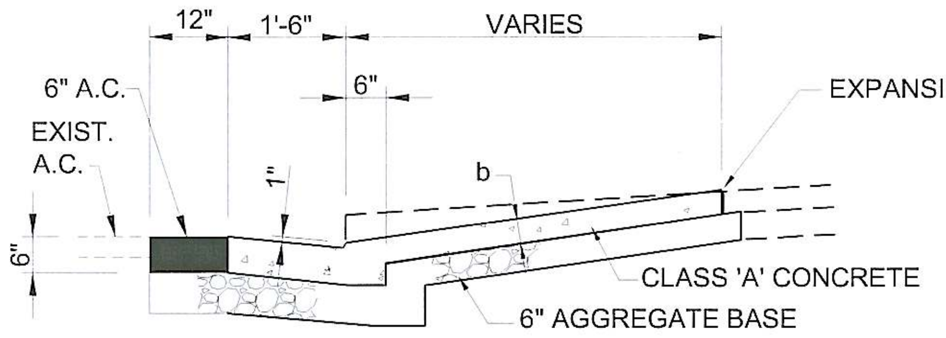
STD. DETAIL No.
18



PLAN

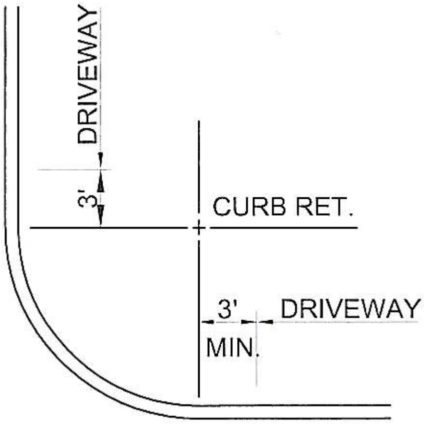


FRONT ELEVATION



SECTION A-A

TYPE DRIVEWAY	a	b	c (Maximum)
RESIDENTIAL	1'-6"	4"	SINGLE GARAGE 14' DOUBLE GARAGE 23'
COMMERCIAL	4'-0"	6"	30'



CITY OF SAN CARLOS, CALIFORNIA STANDARD DETAIL

APPROVED BY:

CITY ENGINEER

DATE: SEPTEMBER 15, 2010

COMMERCIAL AND RESIDENTIAL DRIVEWAYS

STD. DETAIL No.

9

O. ATTACHMENT

Sole Source Specification and Purchase of Standardized Equipment List

Sole Source Specification and Purchase of Standardized Equipment List
Approved via Resolution at September 13, 2012 SBSA Commission Meeting

The following list of equipment eligible to sole source is valid for a five-year period from September 2012 to September 2017. This list does not REQUIRE the listed equipment to be sole-sourced; it ALLOWS the equipment to be sole-sourced if deemed appropriate. The following list is subject to updates.

Equipment to Match Existing for Standardization:

Equipment	***Manufacturer***	***Location Used***	***Reason for Sole Source***
Temperature Monitoring	Rosemount	Hot Water System	Match Existing Equipment for Standardization and Proven Effective and Reliable
Gas Flow Monitoring	FCI	Biogas and Natural Gas Systems	Match Existing Equipment for Standardization and Proven Effective and Reliable
Thermal Dispersion Flow Monitoring	FCI	Hot Water and Lube Oil Systems	Match Existing Equipment for Standardization and Proven Effective and Reliable
Sludge Heat Exchanger	Alpha-Laval	Sludge Heating System	Match Existing Equipment for Standardization and Proven Effective and Reliable
Power Distribution Panel[1]	Eaton Cutler-Hammer	Electrical Power Distribution	Match Existing Equipment for Standardization
Paints and Coatings	Sherwin-Williams	Walls, Tanks, Digester Domes, Piping	Standardize, Proven Effective and Reliable; also Tested as Effective and Recommended
Positive Displacement Pumps	Moyno	Thickeners, Digesters, Dewatering, Grease Receiving Station	Match Existing Equipment for Standardization
Centrifugal Pumps	FloServe (Worthington)	Final Effluent, DMFs, RAS, Pump Stations	Match Existing Equipment for Standardization
Centrifugal Pumps	WEMCO	Primary Sludge	Match Existing Equipment for Standardization
Gas Management	Varec	Digester Gas	Match Existing Equipment for Standardization
Grinders	Franklin Miller	Pump Stations	Tests on various manufacturers proved this one effective

Equipment	***Manufacturer***	***Location Used***	***Reason for Sole Source***
Valves	Pratt	Various and numerous locations	Match Existing Equipment for Standardization
Plug Valves	Dezurik	Various and numerous locations	Match Existing Equipment for Standardization
Sample Pumps	Paco	Various and numerous locations	Match Existing Equipment for Standardization
Submersible Pumps	WILO	Bilge system	Match Existing (4 pumps)
Submersible Pumps	FloServe (Worthington)	Stormdrain System	Match Existing (3 pumps)
Electrical Parts	Allen Bradley	Electrical Equipment and Motor Drives	Match Existing Equipment For Standardization
Pump Station Flow Meters	Thermo Scientific (Doppler)	Pump Stations	Standardized and proven effective
Flow Monitoring	Flowtect (pressure switch)	Eyewash/Emergency Showers	Standardized and proven effective
Pressure Monitoring	Rosemount	No. 3 Water Uses	Standardized and proven effective
Turbidity	Hach	DMF Effluent	Matching existing (7)
Chlorine Analyzers	DULCO	Disinfection, Recycled Water, Dechlorination	Match Existing and only one found to work consistently
Hypochlorite and bisulfite peristaltic dosing pumps	Watson Marlow	Hypo and bisulfate storage tanks	Standardized and proven effective
Hydrogen Sulfide meter	Arizona Instrument	Digester Gas and various staff and instrument buildings	Match Existing Equipment (2) which have operated for 18 years
Flow-through Bioassay System	Aqua Science	Final Effluent monitoring n Laboratory	Sole provider for Cal EPA Region 2 Dischargers
Steam sterilizer	Getinge	Disinfect Lab materials and media	Standardize, Proven Effective and Reliable
Switches, Routers and other Network Appliances	Cisco	Data Center	Match Existing Equipment for Standardization and Proven Effective & Reliable
Servers and Storage Devices	Dell	Data Center	Match Existing Equipment for Standardization and Proven Effective & Reliable
Uninterruptable Power Supply (UPS)	Eaton/Powerware	Data Center	Match Existing Equipment for Standardization and Proven Effective & Reliable

Equipment Selected based on Testing and Efficacy[1]:

Equipment	***Manufacturer***	***Location Used***	***Reason for Sole Source***
Ultrasonic Level Monitoring	Siemens (aka Milltronics)	Various locations	Tests on various manufacturers proved this one effective
In-Plant Flow Meters	Krohne (Magnetic) Rosemount (Magnetic) Thermo Scientific (Doppler)	Various locations with high solids content material	Tests on various manufacturers proved these effective
Pressure Level Transducers	Rosemount Druck (hydrostatic)	Various locations	Tests on various manufacturers proved these effective
pH Monitoring	Horiba	Various locations	Tests on various manufacturers proved this one effective
TSS Monitoring[1]	Cerlic ITX (in-line)	RAS, WAS, Thickener Overflow, Effluent	Tested and recommended
MLSS Monitoring[1]	Cerlic ITX (immersion style)	Aeration basins	Tested and recommended
Dissolved Oxygen[1]	Cerlic O2X	Aeration basins	Tested and recommended
Sludge Blanket Level[1]	Entech EchoSmart	Secondary Clarifiers	Tested and recommended

[1] Reference Instrumentation Screening and Evaluation Technical Memorandum for Activated Sludge Process Automation Design (CIP 8017), December 20, 2010, by Kennedy/Jenks

Basis for ability to Sole Source Equipment, Material, Product, Service

SBSA’s purchasing guidelines are delineated by the charter of the City of Redwood City which, in turn, is guided by the Public Contracts Code (PCC). One of the statutes in the PCC (Section 3400) restricts public agencies from drafting specifications for bids (1) in a manner that limits the bidding, directly or indirectly, to any one specific concern, or (2) calling for a designated material, product, thing, or service by specific brand or trade name unless the specification is followed by the words “or equal” that that bidders may furnish any equal material, product, thing, or service. However, this subdivision is not applicable under certain circumstances, including:

(1) in order for a field test or experiment to be made to determine the product’s suitability for future use
(2) in order to match other products in use on a particular public improvement either completed or in the course of completion
(3) in order to obtain a necessary item that is only available from one source or
(4) in order to respond to an emergency declared by a local agency or by the state.

TM 8.1 – Predesign vs. Proposed Project Summary

The following major changes between pre-design of the conveyance pump station completed in 2015 and conceptual design completed in 2016 as directly applied to TM 8.1 are summarized below.

Table C-1. TM 8.1 Summary of Changes

Section	Pre-Design	Proposed Project Selection
Background	• BPS and SCPS combined into one pump station, routing the BPS flows to the SCPS via gravity sewer main. • Three future pump stations will be constructed: (1) PS1, currently MPPS; (2) PS2, current RCPS and PS3 (the combined BPS and SCPS).	• BPS flows routed to SCPS via a rehabilitated force main for combination with San Carlos flows prior to discharge into the San Carlos Inlet Structure and gravity pipeline. • A single new pump station will be built at RCPS. MPPS will be rehabilitated. BPS will be rehabilitated. SCPS will be repurposed into odor control facilities for the gravity pipeline. • References to PS1, PS2 and PS3 are no longer used. Pump stations will be referred to as their existing names (e.g. MPPS, RCPS, SCPS and BPS).
Section 1: Pumps	• Dry weather and wet weather operating conditions were based on the conveyance system comprised of force main to the WWTP. • Each of the three pump stations will have a dedicated set of wet weather and dry weather pumps.	• Dry weather and wet weather operating conditions are based on the conveyance system comprised of gravity pipeline from the Inner Bair Island Drop Shaft. Updated operating conditions are presented in Sections 4 and 5 of the planning report. • BPS and MPPS may or may not have dedicated sets of wet dry weather and wet weather pumps due to the space limitations at the existing pump stations. RCPS will have a dedicated set of wet weather and dry weather pumps.
Section 2: Wet Well Design	• All pump stations will consist of two trench-style wet wells with variable speed pumps. • Each wet well will contain two dry weather pumps and two wet weather pumps.	• RCPS will be the only pump station that will include two trench-style wet wells with variable speed pumps. Each RCPS wet well will contain two dry weather pumps and two wet weather pumps. • MPPS will consist of two existing wet wells with five of the same sized, variable speed pumps. One wet well include two pumps and the second wet well will include three pumps. MPPS's existing wet wells will not accommodate conversion into trench-style wet wells. • BPS will consist of a single, existing wet well with three variable speed pumps. BPS's existing wet wells will not accommodate conversion into a trench-style wet well. • Modifications to improve the hydraulics of the approach channels/pipes and wet well will be evaluated for MPPS and BPS.

Table C-1. TM 8.1 Summary of Changes

Section	Pre-Design	Proposed Project Selection
Section 3: Hydraulic Transient Control	• Hydraulic transient control and analysis was completed for force main conveyance to the WWTP. • Hydropneumatic tanks are recommended at RCPS and SCPS.	• Hydraulic transient control and analysis was not completed for the gravity pipeline conveyance to the WWTP. This will be completed in pre-design and/or detailed design.
Section 4: Odor Control	• Chemical scrubbers recommended at MPPS, RCPS and SCPS.	• MPPS and RCPS will have chemical scrubbers for odor control. Design and size to be confirmed. • BPS will include an activated carbon system for odor control. • SCPS odor control system will include chemical scrubbers sized to treat foul air from the gravity tunnel.
Section 5: Bar Screens	• Bar screens recommended at RCPS with no screening or primary treatment located at BPS and SCPS.	• Bar screens are still recommended at RCPS due to volume of rags in influent based on location downstream of jail facilities. • Grinders are recommended at MPPS and BPS.

Appendix G: South Bayside System Authority, Belmont Pump Station Record Drawings

Jenks & Harrison Consulting Sanitary & Civil Engineers, August 1977/
September 1979

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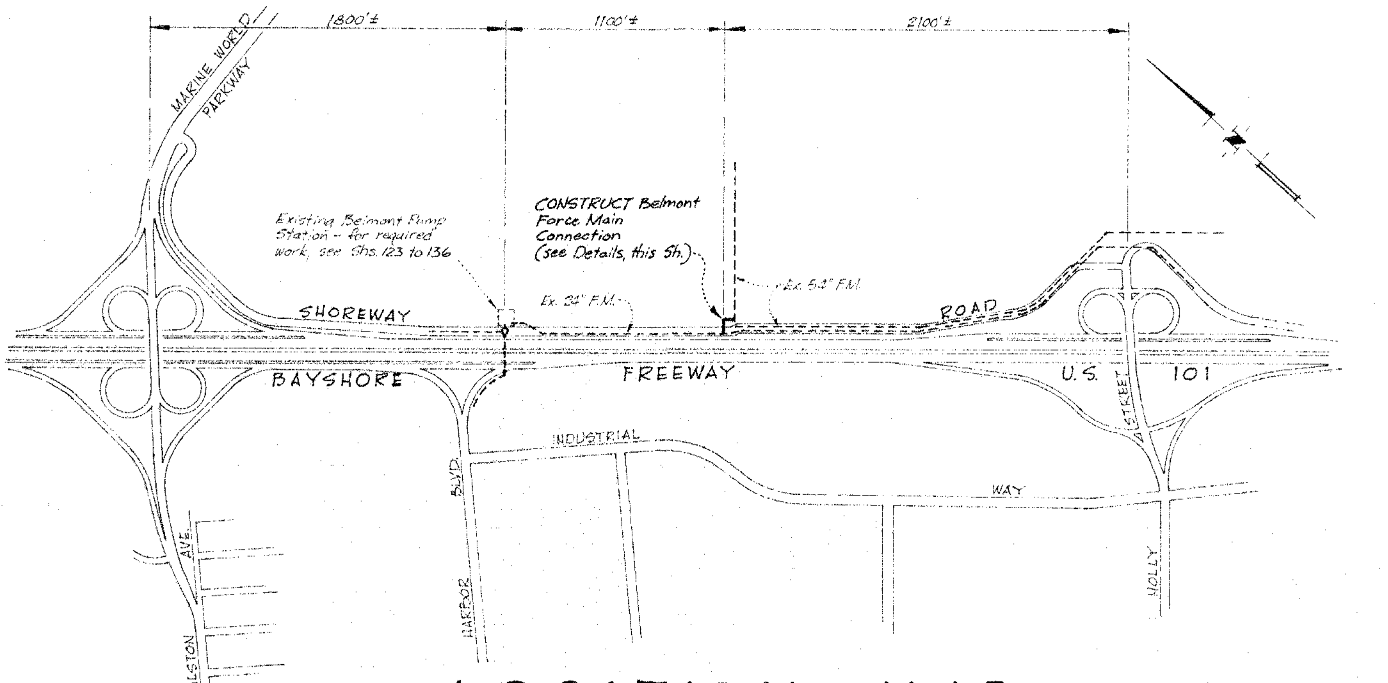
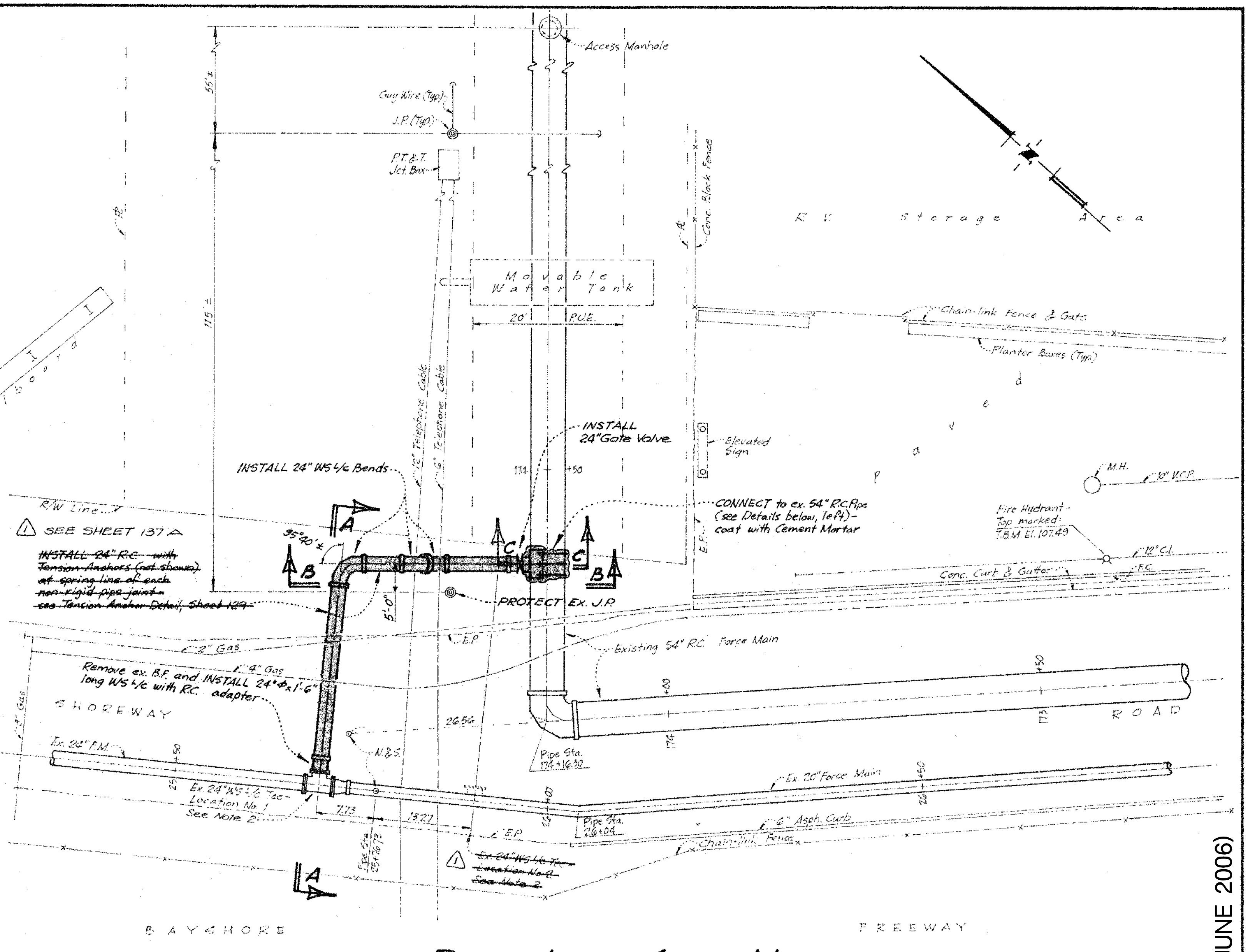


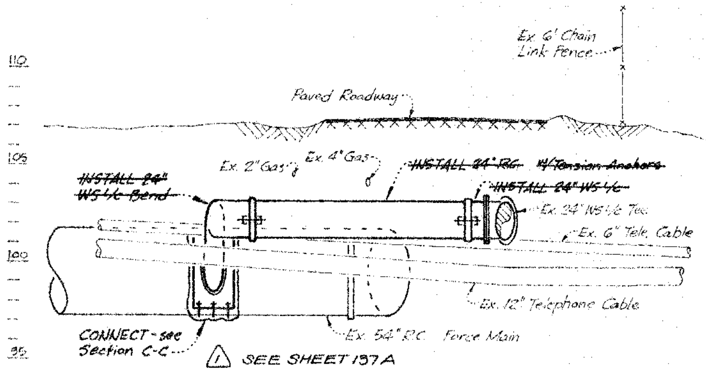
LOCATION MAP

Scale: 1" = 500'



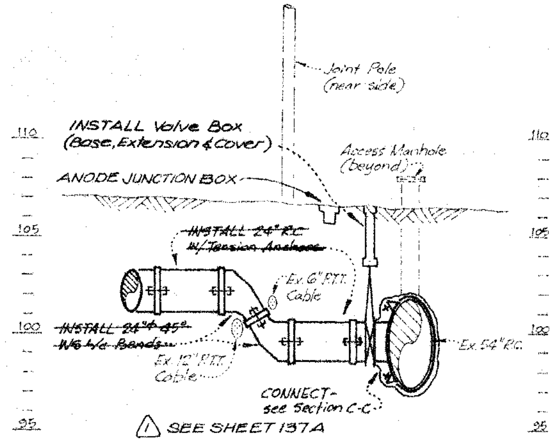
PLAN

Scale: 1" = 10'



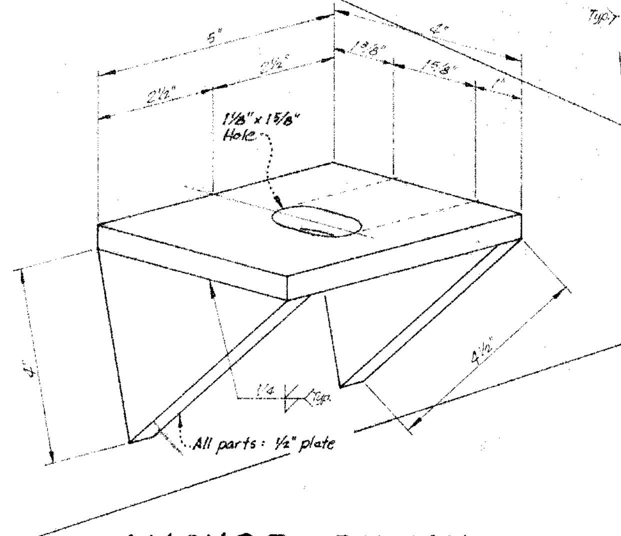
SECTION A-A

Scales - Horiz: 1" = 10'
Vert: 1" = 5'



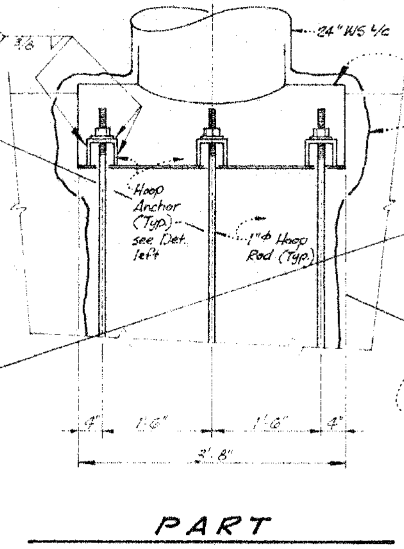
SECTION B-B

Scales - Horiz: 1" = 10'
Vert: 1" = 5'



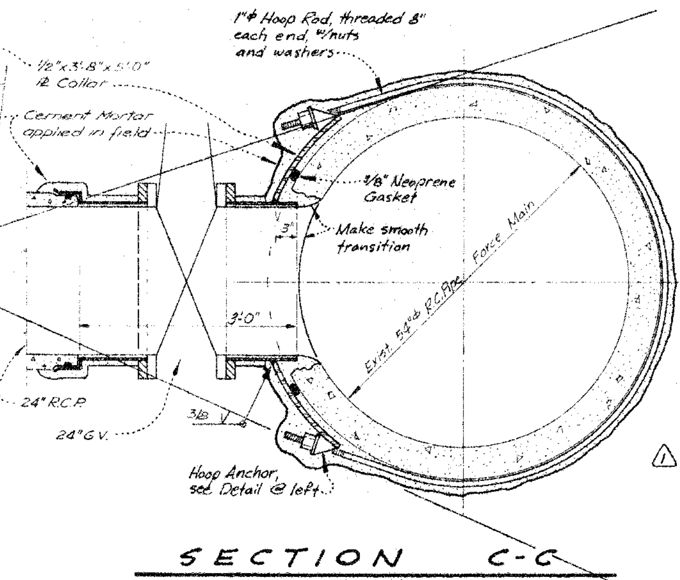
ANCHOR DETAIL

No Scale



PART ELEVATION

Scale: 3/4" = 1'-0"



SECTION C-C

Scale: 3/4" = 1'-0"

⚠ SEE SHEET 137 B

NOTES

1. The Construction Notes shown on Sheet 123 which apply to the Belmont Pump Station Improvements shall also apply to the Belmont Force Main Connection Construction.
2. The Contractor shall uncover and expose the existing 24" and 54" Force Mains and the underground telephone cables and shall then layout the 24" Belmont Force Main Connection. The Contractor shall complete this layout work and shall submit it for approval prior to the fabrication of this pipework. The Contractor's attention is directed to the alternate locations of the existing 24" WS L/C Tee as shown on the Plan above, Location No. 1 is considered the more likely location.

Record Drawing

These Record Drawings have been prepared based on information provided by the contractor and others. Kennedy/Jenks Consultants has not verified the accuracy or completeness of the information provided to them and does not warrant the accuracy or completeness of these Record Drawings. Users of these Record Drawings assume all risk of loss resulting from their use.

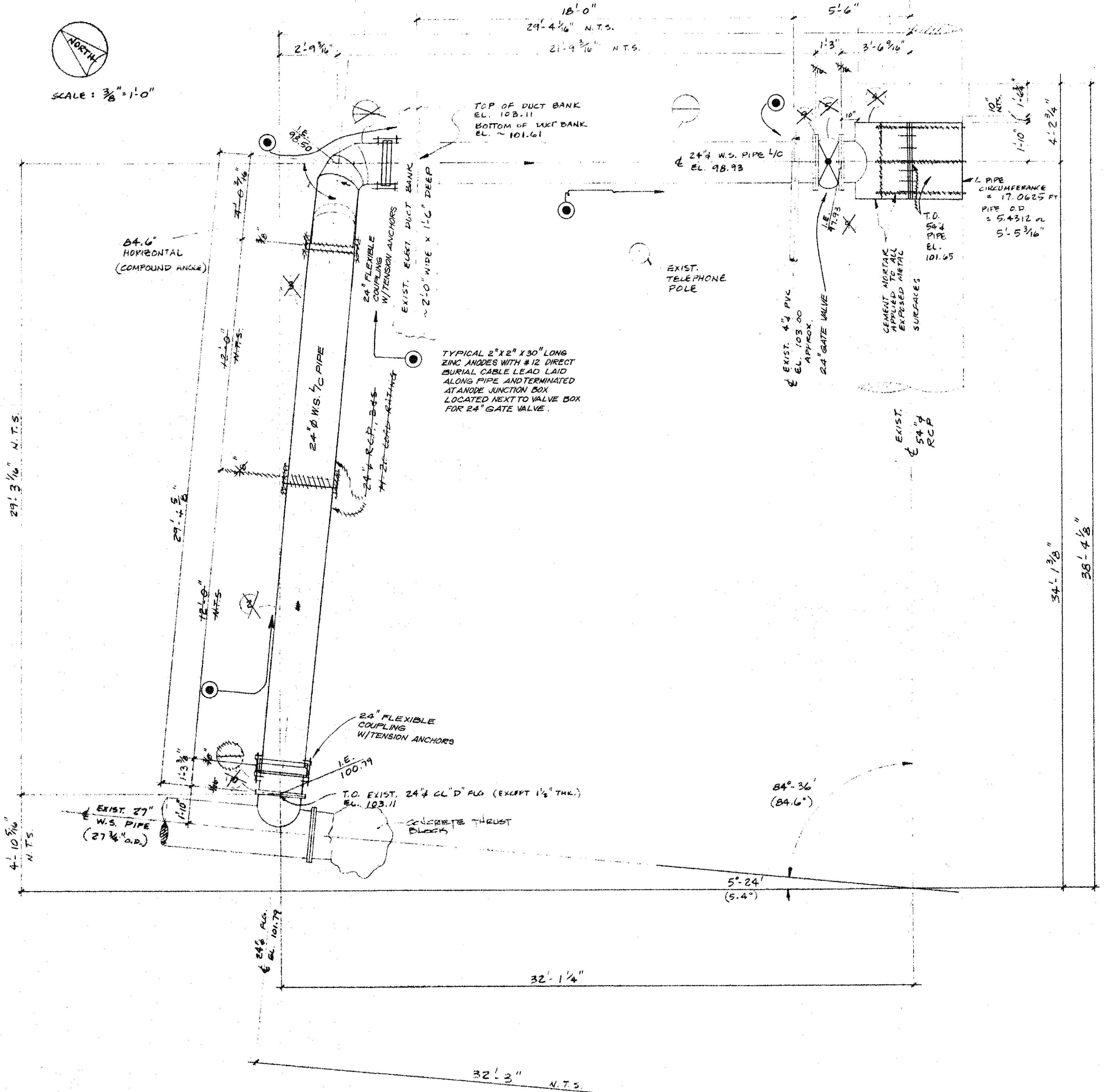
(REVISED SET JUNE 2006)

⚠ RECORD DRAWING , JUNE 1982

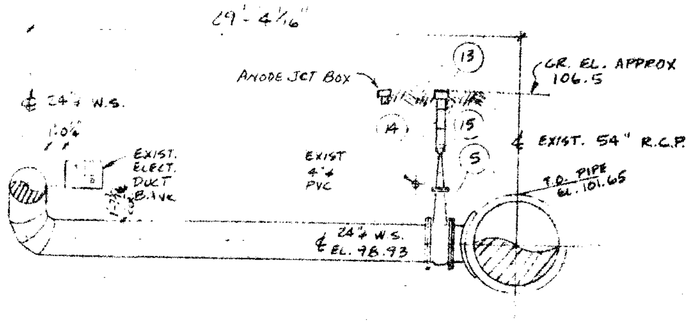
137 OF 141

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	BELMONT PUMP STATION BELMONT FORCE MAIN CONNECTION PLANS, SECTIONS AND DETAILS
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: CVB Scale: AS NOTED Des/Chkd by: DAB Date: 8-77/9-79

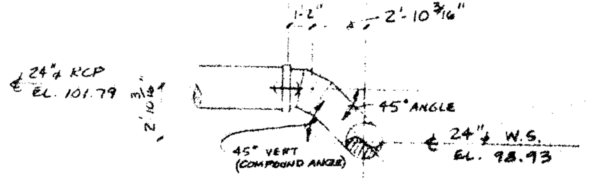
O:\CLIENTS.LIB\Sbsa.lib\SBSA_RecordDrawings\SBSA_RecordDrawings\SBSAPumpStationsUnitNo3\ps137.dwg 6-16-10 08:27:40 AM pooguest



SHOREWAY ROAD
PLAN - ~~BELMONT STREET~~ PIPING



ELEVATION
SCALE 3/16" = 1'-0"



ELEVATION
SCALE: 3/16" = 1'-0"

(REVISED SET JUNE 2006)

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⚠ RECORD DRAWING , JUNE 1982

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
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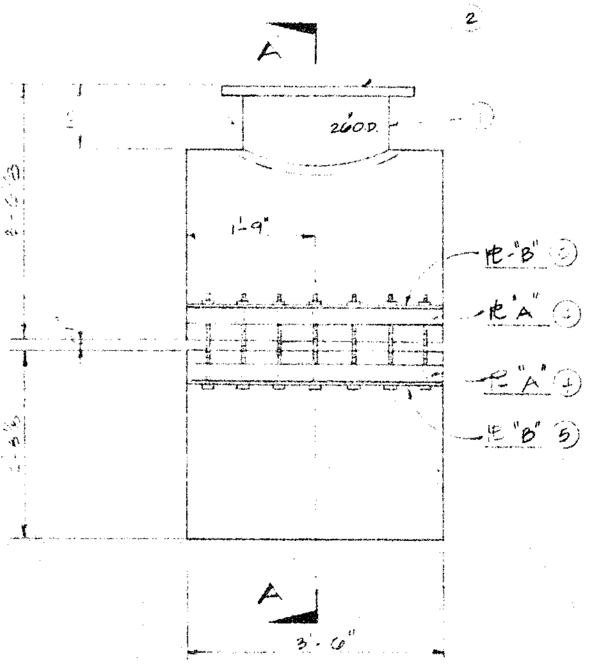
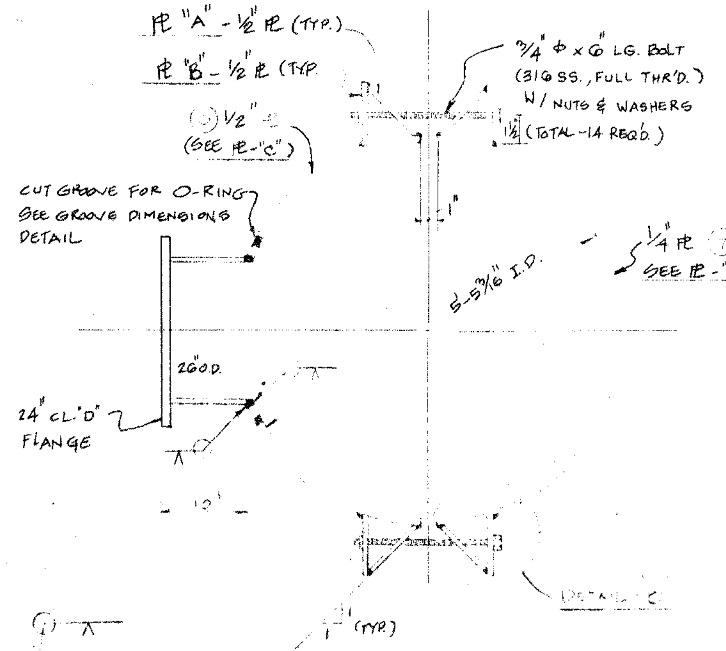
APPROVED MENLO PARK S.D. DATE	Drawn by: CVB — Scale: AS NOTED Des/Chkd by: DAB — Date: 8-77/9-79



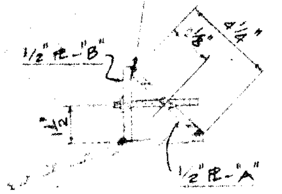
(1) REQ'D. M-, 455 - 4

CML — OUTLET ONLY

CTx C ~ CTxL

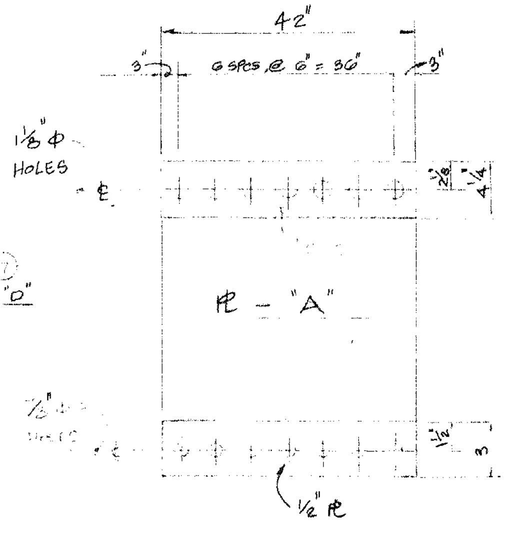


SECTION 'A - A'

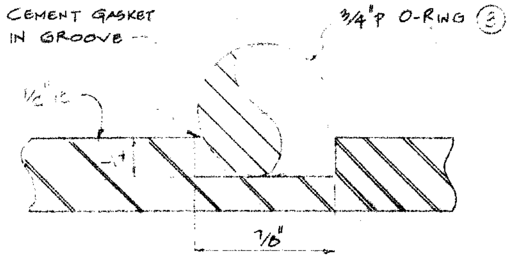


DETAIL - "B"

TYPICAL 4 PLCS.

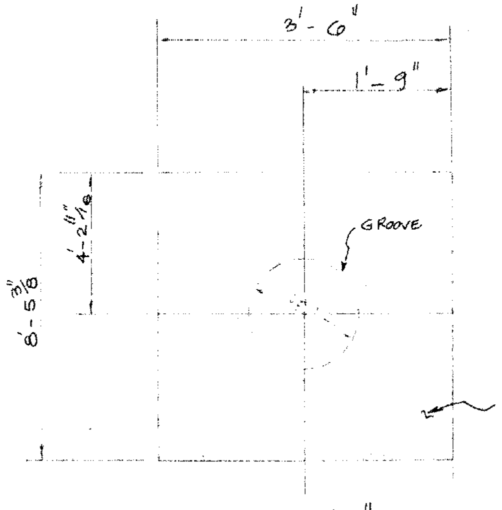


PL ~ 'B'

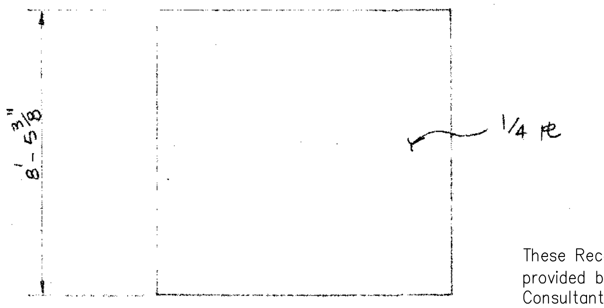


GROOVE DIMENSIONS - DETAIL

GROOVE I.D. = 28"



PL - "C"



PL - "D"

Record Drawing

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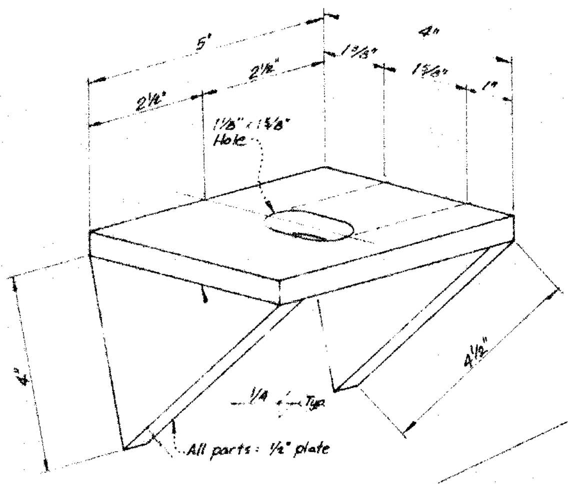
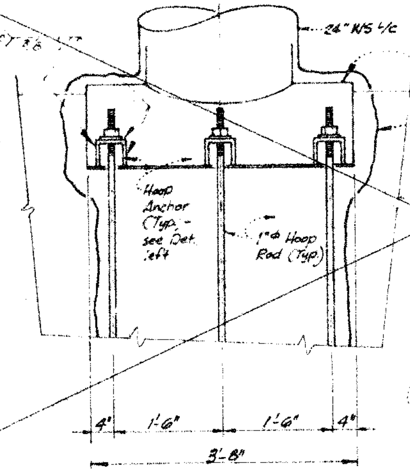
(REVISED SET JUNE 2006)



ANCHOR DETAIL

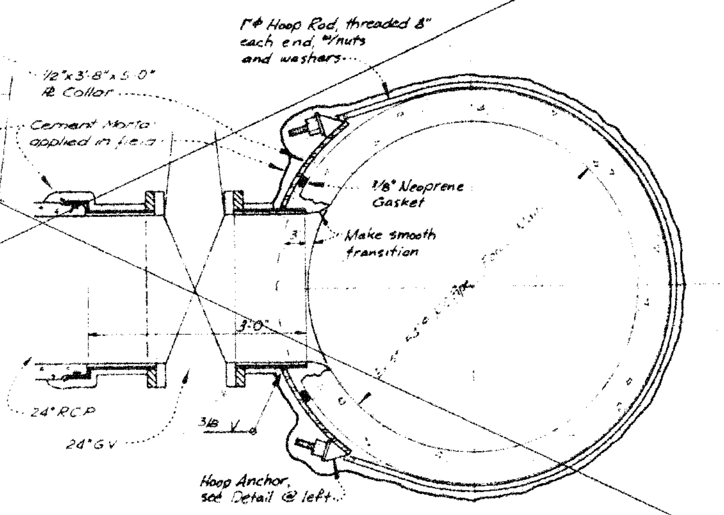
No Scale



PART

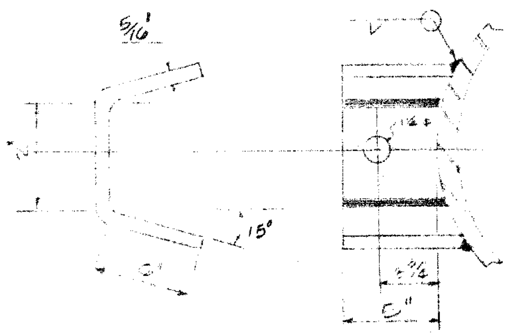
ELEVATION

Scale: ¾" = 1'-0"



SECTION C-C

Scale: ¾" x 1'-0"



24" HARNESS LUG DETAIL

137B
OF
141

△ RECORD DRAWING, JUNE 1982

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	BELMONT PUMP STATION BELMONT FORCE MAIN CONNECTION PLANS, SECTIONS AND DETAILS
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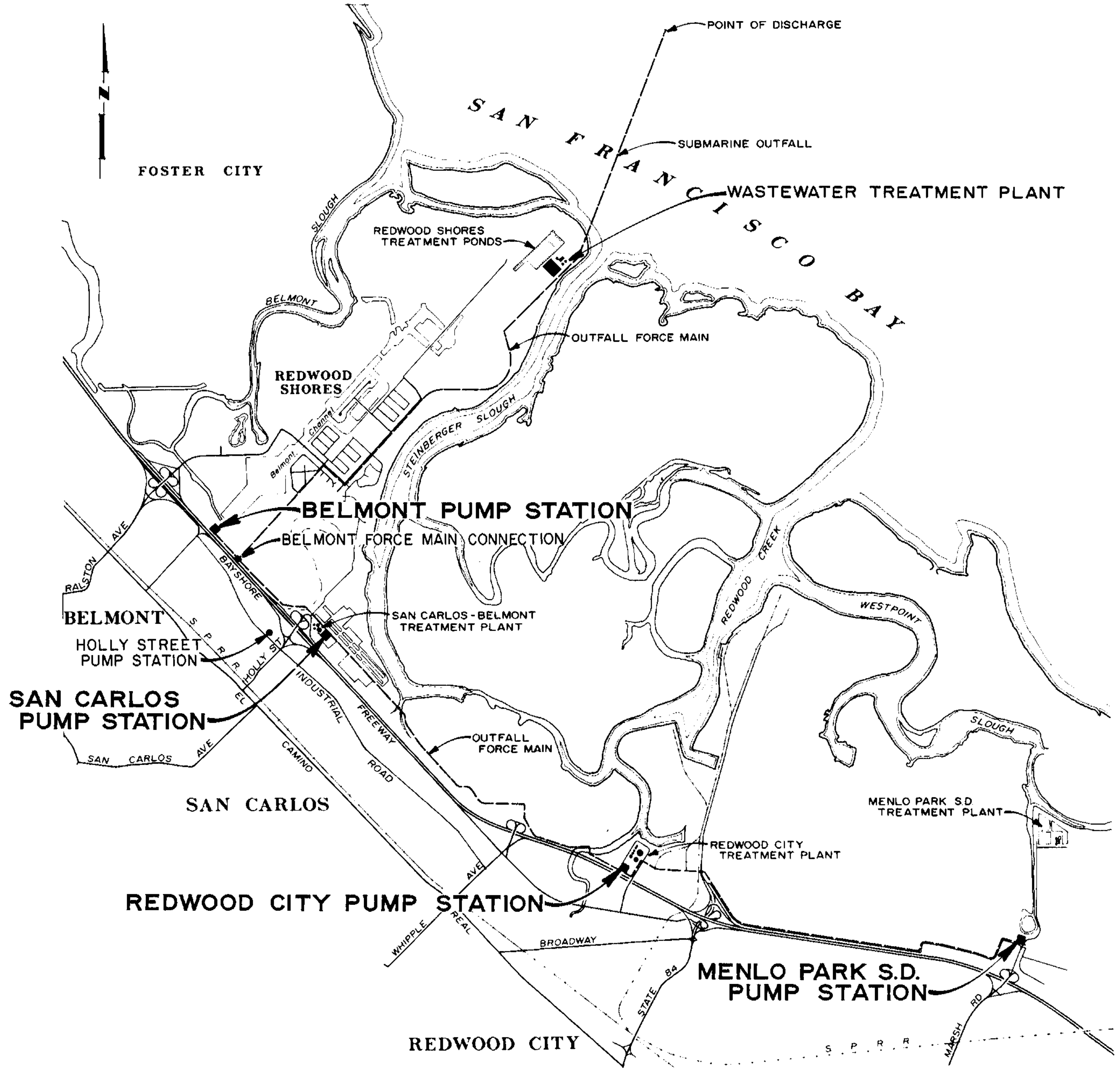
APPROVED MENLO PARK S.D. DATE	Drawn by: CVB — Scale: AS NOTED Des/Chkd by: DAB — Date: 8-77/9-79



PROJECT LOCATION MAP

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

PLANS
FOR THE CONSTRUCTION OF
UNIT NO. 3
PUMP STATIONS

SOUTH BAYSIDE SYSTEM AUTHORITY
CHARLES R. ALLEN, SECRETARY

PARTICIPATING AGENCIES
CITY OF REDWOOD CITY
CITY OF SAN CARLOS CITY OF BELMONT
MENLO PARK SANITARY DISTRICT

KENNEDY / JENKS ENGINEERS
PALO ALTO, CALIFORNIA

FORMERLY
JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS
PALO ALTO, CALIFORNIA

1980

(REVISED SET JUNE 2006)

DATUM

ALL ELEVATIONS SHOWN ARE BASED ON THE DATUM OF U.S. COAST AND GEODETIC SURVEY MEAN SEA LEVEL PLUS ONE HUNDRED FEET.
ELEVATION 100.00 PUMP STATION DATUM EQUALS ELEVATION 0.00 MEAN SEA LEVEL DATUM.

Record Drawing

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INDEX TO PLANS SUMMARY

(COMPLETE INDEX TO PLANS LISTED ON SHEET 2)

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49 THRU 61	REDWOOD CITY PUMP STATION
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△2 5B	MENLO PARK S.D. PUMP STATION MISCELLANEOUS DETAILS
5C	MENLO PARK S.D. PUMP STATION METER PIT NO. 1 AND VALVE BOX NO. 2 DETAILS
8A	MENLO PARK S.D. PUMP STATION PIPEWORK & EQUIPMENT, INTERMEDIATE FLOOR PLAN, TOP PLAN
8B	MENLO PARK S.D. PUMP STATION PIPEWORK & EQUIPMENT VALVE BOX NO. 1
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1 OF 141

△1 *RECORD DRAWING JUNE 1982*

REV. NO.	DATE	PROJECT NAME
△2	NOV 2007	WEST BAY SANITARY DISTRICT FLOW EQUALIZATION PROJECT 1990, K/J 895229.00
△3	AUG 1999	BOORSTER STATION OVERFLOW PROJECT 1999, K/J 985061.20

SUBMITTED
John H. Jenks
JENKS & HARRISON DATE

APPROVED
Frank J. Allings
REDWOOD CITY DATE

APPROVED
SAN CARLOS DATE

APPROVED
James P. DeChaine
BELMONT DATE

APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

PROJECT LOCATION MAP
AND
INDEX TO PLANS SUMMARY

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: SLH
Scale: AS NOTED
Des/Chkd by: JHJ
Date: 8-77 / 9-79

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SH. NO.	TITLE
1.	PROJECT LOCATION MAP AND INDEX TO PLANS SUMMARY
2.	INDEX TO PLANS
3.	WASTEWATER TRANSPORT SYSTEM - SCHEMATIC HYDRAULIC PROFILE

MENLO PARK S.D. PUMP STATION

SH. NO.	TITLE
4.	SITE PLAN
5.	PLANT LAYOUT
6.	PIPEWORK & EQUIPMENT - ROOF PLAN AND DETAILS
7.	———— - GROUND FLOOR PLAN
8.	———— - INTERMEDIATE FLOOR PLAN
9.	———— - PUMP ROOM PLAN
10.	———— - SECTION A-A
11.	———— - SECTION B-B AND C-C
12.	———— - SYSTEM SCHEMATICS
13.	———— - MONORAIL AND MISC. DETAILS
14.	———— - MISCELLANEOUS DETAILS
15.	STRUCTURAL - PUMP ROOM & WET WELL PLANS
16.	———— - INTERMEDIATE FLOOR PLAN & DETAILS
17.	———— - GROUND FLOOR PLAN
18.	———— - SECTION A-A
19.	———— - SECTION B-B AND C-C
20.	———— - SECTION D-D AND E-E
21.	———— - SECTION F-F
22.	———— - SECTION G-G
23.	———— - SECTION H-H THRU L-L
24.	———— - MOTOR ROOM BEAM DETAILS
25.	———— - GROUND FLOOR BEAM DETAILS
26.	———— - TYPICAL REINFORCING STEEL DETAILS
27.	SUPERSTRUCTURE - SECTIONAL PLANS AND SECTIONS
28.	———— - ROOF PLAN AND DETAILS
29.	———— - EXTERIOR ELEVATIONS & DETAILS
30.	———— - EXTERIOR WALL DETAILS
31.	———— - ROOF BEAM DETAILS
32.	DIESEL FUEL SYSTEM - PLANS, SECTIONS AND DETAILS
33.	SEWERS AND FORCE MAIN - PLAN AND PROFILES
34.	FLOWMETER PIT - PLANS AND SECTIONS
35.	JUNCTION BOX - PLANS AND SECTIONS
36.	MANHOLE DETAILS AND TRENCH SECTIONS
37.	GRADING AND PAVING - PLAN AND SECTIONS
38.	LANDSCAPING - PLANTING & IRRIGATION PLANS
39.	LOG OF BORINGS - KEY MAP AND SAMPLE DATA
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E-5 44.	———— - BUILDING SECTION
E-6 45.	———— - SINGLE LINE DIAGRAM
E-7 46.	———— - TELEMETRY SYSTEM DIAGRAMS
E-8 47.	———— - SCHEDULES AND AUXILIARY PANEL
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△1 35A.	———— - *JUNCTION BOX MODIFICATIONS*

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53.	———— - MISCELLANEOUS DETAILS
54.	STRUCTURAL - HYPOCHLORITE STORAGE FACILITIES
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E-14 61.	———— - DETAILS AND DIAGRAMS
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SH. NO.	TITLE
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63.	PLANT LAYOUT
64.	PIPEWORK & EQUIPMENT - ROOF PLAN AND DETAILS
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70.	———— - SECTION D-D
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76.	STRUCTURAL - PUMP ROOM & WET WELL PLANS
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87.	———— - SECTION M-M, N-N AND P-P
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89.	———— - BARMINUTOR CHANNEL DETAILS
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92.	———— - MOTOR ROOM BEAM DETAILS
93.	———— - PILASTER AND BEAM DETAILS
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95.	———— - TYPICAL REINFORCING STEEL DETAILS
96.	SUPERSTRUCTURE - SECTIONAL PLANS AND SECTIONS
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BELMONT PUMP STATION

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124.	PLANT LAYOUTS
125.	EXISTING CONDITION - PLANS AND SECTIONS
126.	PIPEWORK & EQUIPMENT - PLANS AND DETAILS
127.	———— - SECTIONS AND DETAILS
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130.	STRUCTURAL - INTERMEDIATE FLOOR PLAN & DETAILS
131.	———— - GROUND FLOOR PLAN & DETAILS
132.	SUPERSTRUCTURE - PLANS AND DETAILS
133.	———— - EXTERIOR ELEVATIONS & DETAILS
134.	———— - EXTERIOR WALL DETAILS
135.	———— - ROOF BEAM DETAILS
136.	FLOWMETER PIT - PLANS, SECTIONS AND DETAILS
137.	BELMONT FORCE MAIN CONNECTION - PLANS, SECTIONS AND DETAILS
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E-29 140.	———— - TELEMETRY - METER PIT PLAN
E-30 141.	———— - WIRING DIAGRAMS
△1 137A.	———— - *FORCE MAIN CONNECTION & CATHODIC PROTECTION*
△1 137B.	———— - *FORCE MAIN CONNECTION DETAILS*

(REVISED SET JUNE 2006)

Record Drawing

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2
OF
141

△1 *RECORD DRAWING, JUNE 1982*

REV. NO.	DATE	PROJECT NAME
△2	NOV 2007	WEST BAY SANITARY DISTRICT FLOW EQUALIZATION PROJECT 1990, K/J 895229.00

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

INDEX TO PLANS

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: SLH	Scale: NONE
Des/Chkd by: DAB	Date: 8-77/9-79

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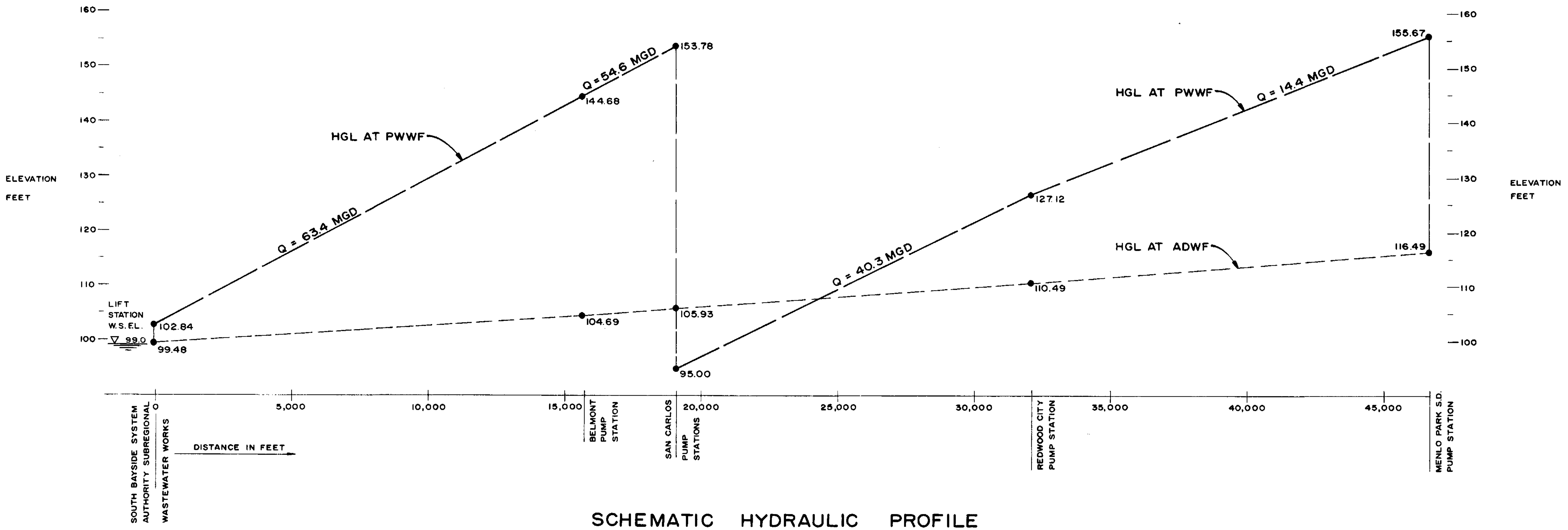

SCHEMATIC HYDRAULIC PROFILE

(REVISED SET JUNE 2006)

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Record Drawing

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3 OF 141

REV. NO.	DATE	PROJECT NAME
2	NOV 2007	WEST BAY SANITARY DISTRICT FLOW EQUALIZATION PROJECT 1990, K/J 895229.00

1 RECORD DRAWING , JUNE 1982

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

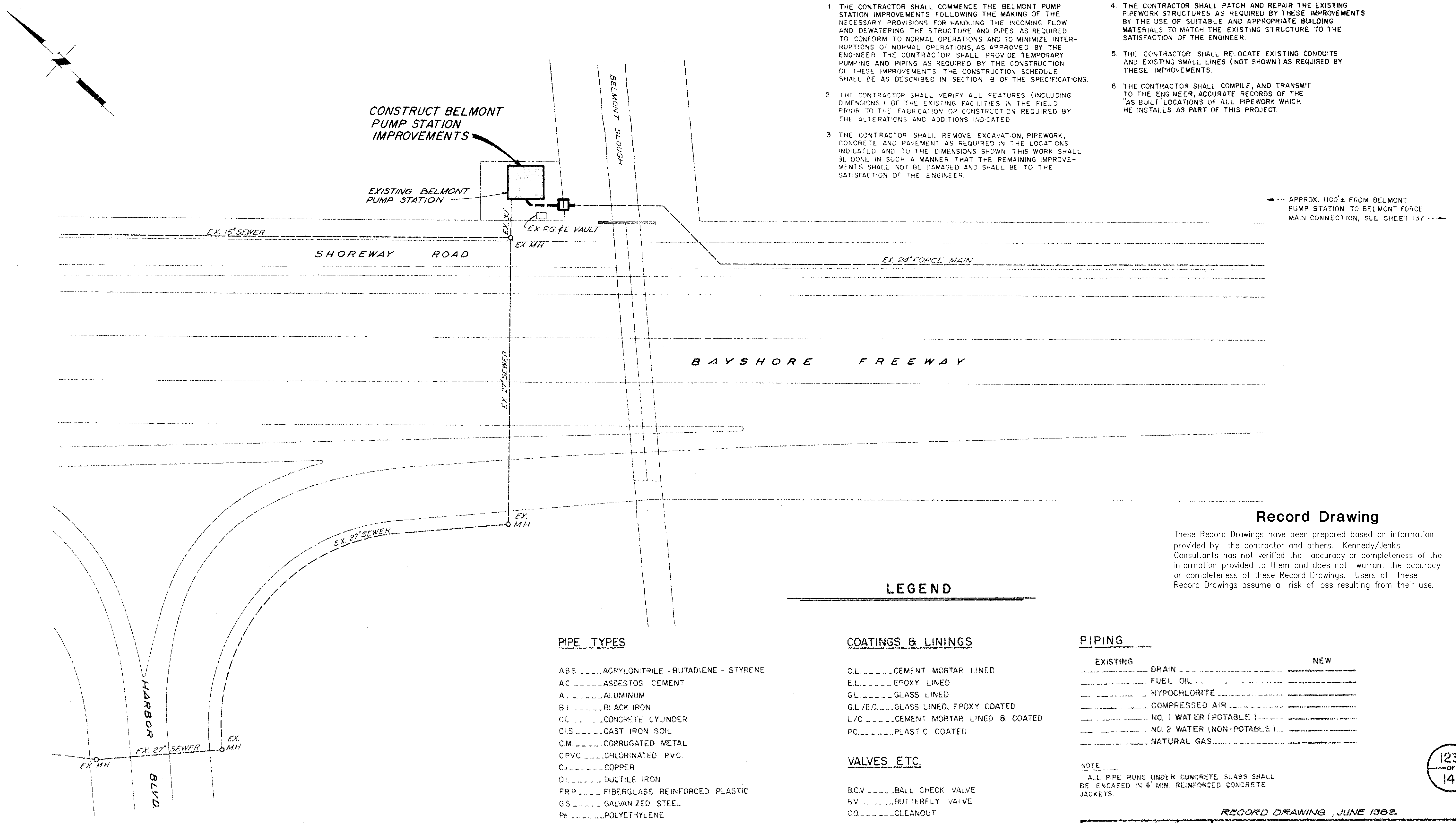
SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

WASTEWATER TRANSPORT SYSTEM
SCHEMATIC HYDRAULIC PROFILE

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by:	SLH	Scale:	NONE
Des/Chkd by:	BMW	Date:	8-77/9-79



CONSTRUCTION NOTES

1. THE CONTRACTOR SHALL COMMENCE THE BELMONT PUMP STATION IMPROVEMENTS FOLLOWING THE MAKING OF THE NECESSARY PROVISIONS FOR HANDLING THE INCOMING FLOW AND DEWATERING THE STRUCTURE AND PIPES AS REQUIRED TO CONFORM TO NORMAL OPERATIONS AND TO MINIMIZE INTERRUPTIONS OF NORMAL OPERATIONS, AS APPROVED BY THE ENGINEER. THE CONTRACTOR SHALL PROVIDE TEMPORARY PUMPING AND PIPING AS REQUIRED BY THE CONSTRUCTION OF THESE IMPROVEMENTS. THE CONSTRUCTION SCHEDULE SHALL BE AS DESCRIBED IN SECTION B OF THE SPECIFICATIONS.
2. THE CONTRACTOR SHALL VERIFY ALL FEATURES (INCLUDING DIMENSIONS) OF THE EXISTING FACILITIES IN THE FIELD PRIOR TO THE FABRICATION OR CONSTRUCTION REQUIRED BY THE ALTERATIONS AND ADDITIONS INDICATED.
3. THE CONTRACTOR SHALL REMOVE EXCAVATION, PIPEWORK, CONCRETE AND PAVEMENT AS REQUIRED IN THE LOCATIONS INDICATED AND TO THE DIMENSIONS SHOWN. THIS WORK SHALL BE DONE IN SUCH A MANNER THAT THE REMAINING IMPROVEMENTS SHALL NOT BE DAMAGED AND SHALL BE TO THE SATISFACTION OF THE ENGINEER.
4. THE CONTRACTOR SHALL PATCH AND REPAIR THE EXISTING PIPEWORK STRUCTURES AS REQUIRED BY THESE IMPROVEMENTS BY THE USE OF SUITABLE AND APPROPRIATE BUILDING MATERIALS TO MATCH THE EXISTING STRUCTURE TO THE SATISFACTION OF THE ENGINEER.
5. THE CONTRACTOR SHALL RELOCATE EXISTING CONDUITS AND EXISTING SMALL LINES (NOT SHOWN) AS REQUIRED BY THESE IMPROVEMENTS.
6. THE CONTRACTOR SHALL COMPILE, AND TRANSMIT TO THE ENGINEER, ACCURATE RECORDS OF THE "AS BUILT" LOCATIONS OF ALL PIPEWORK WHICH HE INSTALLS A3 PART OF THIS PROJECT.

Record Drawing

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LEGEND

PIPE TYPES

A.B.S.	ACRYLONITRILE - BUTADIENE - STYRENE
A.C.	ASBESTOS CEMENT
Al.	ALUMINUM
B.I.	BLACK IRON
C.C.	CONCRETE CYLINDER
C.I.S.	CAST IRON SOIL
C.M.	CORRUGATED METAL
C.P.V.C.	CHLORINATED P.V.C.
Cu	COPPER
D.I.	DUCTILE IRON
F.R.P.	FIBERGLASS REINFORCED PLASTIC
G.S.	GALVANIZED STEEL
Pe	POLYETHYLENE
P.V.C.	POLY VINYL CHLORIDE
R.C.	REINFORCED CONCRETE
R.C. T/G	REINFORCED CONCRETE, TONGUE & GROOVE JOINT
R.P.M.	REINFORCED PLASTIC MORTAR
V.C.	VITRIFIED CLAY
W.S.	WELDED STEEL

COATINGS & LININGS

C.L.	CEMENT MORTAR LINED
E.L.	EPOXY LINED
G.L.	GLASS LINED
G.L./E.C.	GLASS LINED, EPOXY COATED
L/C	CEMENT MORTAR LINED & COATED
P.C.	PLASTIC COATED

VALVES ETC.

B.C.V.	BALL CHECK VALVE
B.V.	BUTTERFLY VALVE
C.O.	CLEANOUT
C.V.	CHECK VALVE
F.D.	FLOOR DRAIN
G.C.	GROOVED COUPLING
G.V.	GATE VALVE
H.B.	HOSE BIBB
P.D.V.	PLUG DRAIN VALVE
P.V.	PLUG VALVE
S.G.	SLIDE (SLUICE) GATE

PIPING

EXISTING		NEW
— — — —	DRAIN	━ ━ ━ ━
— — - — —	FUEL OIL	━ ━ · ━ ━
— - - — - -	HYPOCHLORITE	━ · · ━ · ·
— · · · —	COMPRESSED AIR	━ · · · ━
— — —	NO. 1 WATER (POTABLE)	━ · ━ ·
— — —	NO. 2 WATER (NON-POTABLE)	━ ━ ━
— — —	NATURAL GAS	━ ━ ━

NOTE

ALL PIPE RUNS UNDER CONCRETE SLABS SHALL BE ENCASED IN 6" MIN. REINFORCED CONCRETE JACKETS.

123 OF 141

RECORD DRAWING, JUNE 1982.

SUBMITTED
James M. [illegible]
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

BELMONT PUMP STATION

SITE PLAN

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: SLH
Scale: 1" = 40'
Des/Chkd by: DAB
Date: 8-77/9-79

(REVISED SET JUNE 2006)

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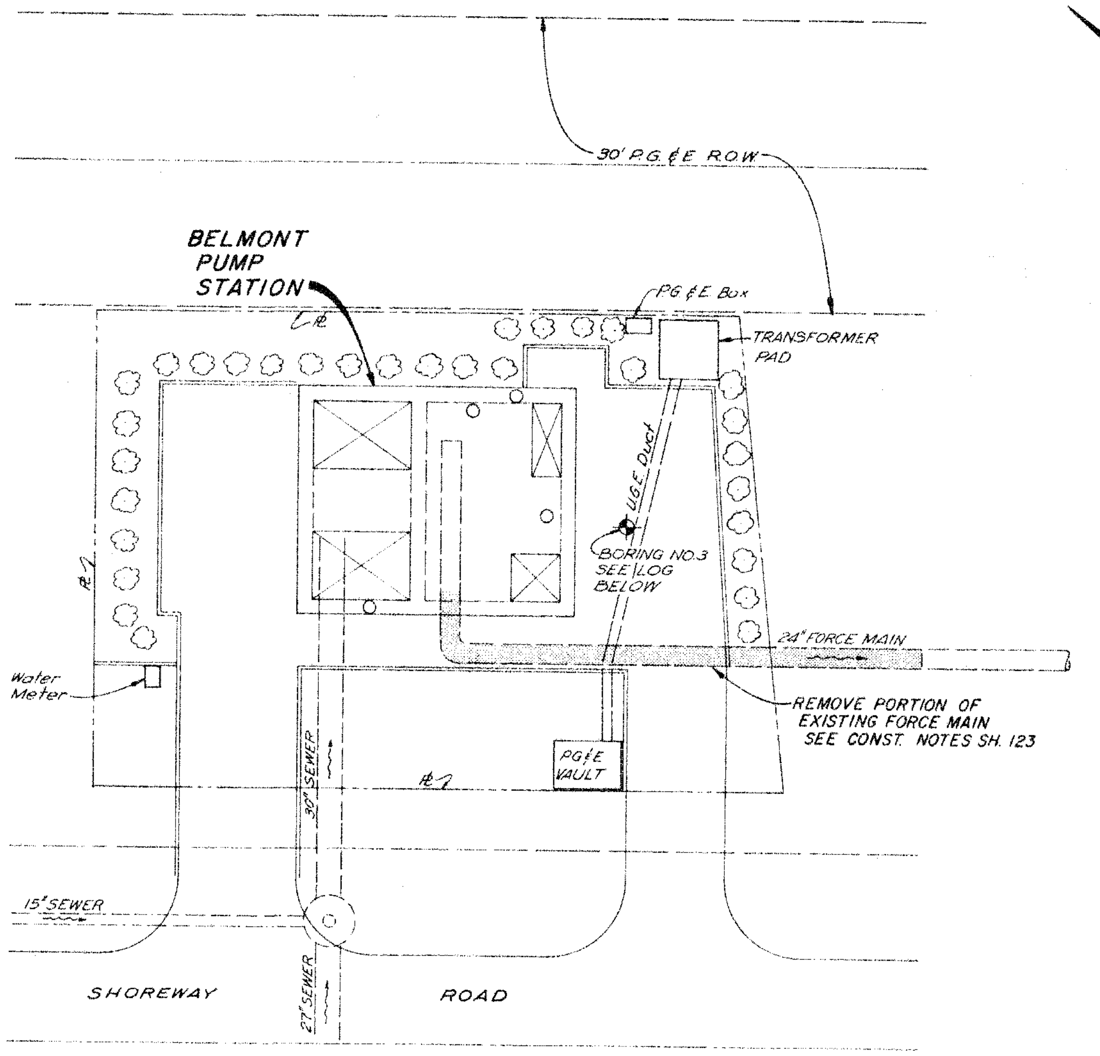
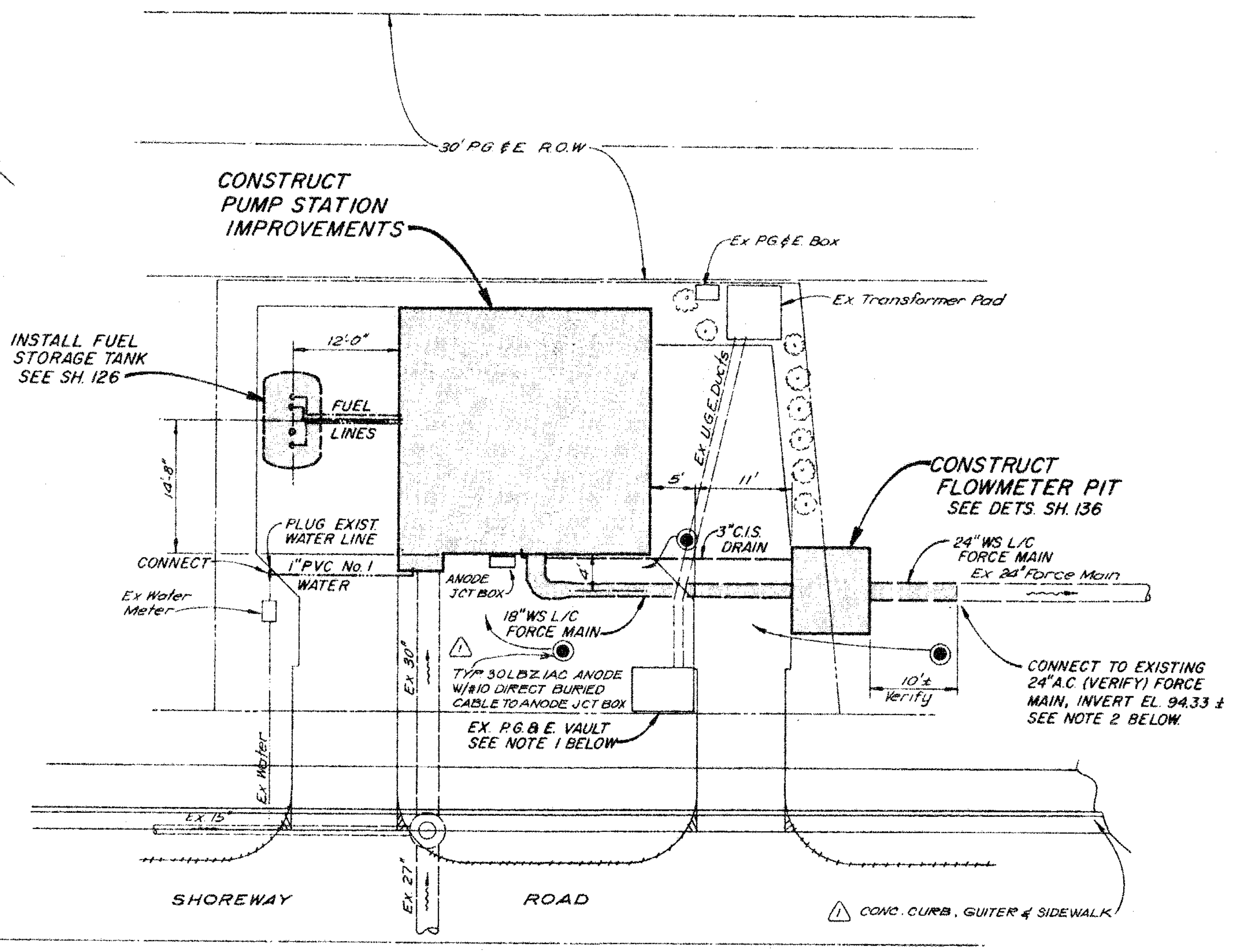


EXISTING CONDITION

PLANT LAYOUT



PLANT LAYOUT

(REVISED SET JUNE 2006)

Record Drawing

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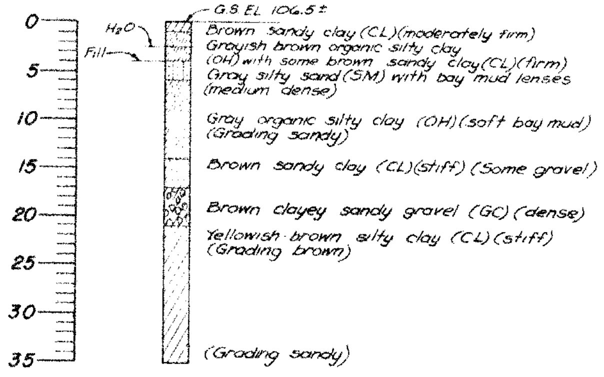
BORING LOG NO. 3 TAKEN 1/15/73



NOTES

1. THE CONTRACTOR SHALL PROTECT THE EXISTING P.G. & E. VAULT AND UNDERGROUND ELECTRICAL DUCT FROM ANY DAMAGE CAUSED BY THIS CONSTRUCTION AND/OR INSTALLATION OPERATION

2. THE LOCATION OF THIS CONNECTION HAS BEEN ESTIMATED FOR BIDDING PURPOSES. THE FINAL CONNECTION LOCATION SHALL BE ESTABLISHED IN THE FIELD TO UTILIZE STANDARD RUBBER GASKET JOINTS CONNECTING THE NEW FORCE MAIN TO THE EXISTING FORCE MAIN AT EXISTING JOINTS. THE CONTRACTOR SHALL UNCOVER AND EXPOSE THE EXISTING FORCE MAIN TO DETERMINE THE LOCATIONS, DIMENSIONS AND CONFIGURATIONS OF THE EXISTING FORCE MAIN JOINTS AS WELL AS TO VERIFY THE EXISTING FORCE MAIN PIPE TYPE. THE CONTRACTOR SHALL UTILIZE AN ADAPTOR COUPLING OR SPECIAL END JOINT ON THE NEW FORCE MAIN AT THE CONNECTION AND SHALL INCREASE THE LENGTH OF THE NEW FORCE MAIN AS REQUIRED TO CONFORM TO THIS CONNECTION JOINT.

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⚠ RECORD DRAWING , JUNE 1982

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

BELMONT PUMP STATION

PLANT LAYOUTS

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: MB SLH		Scale: 1" = 10'
Des./Chkd by: DAB		Date: 8-77/9-79

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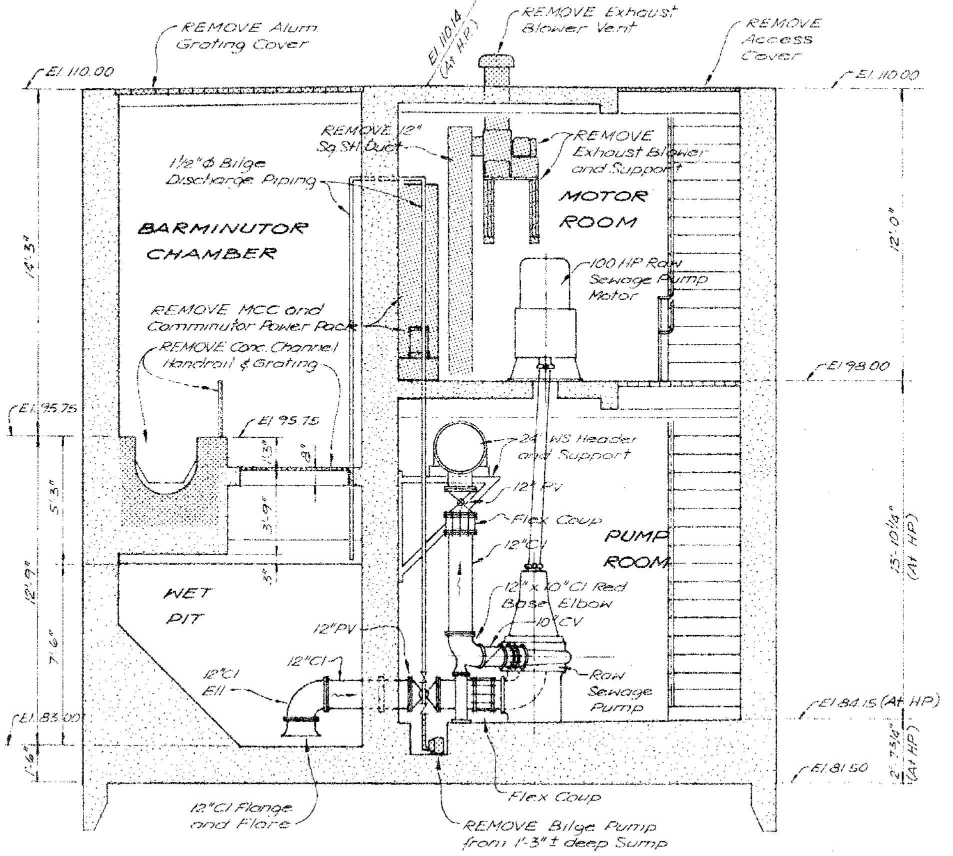

SECTION A-A

Record Drawing

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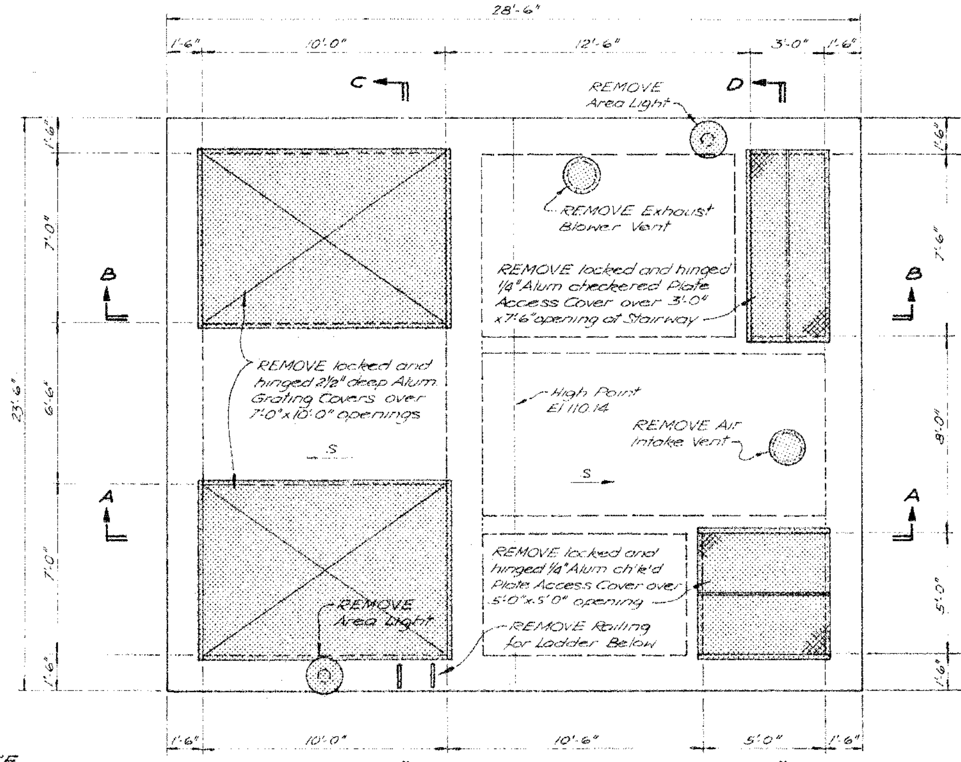
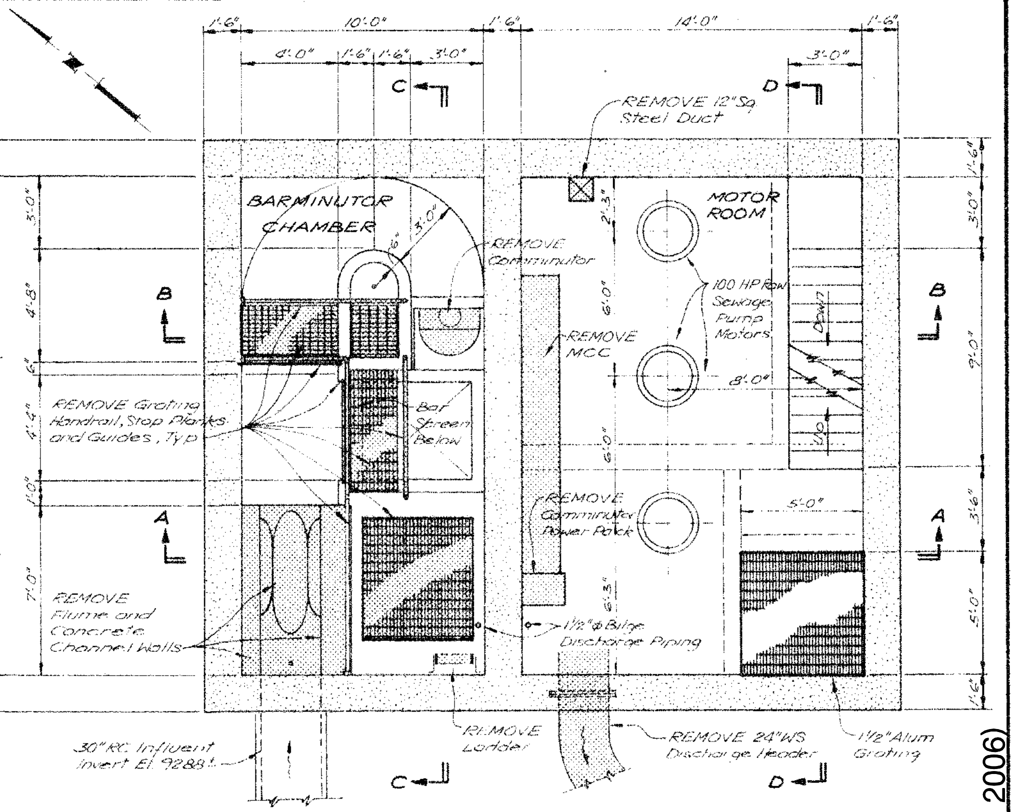


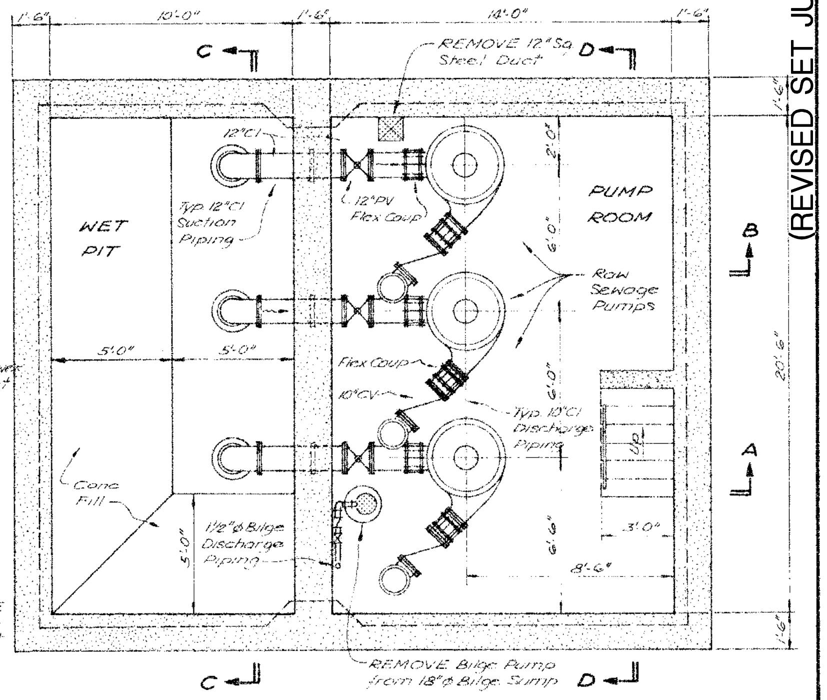
NOTE

The required Concrete removal for portions of the Ground Floor Slab is Not Shown on this Plan

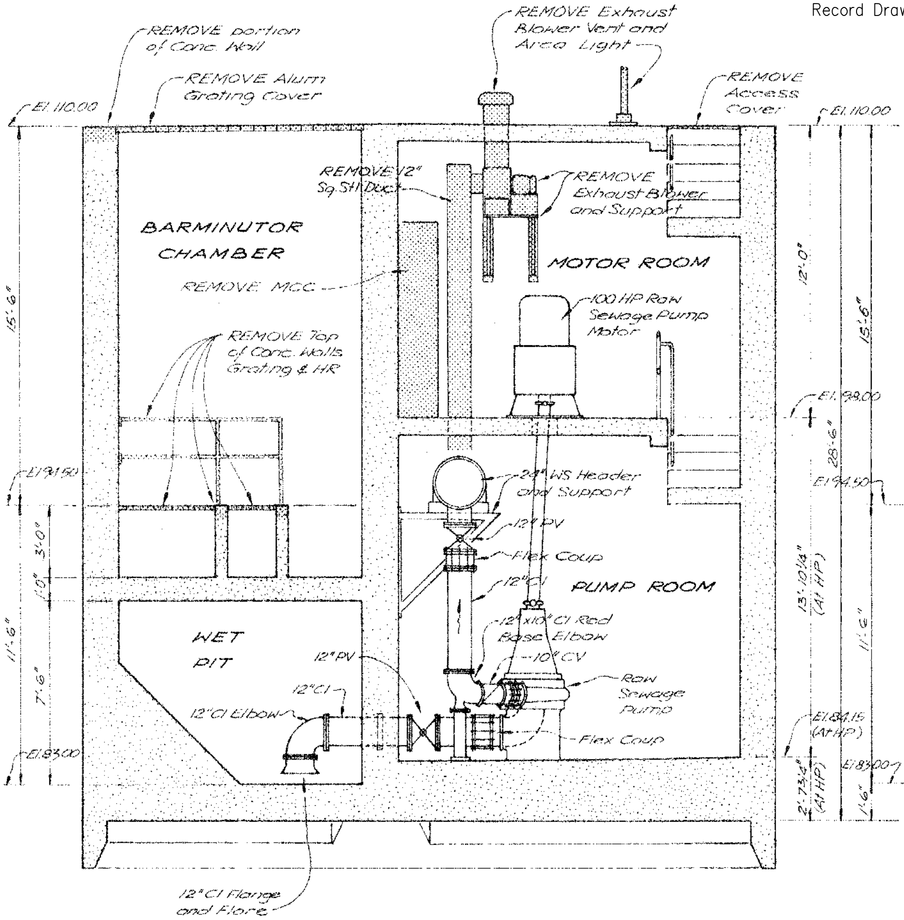
GROUND FLOOR PLAN



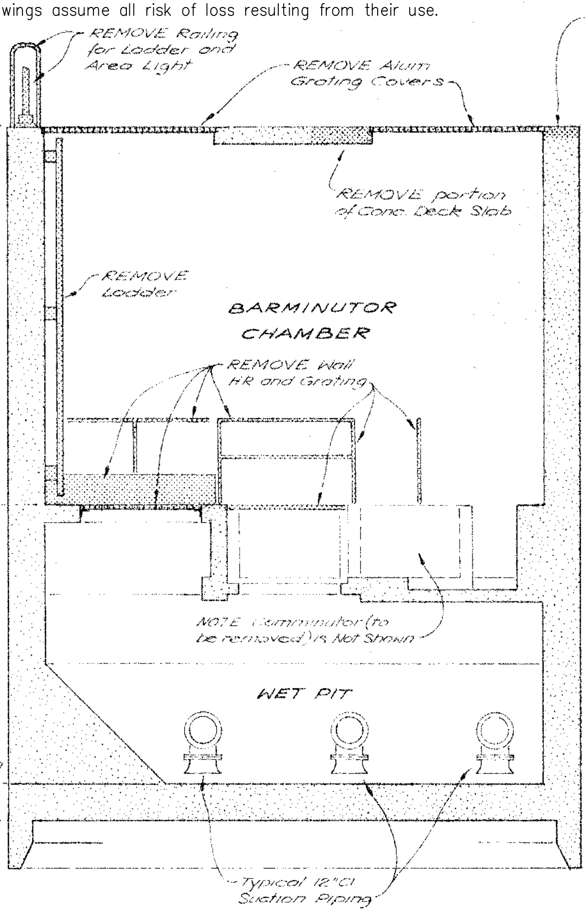
INTERMEDIATE FLOOR PLAN



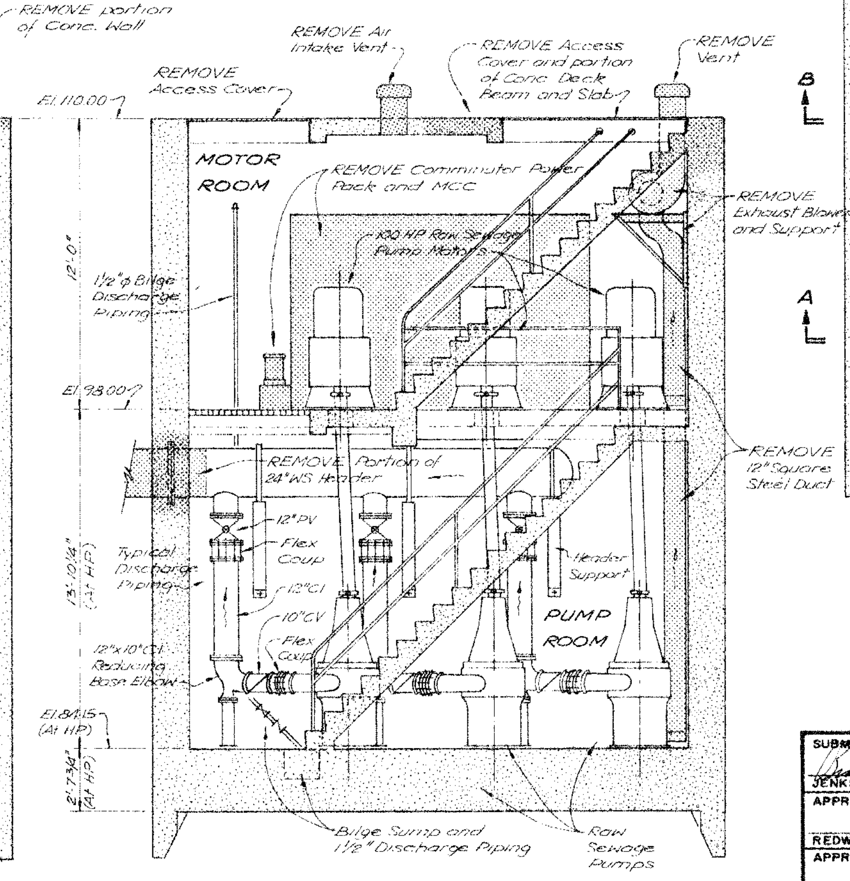
PUMP ROOM PLAN



SECTION B-B



SECTION C-C



SECTION D-D

NOTE

THE EXISTING BELMONT PUMP STATION PIPEWORK, EQUIPMENT AND STRUCTURAL COMPONENTS SHOWN THUS ▨ SHALL BE REMOVE AS A PART OF THIS PROJECT

RECORD DRAWING , JUNE 1982

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SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

BELMONT PUMP STATION
EXISTING CONDITION
PLANS AND SECTIONS

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by:	SLH CGS	Scale: 1/4"=1'-0"
Des/Chkd by:	DAB	Date: 8-77/9-79

Record Drawing

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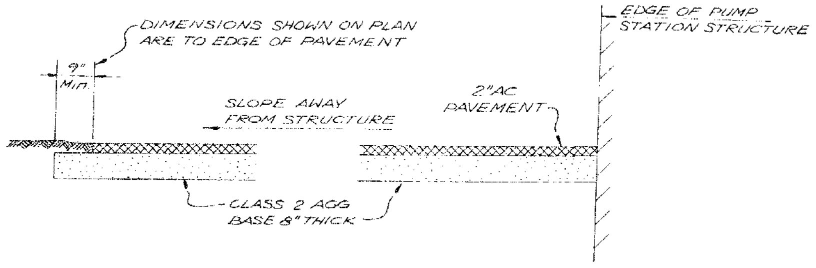
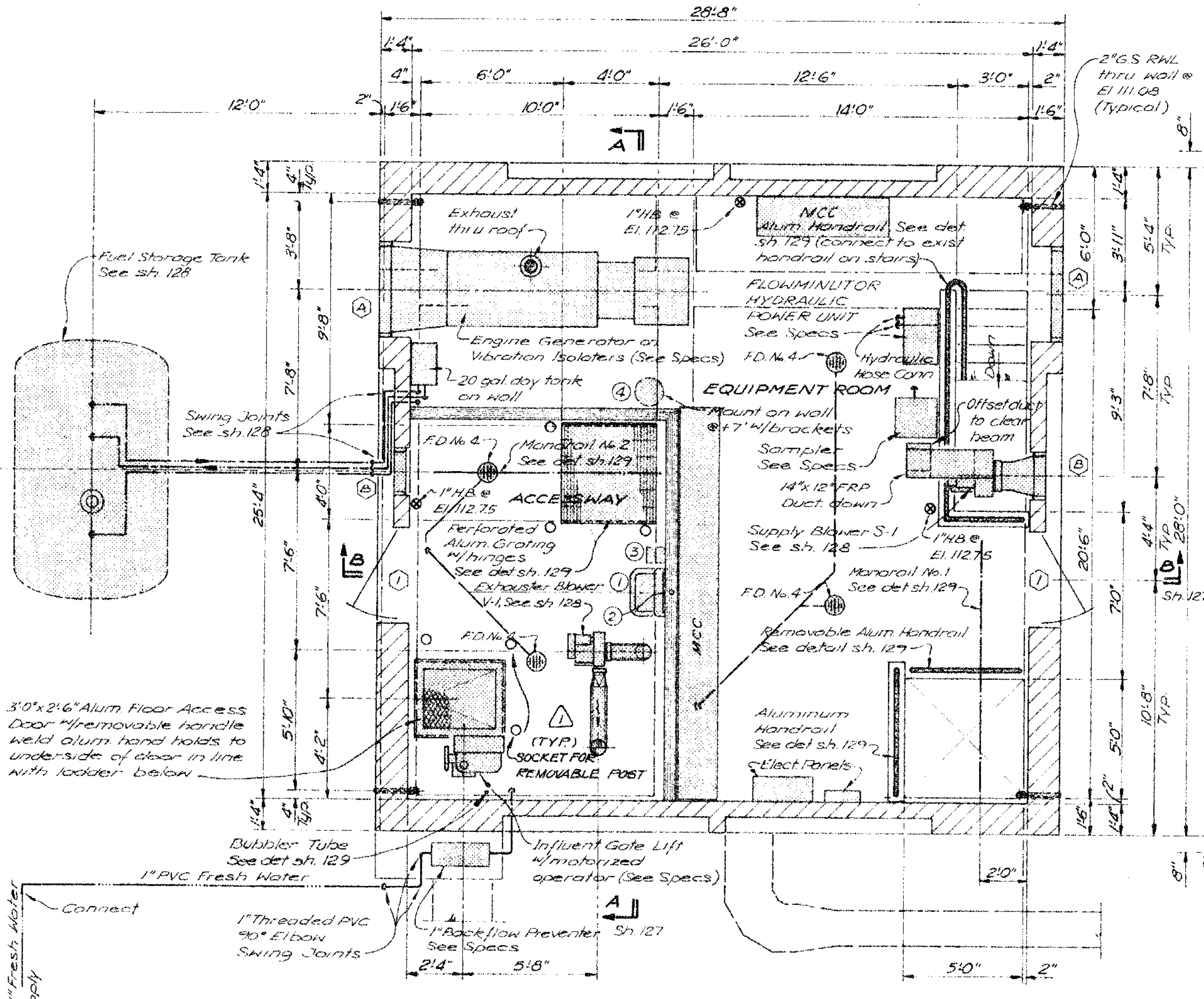
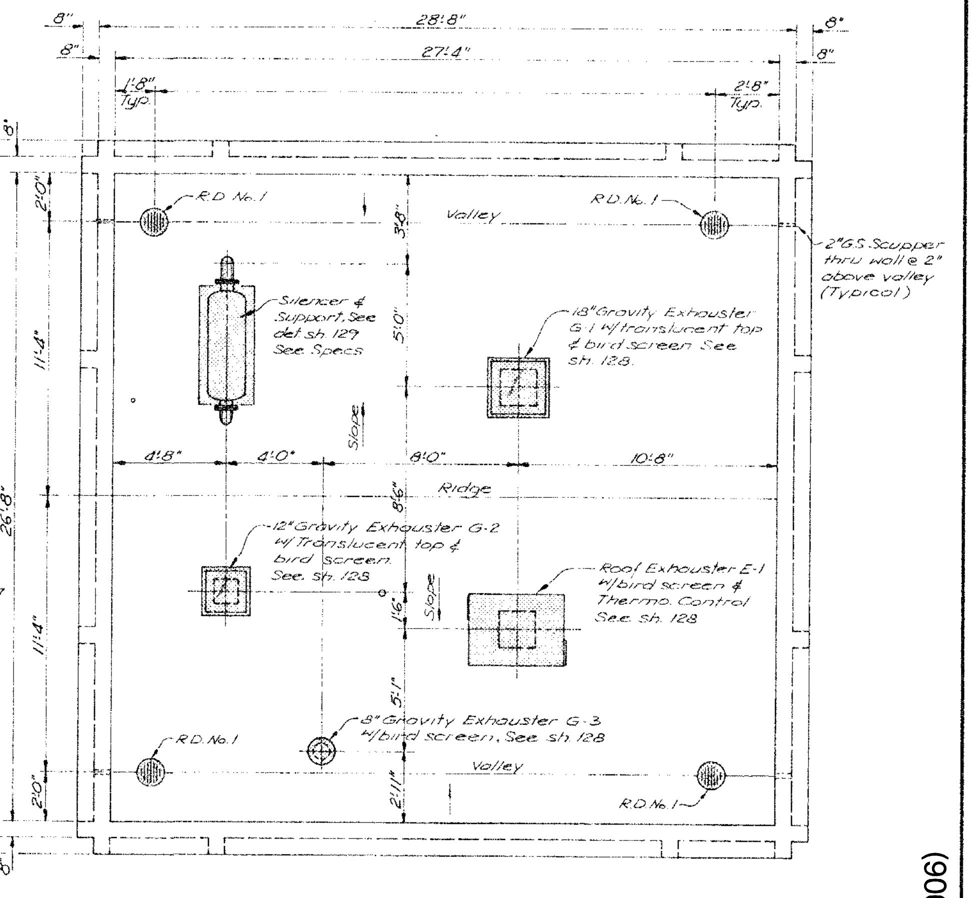


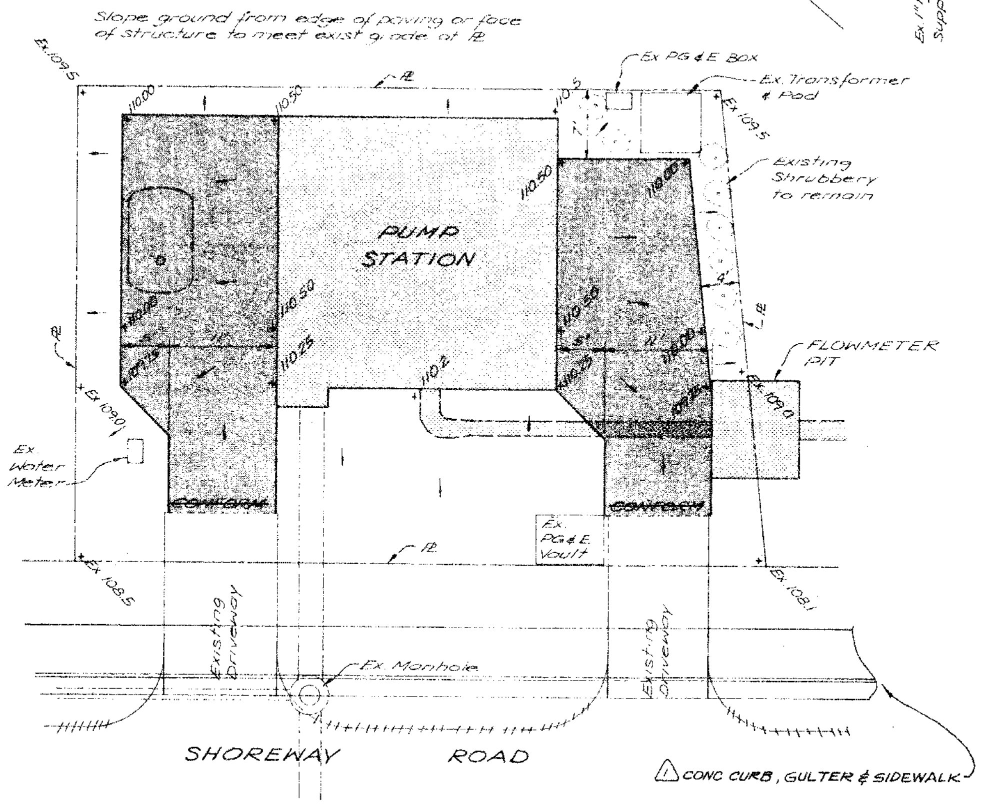
TYPICAL AREA PAVING
Scale: 1/2" = 1'-0"



GROUND FLOOR PLAN

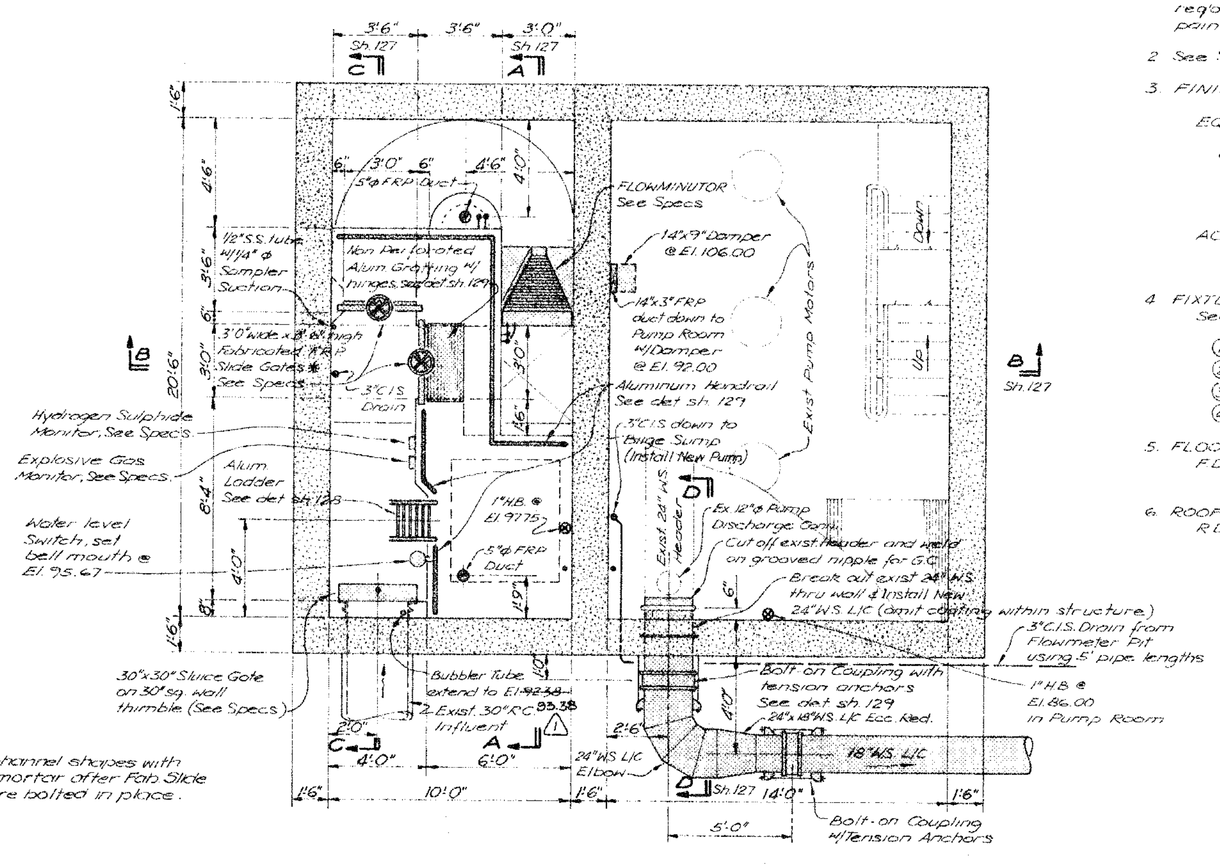


ROOF PLAN



GRADING AND PAVING PLAN
Scale: 1" = 10'

▨ Indicates area to be surfaced with 2" thickness of Asphaltic Concrete over 8" Compacted Aggregate Base to Elev. of finish grade as shown.



* Form channel shapes with epoxy mortar after Fab. Slide Gates are bolted in place.

INTERMEDIATE FLOOR PLAN

NOTES

1. Furred walls shall consist of metal studs @ 16"cc with req'd plates, etc & 1/2" sheetrock covering, taped & painted, see Sh. 132.
2. See Sh. 133 for Door & Louver Schedule.
3. FINISH SCHEDULE

   EQUIPMENT ROOM:

   Concrete Block & Plaster Walls & Concrete Ceiling:
   Two coats Latex Masonry Paint & Flat
   Concrete Floor
   Color Hardener

   ACCESSWAY

   Finishes same as Equip. Rm.

4. FIXTURE AND EQUIPMENT LIST
   See Specifications for description
   ① Lavatory
   ② Mirror (24"x 18")
   ③ Towel Dispenser
   ④ Water Heater
5. FLOOR DRAINS
   F.D. No. 4 = 3" C.I. Bottom Outlet body w/adjustable collar and 8"ϕ Min. anti-tilt D.I. Grate.
6. ROOF DRAINS
   R.D. No. 1 = 2" C.I. Bottom Outlet body with 124 sq. in C.I. Dome.

LEGEND

░	Items to be provided and installed and/or constructed as part of this project
▒	Existing reinforced concrete structure

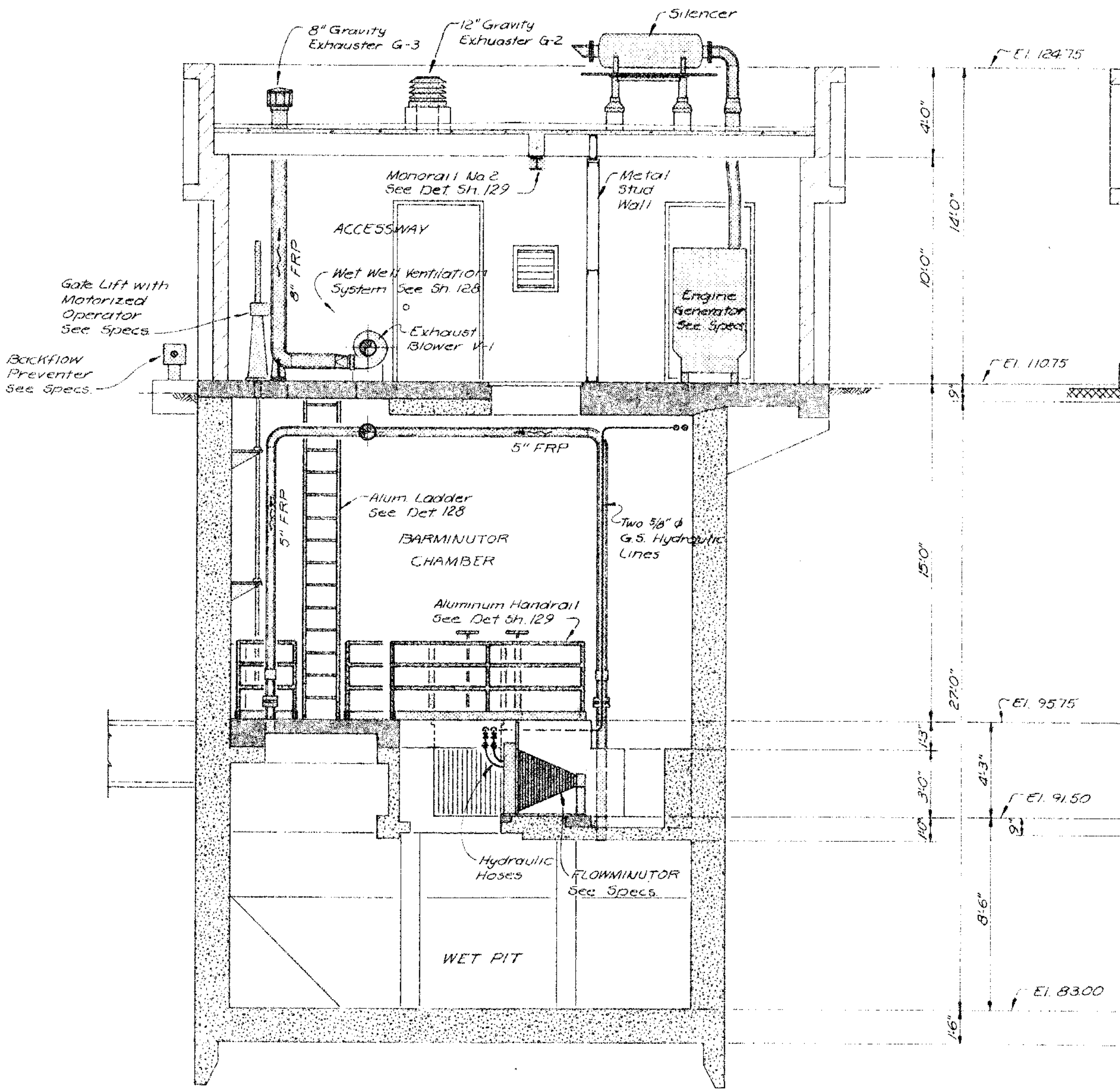
(REVISED SET JUNE 2006)

126 OF 141

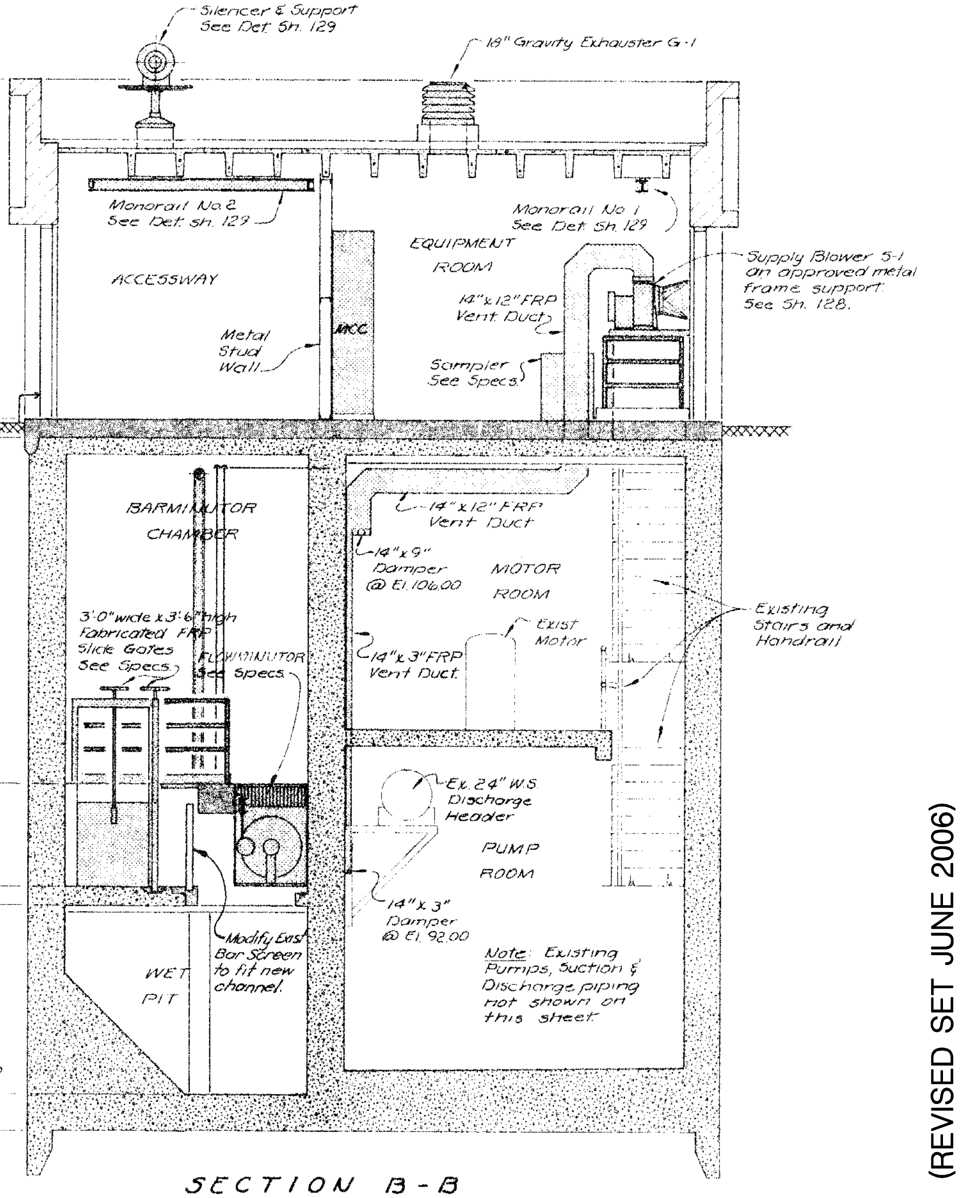
⚠1 RECORD DRAWING , JUNE 1982

SUBMITTED JENKS & HARRISON DATE	SOUTH BAYSIDE SYSTEM AUTHORITY SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	BELMONT PUMP STATION PIPEWORK AND EQUIPMENT PLANS AND DETAILS
APPROVED BELMONT DATE	JENKS & HARRISON CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: LLK CGS — Scale: 1/4" = 1'-0" Des/Chkd by: DAB — Date: 8-77 / 9-79

O:\CLIENTS.LIB\Sbsa.lib\SBSA_RecordDrawings\SBSAPumpStationsUnitNo3\ps126.dwg 6-16-10 08:18:17 AM pooguest



SECTION A-A



SECTION B-B

(REVISED SET JUNE 2006)

Record Drawing

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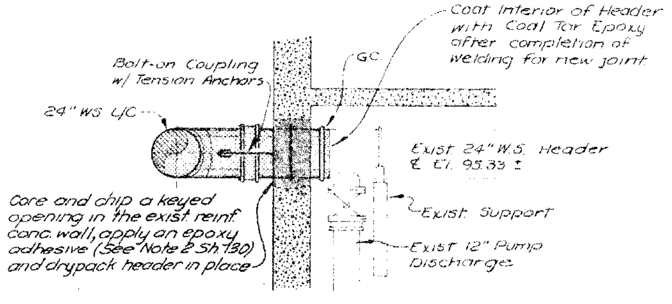
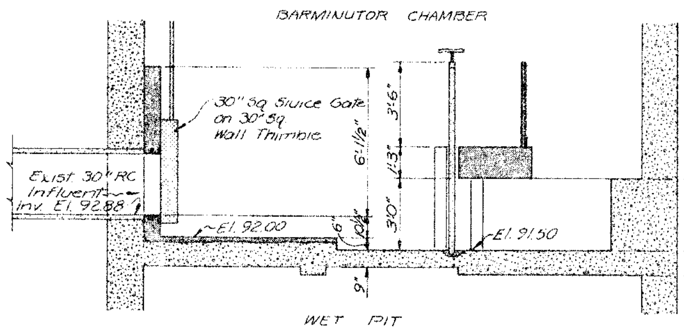


SECTION D-D



SECTION C-C

127 OF 141

LEGEND

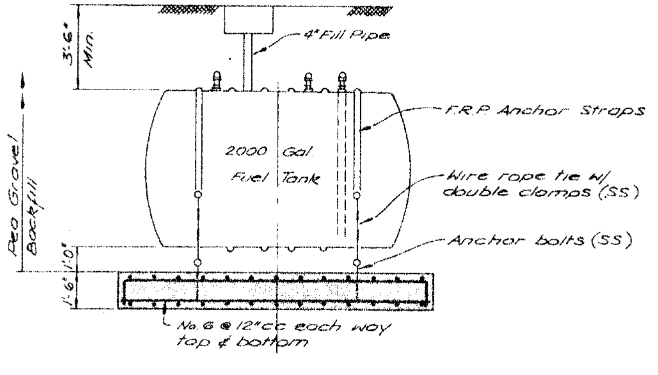
☐ Items to be provided and installed and/or constructed as part of this project.

▨ Concrete to be constructed as part of this project.

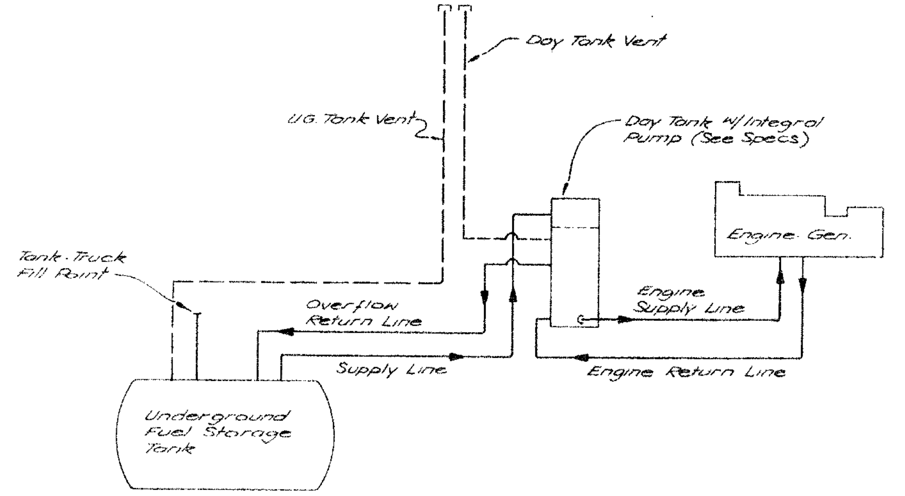
░ Existing reinforced concrete structure.

RECORD DRAWING, JUNE 1982

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	BELMONT PUMP STATION PIPEWORK AND EQUIPMENT SECTIONS AND DETAILS
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: LLK EB Scale: 1/4" = 1'-0" Des/Chkd by: DAB Date: 8-77 / 9-79



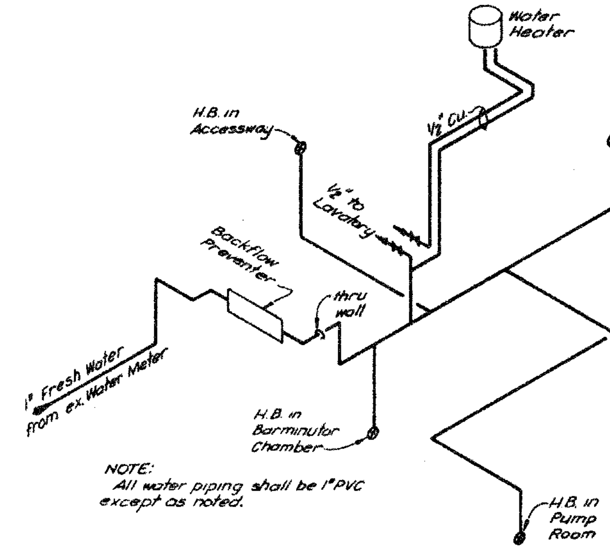
SECTION A-A



DIESEL FUEL SYSTEM

SCHEMATIC DIAGRAM

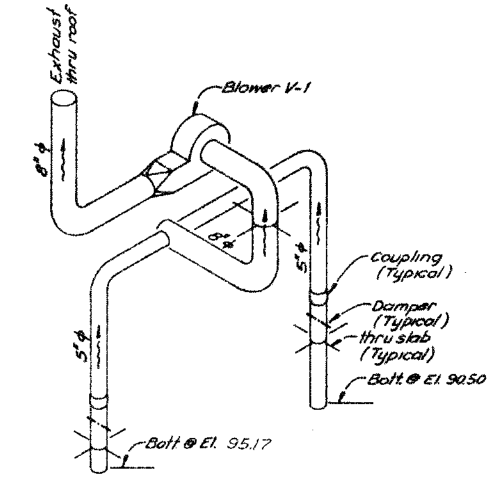
No Scale



NOTE:
All water piping shall be 1" PVC except as noted.

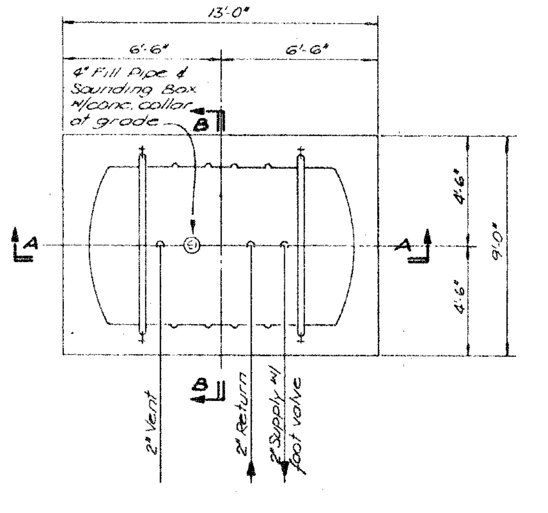
WATER SUPPLY SYSTEM DIAGRAM

No Scale

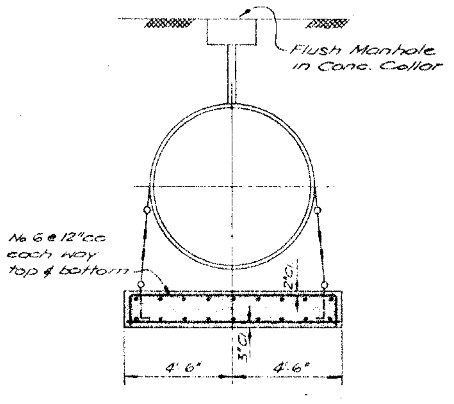


WET WELL VENTILATION SYSTEM

No Scale



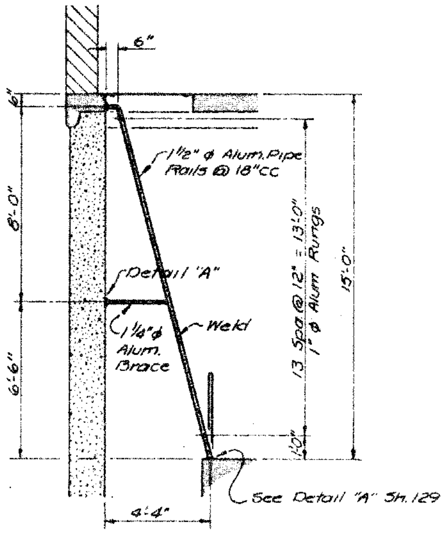
PLAN



SECTION B-B

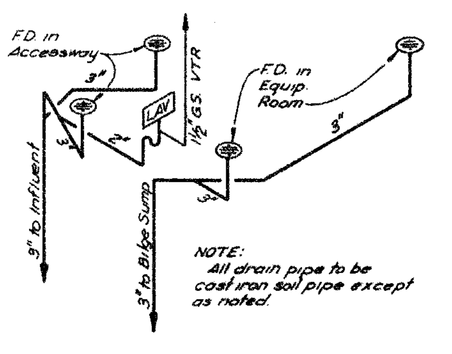
DIESEL FUEL STORAGE TANK

Scale: 1/4" = 1'-0"



PIPE LADDER DETAIL

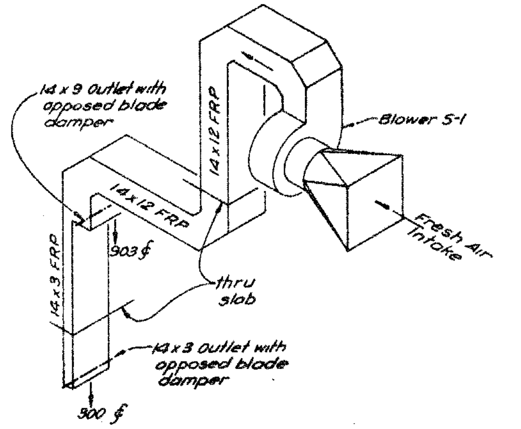
Scale 1/4" = 1'-0"



NOTE:
All drain pipe to be cast iron soil pipe except as noted.

DRAINS & PLUMBING DIAGRAM

No Scale



PUMP ROOM AND MOTOR ROOM VENTILATION SYSTEM

No Scale

NOTES

1. All diesel fuel piping shall be either Standard Schedule 40 Black Iron Pipe or Fiberglass Pipe as delineated on this drawing. Black Iron Pipe shall be used for diesel fuel inside of the Pump Station Structure and Fiberglass Pipe shall be used for diesel fuel in the ground all as detailed on this drawing. Where black iron pipe and fittings are installed under the ground; they shall be plastic coated. Uncoated Black Iron Pipe and Fittings shall not be exposed to the soil.

2. Install swing joints at all locations in the fuel piping system where horizontal pipe runs change to vertical pipe runs and where pipe runs enter the structure as detailed on this drawing.

3. Keep all fuel system lines to a minimum height at the Storage Tank to permit maximum slope to the Tank.

Record Drawing

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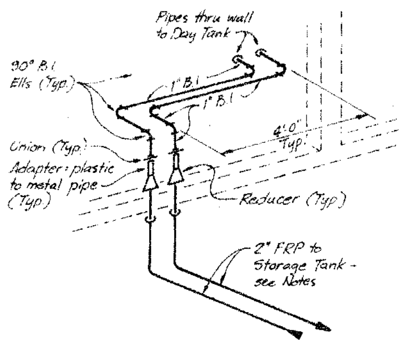
FAN SCHEDULE

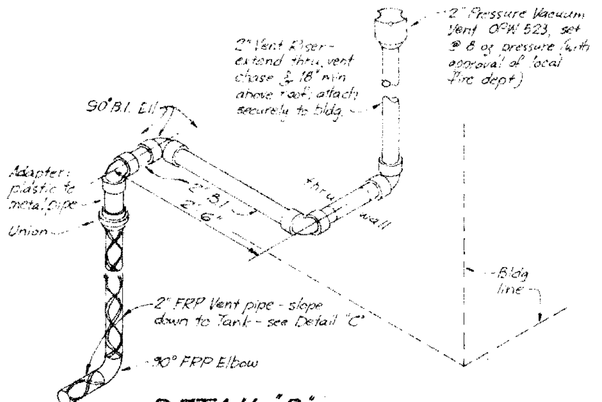
MARK	SERVICE	TYPE	SIZE	S.P.	CFM	H.P.	ø	VOLT	REMARKS
S-1	SUPPLY	NY/B UTILITY	128	1"	1203	1/2	1	120	
V-1	EXHAUST WET WELL	"	124	3"	459	1/2	1	120	EXPLOSION PROOF MOTOR-SEE SPECS
E-1	EXHAUST EQUIP. RM.	ROOF	L01805	1/8"	1950	1/2	1	120	THERMOSTAT CONTROLLED
G-1	GRAVITY	ROOF	SG-18	-	921	-	-	-	TRANSLUCENT TOP
G-2	"	"	SG-12	-	410	-	-	-	"
G-3	V-1 DISCH.	"	L-8	-	137	-	-	-	

NOTE : Gravity Exhausters G-1 thru G-3 shall be certified to perform as shown in cfm of wind induced ventilation assuming the following: Wind Velocity 8 mph, Height of Stack 15', Temp. Differential 10°.



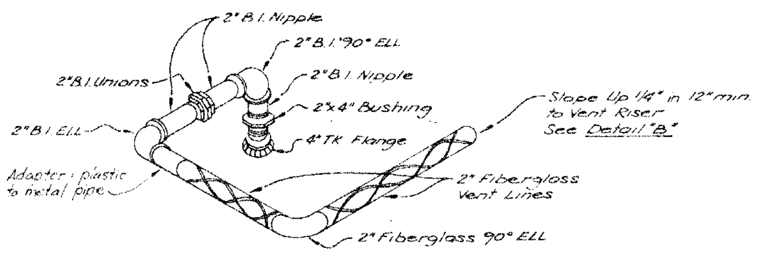
DETAIL "A"

SWING JOINT DIAGRAM



DETAIL "B"

VENT RISER ASSEMBLY



DETAIL "C"

VENT ASSEMBLY

RECORD DRAWING , JUNE 1982

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

BELMONT PUMP STATION
PIPEWORK & EQUIPMENT
SYSTEM SCHEMATICS

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by:	LLK	Scale:	AS NOTED
Des/Chkd by:	DAB	Date:	8-77/9-79

(REVISED SET JUNE 2006)

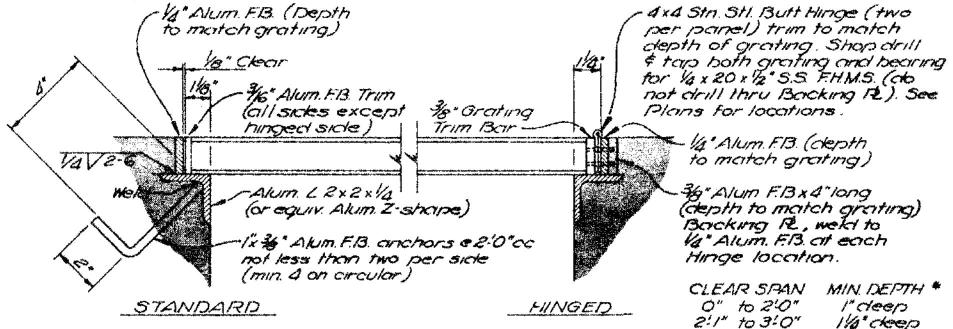
PIPE SUPPORT NOTE

All piping installed as part of this project shall be adequately supported. The elevated piping shall be supported on approved hangers, saddles, straps, brackets, frames and/or concrete piers which shall be securely connected to the reinforced concrete floor slabs, walls and/or roof slabs. The Support System shall be designed to adequately support the full weight of the pipe, pipe fittings and pipe contents as well as to provide lateral and longitudinal support for the complete elevated piping system. The pipe supports shall be located as shown and/or noted on these plans, and they shall also conform to the following maximum spacings and locations:

1. 30"ϕ to 14"ϕ pipes - - - -15'-0" max. spacing.
2. 12"ϕ to 8"ϕ pipes - - - -12'-0" " "
3. 6"ϕ C.I. or W.S. pipes - - - -10'-0" " "
4. 4"ϕ C.I. or W.S. pipes - - - -8'-0" " "
5. 3"ϕ to 2"ϕ metal pipes - - - 6'-0" " "
6. 1½"ϕ to ½"ϕ metal pipes - - 4'-0" " "
7. 6"ϕ to 2½"ϕ P.V.C. pipes - - 4'-0" " "
8. 2"ϕ to ½"ϕ P.V.C. pipes - - 3'-0" " "
9. Locate a support at each end of each pipe.
10. Locate a support at each horizontal and each vertical angle point.

The proposed piping support system shall be submitted for approval prior to the pouring of the concrete structure.

Pipe support components shall be Grinnell, Elcen, Unistrut, Speedstrut or approved equal.

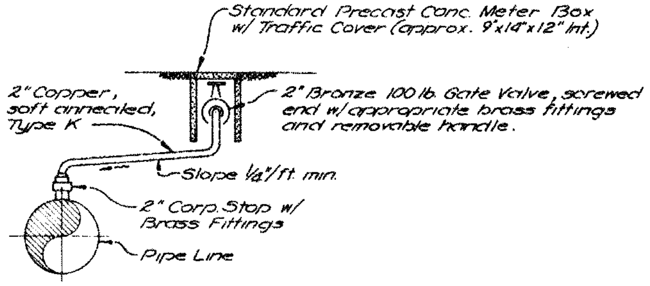


CLEAR SPAN	MIN. DEPTH *
0" to 2'-0"	1" deep
2'-1" to 3'-0"	1¼" deep
3'-1" to 4'-0"	1½" deep
4'-1" to 5'-0"	1¾" deep
5'-1" to 6'-0"	2" deep

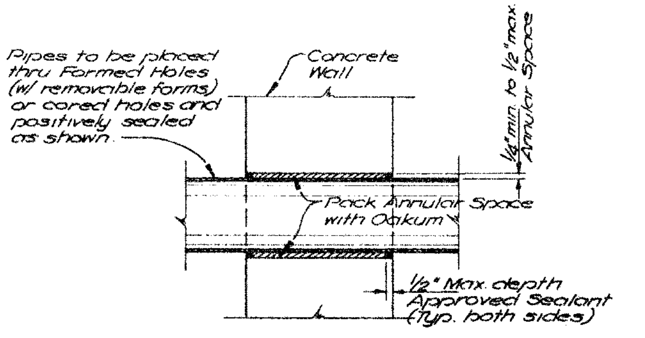
Over 6'-0" use intermediate supports.
*Unless otherwise noted on the plans.

Grating shall be extruded aluminum with 19/32" x 3" rectangular upset perforations (except where noted *without* perforations), heavy duty design. Grating without perforations shall have retractable handles.

GRATING & BEARING DETAIL
Scale 3"=1'-0"



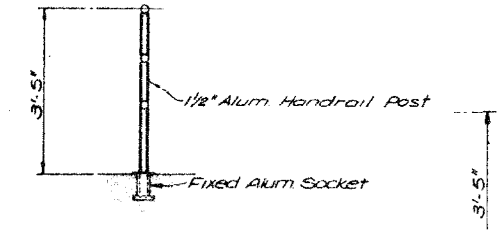
AIR RELIEF ASSEMBLY
No Scale



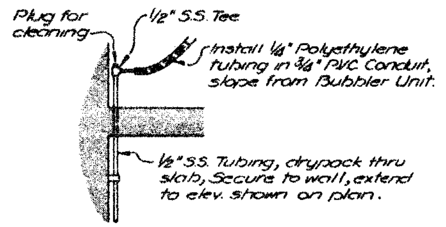
TYPICAL FOR ALL A.C., Cu, F.R.P. & P.V.C. PIPES UNLESS OTHERWISE DETAILED ON THE PLANS.

May also be used for all 2"ϕ and smaller piping.

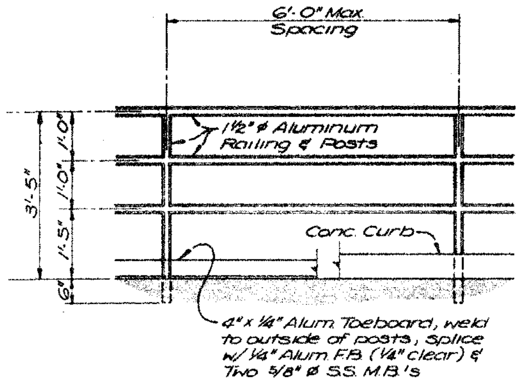
TYPICAL PIPE WALL PENETRATION
NO SCALE



REMOVABLE POST DETAIL
Scale ½"=1'-0"

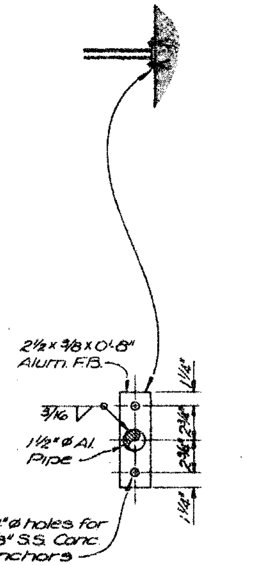


BUBBLER TUBE DETAIL
No Scale



Posts to be set in pipe sleeves or cored holes and securely fixed by means of an approved grout.

All handrail corners and curves shall be smooth, neat and have a 3" min. ℄ radius (unless otherwise shown), vertical miters or offsets in the top rail are not acceptable. All splices shall be smooth and tight as possible. Refer to elect. plans for light post locations and details where required.



DETAIL 'A'

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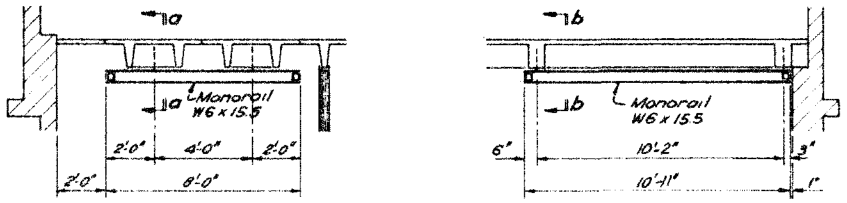
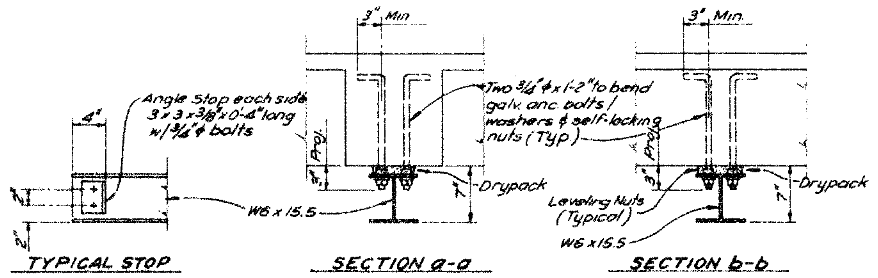
(REVISED SET JUNE 2006)

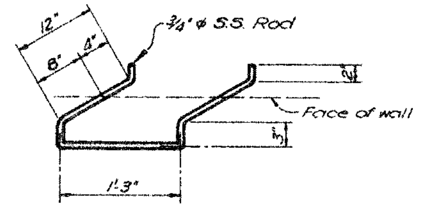


ELEVATIONS
Scale ¼"=1'-0"

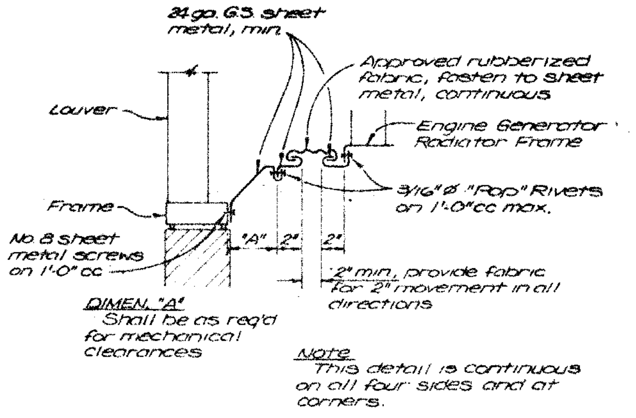


TYPICAL DETAILS
Scale 1"=1'-0"

MONORAIL DETAILS



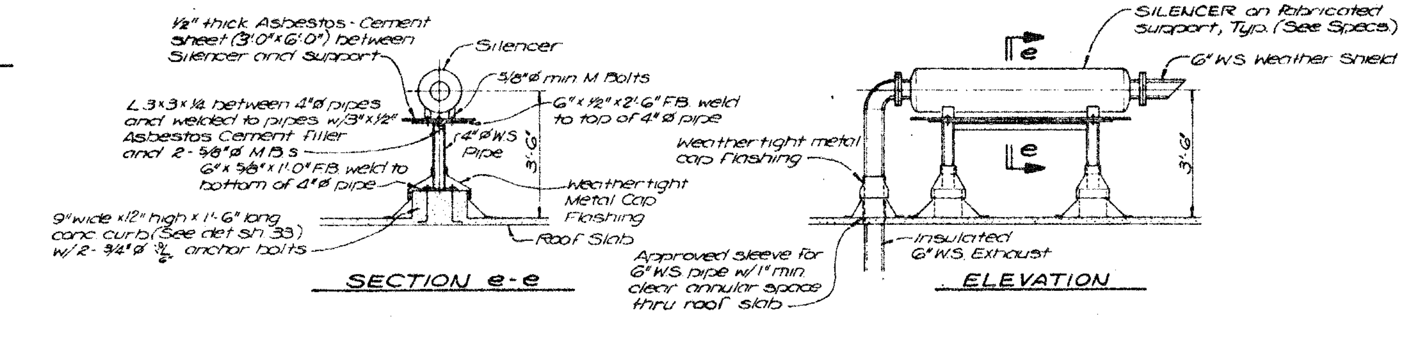
MANHOLE RUNG
Scale 1"=1'-0"



DIMEN. "A"
Shall be as req'd for mechanical clearances

Note
This detail is continuous on all four sides and at corners.

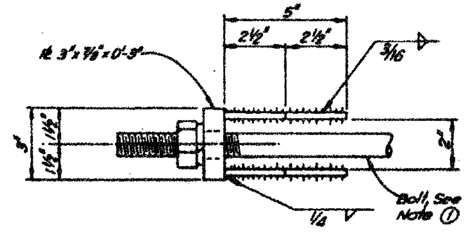
RADIATOR FRAME TO LOUVER FRAME CLOSURE
No Scale



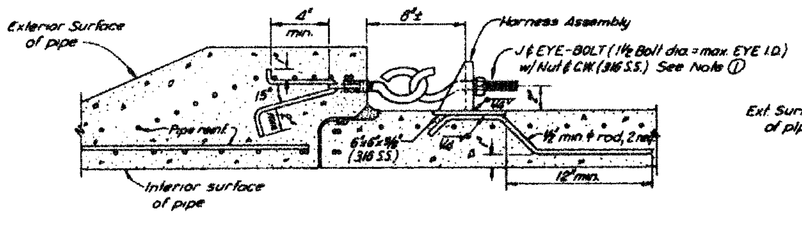
SILENCER SUPPORT DETAILS.
Scale 3/8"=1'-0"

TENSION ANCHOR NOTES

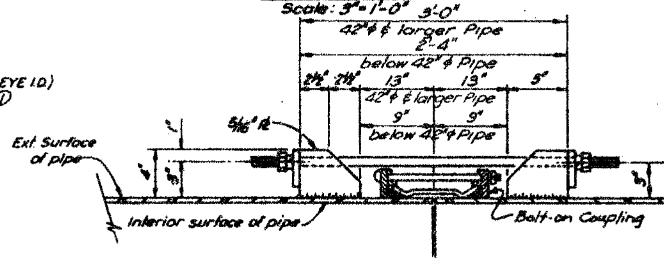
1. Tension anchors on pipe connections will be required at those locations indicated and/or noted on these plans. They will also be required in yard pipework on RC and Welded Steel pipe joints which are located within 8' of any bend greater than 15°. The Contractor shall provide and install two anchors at each required joint located at the springline of the pipe. All exposed tension anchor metal (including bolts) shall be 316 Stainless Steel. The sizes and dimensions shown on this detail are minimums and dimensions may require modification for specific locations. Minimum tension anchor bolt diameters shall be
   ¾"ϕ bolts for pipes smaller than 30" in diameter,
   7/8"ϕ bolts for 30" to 51" diameter pipes,
   1"ϕ bolts for pipes larger than 51" in diameter.
   The Contractor shall submit details for approval prior to fabrication.
2. Typical tension anchors located at the joints for RC and at the couplings for Welded Steel pipes have been detailed below. Portions of these typical details also apply to required tension anchors at other piping connections including RC to WS L/C connections, RC to structure connections and WS L/C to structure connections. Tension anchors at structure connections shall utilize anchor bolts cast in the concrete.



PLAN
Scale: 3"=1'-0"

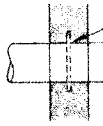


REINFORCED CONCRETE PIPE
Scale 1½"=1'-0"



WELDED STEEL PIPE
(LININGS & COATINGS NOT SHOWN)
Scale 1½"=1'-0"

TENSION ANCHOR DETAILS



¼" PL Wall Ring, placed in center of wall, on all pipes subject to water pressure from within or without, continuous fillet weld all around, O.D. of Ring sized as follows:
3" to 5" Pipe, O.D. of pipe + 3" min.
6" to 12" Pipe, " " " + 4" "
over 12" Pipe, " " " + 6" "

CUT-OFF RING DETAIL
No Scale

129 OF 141

RECORD DRAWING, JUNE 1982

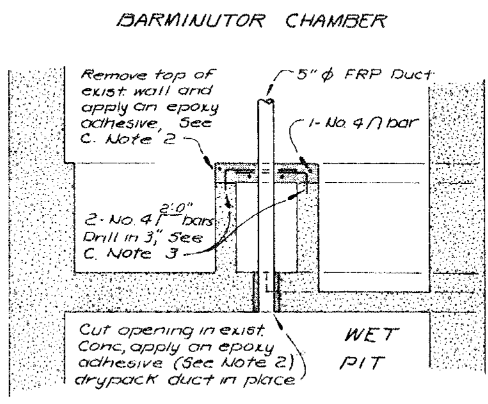
SUBMITTED
Bruce W. Hasspbald
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA
SUBREGIONAL WASTEWATER WORKS

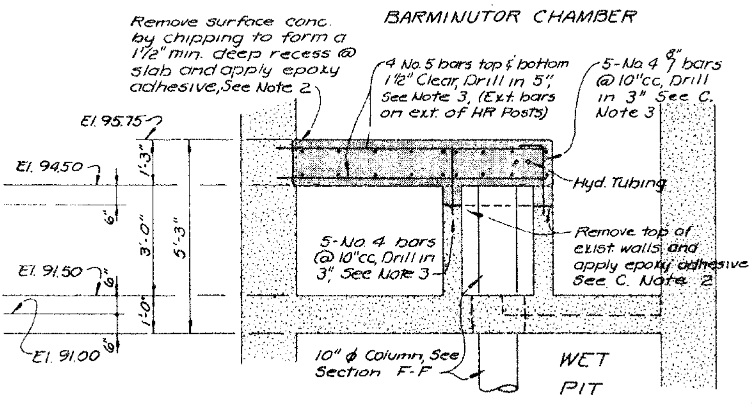
BELMONT PUMP STATION
PIPEWORK & EQUIPMENT
MISCELLANEOUS DETAILS

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

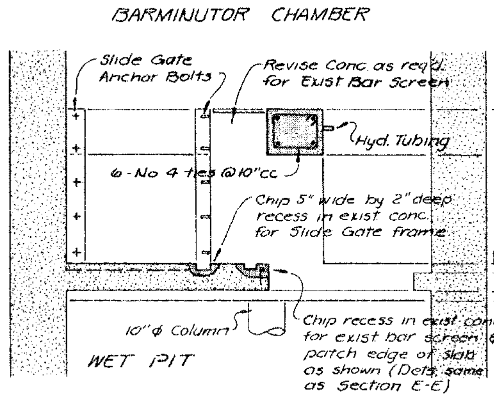
Drawn by: L.L.K. SLH
Scale: AS NOTED
Des/Chkd by: DAB
Date: 8-77/9-79



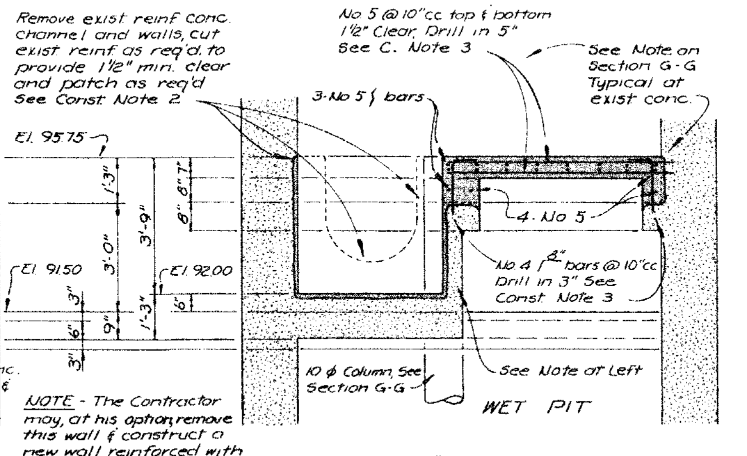
SECTION A-A



SECTION B-B



SECTION C-C



SECTION D-D

Record Drawing

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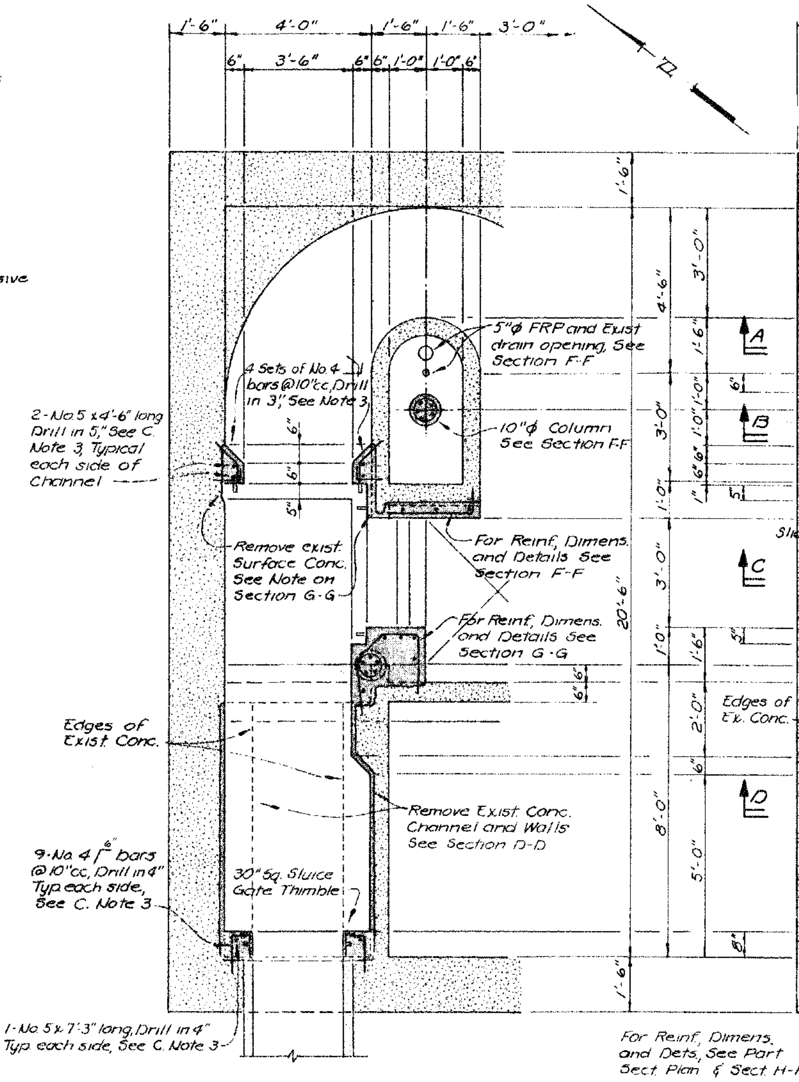
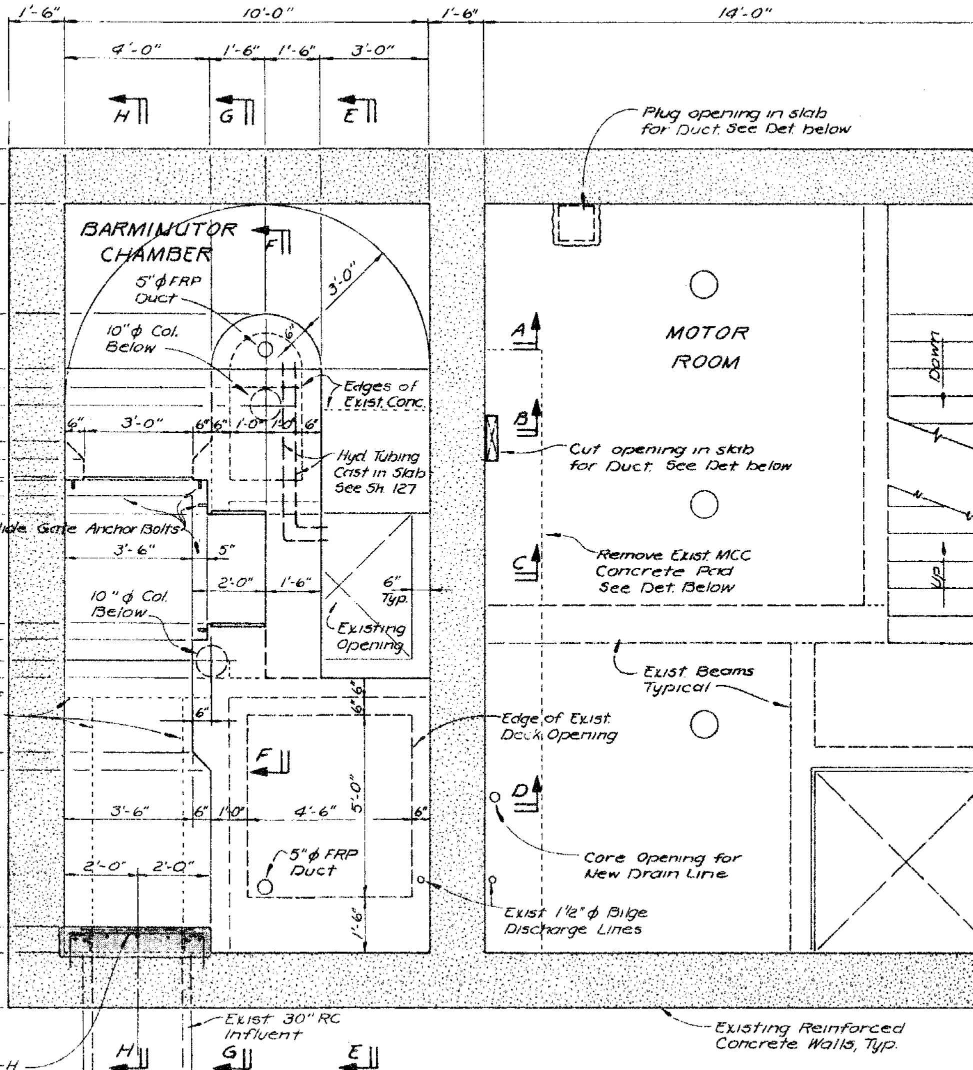
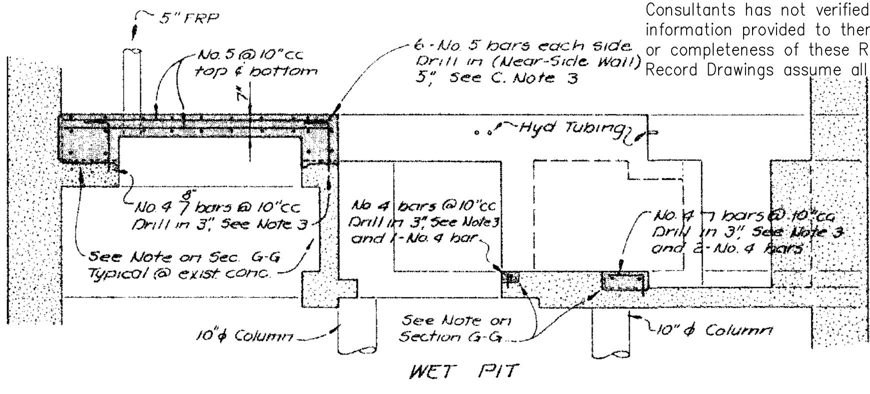


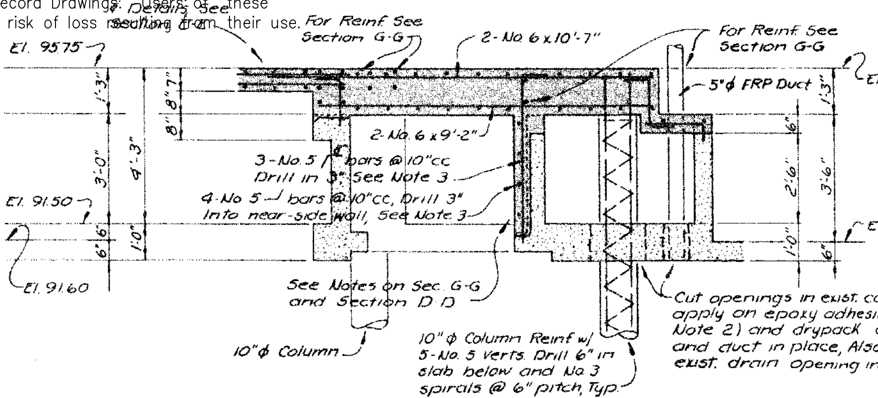
PART SECT. PLAN



INTERMEDIATE FLOOR PLAN



SECTION E-E



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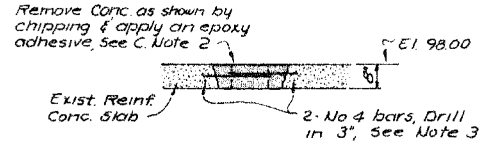
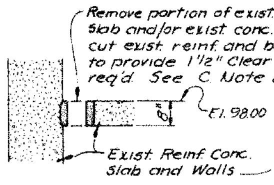
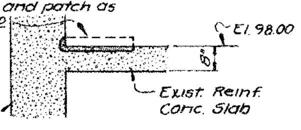


SLAB PLUG DETAIL



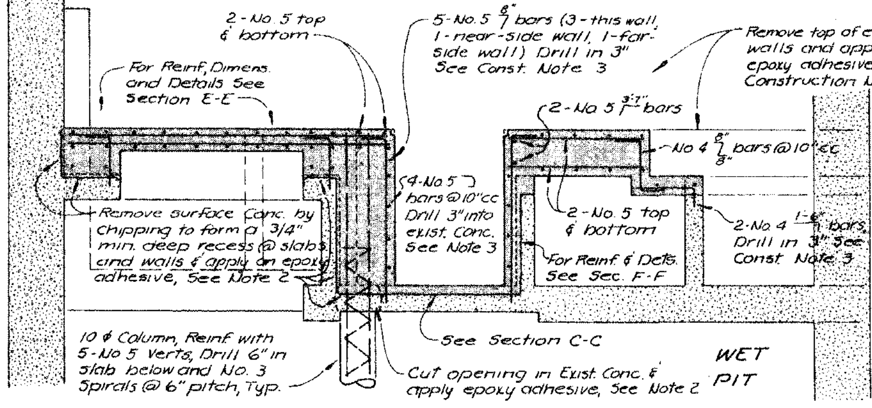
SLAB OPENING DETAIL



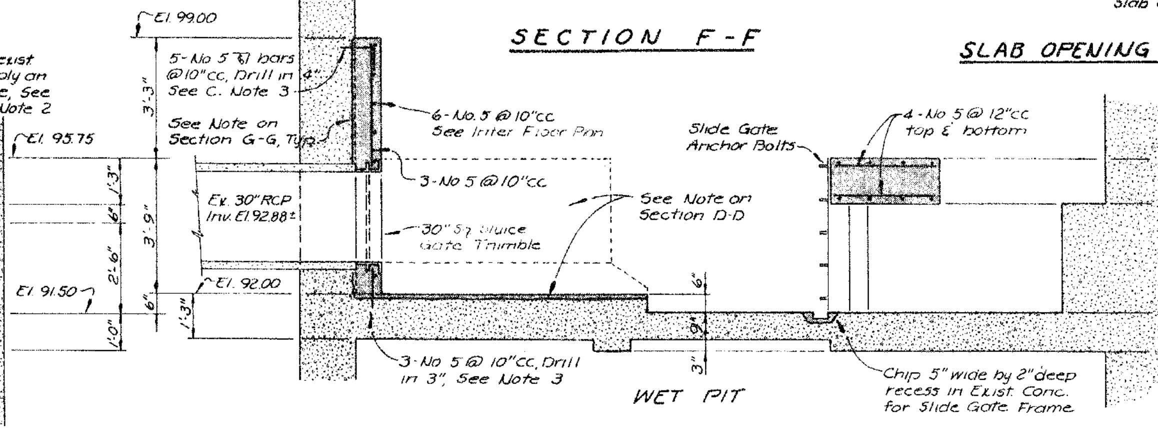
PAD REMOVAL DETAIL

CONSTRUCTION NOTES

1. The Contractor shall remove portions of the existing reinforced concrete sewage influent channels and structure as required and shown and shall then construct the revised reinforced concrete sewage influent channels and structure as detailed and shall patch the existing structure as required. See Construction Notes on Sh. 123.
2. The surface of existing concrete at all junctions of new and existing concrete shall be thoroughly cleaned and free from surface contamination, dust and/or loose particles. Coat these surfaces of existing concrete with an approved epoxy adhesive compound: "Concresive 1001-LPL" (Adhesive Engineering Co.), "Sikadur Hi-Mod" (Sika Chemical Corp.), or approved equal, in accordance with the manufacturers recommendations. New concrete shall be placed against this coating before the coating sets; if the coating should set, apply a second coating before pouring concrete.
3. The Contractor shall drill reinforcing steel dowels as shown into the existing concrete structure. Grout the dowels securely in place with an approved epoxy adhesive compound: "Concresive 1180 or 1387" (Adhesive Engineering Co.), "Sikadur Hi-Mod" (Sika Chemical Corp.), or approved equal. "Horizontal" dowel holes may be sloped down at between 5° and 10° with dowels bent down accordingly.
4. Concrete Notes for this Structure are on Sh. 15



SECTION G-G



SECTION H-H

130 OF 141

RECORD DRAWING, JUNE 1982

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	BELMONT PUMP STATION STRUCTURAL INTERMEDIATE FLOOR PLAN & DETAILS
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: MR EB — Scale: 3/8"=1'-0" Des/Chkd by: DAB — Date: 8-77 / 9-79

(REVISED SET JUNE 2006)

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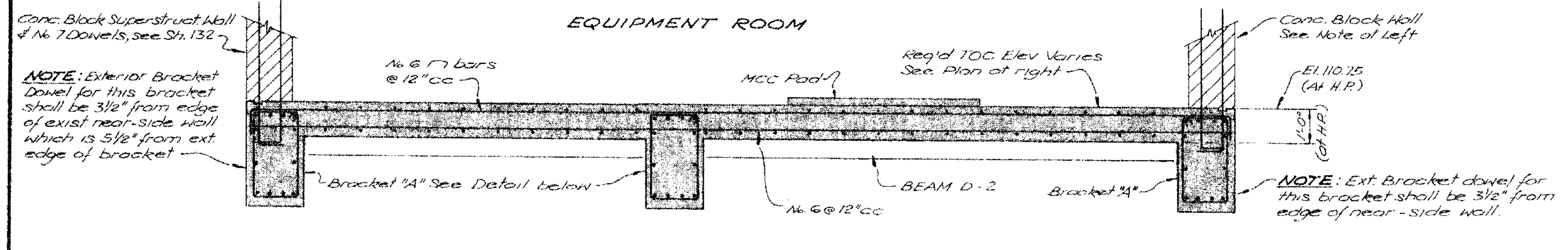
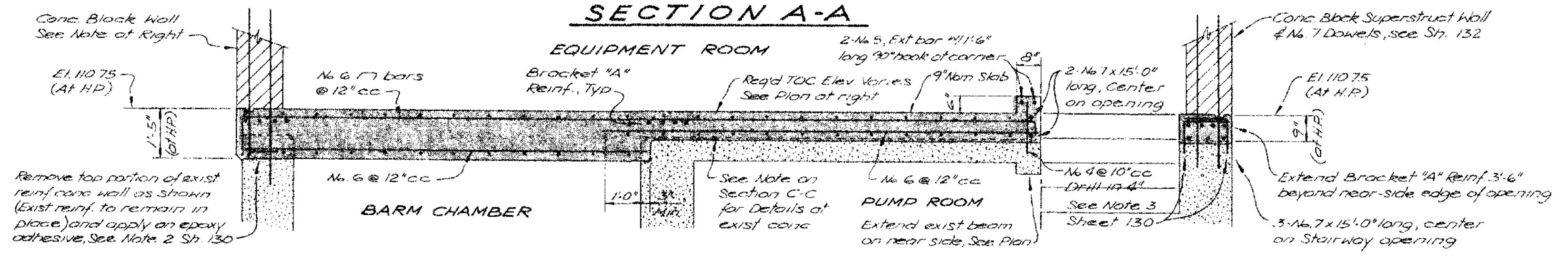


SECTION A-A



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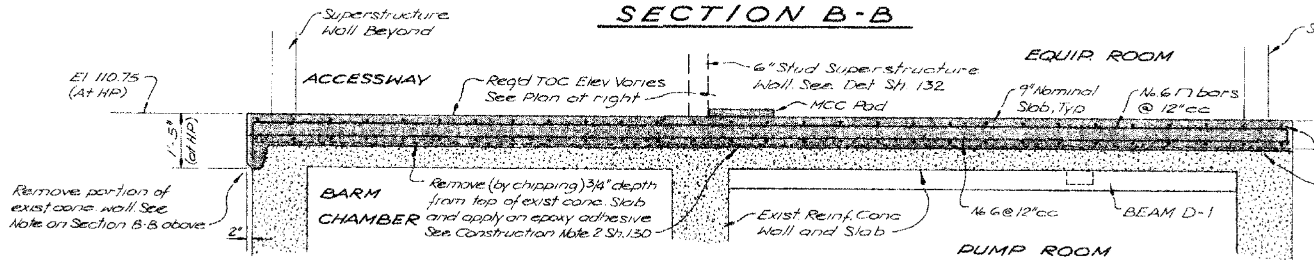

SECTION C-C

Record Drawing

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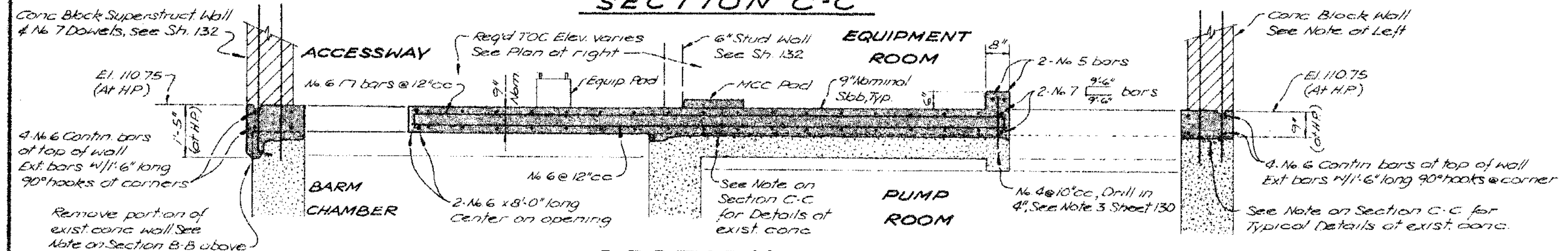
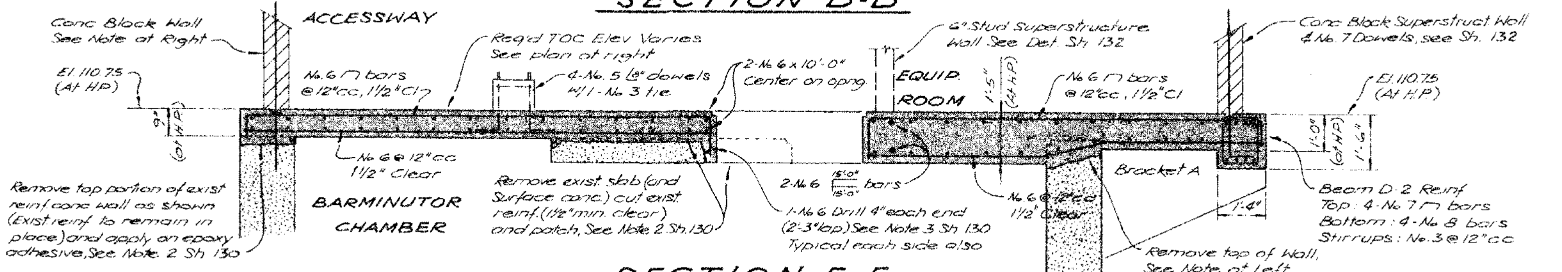
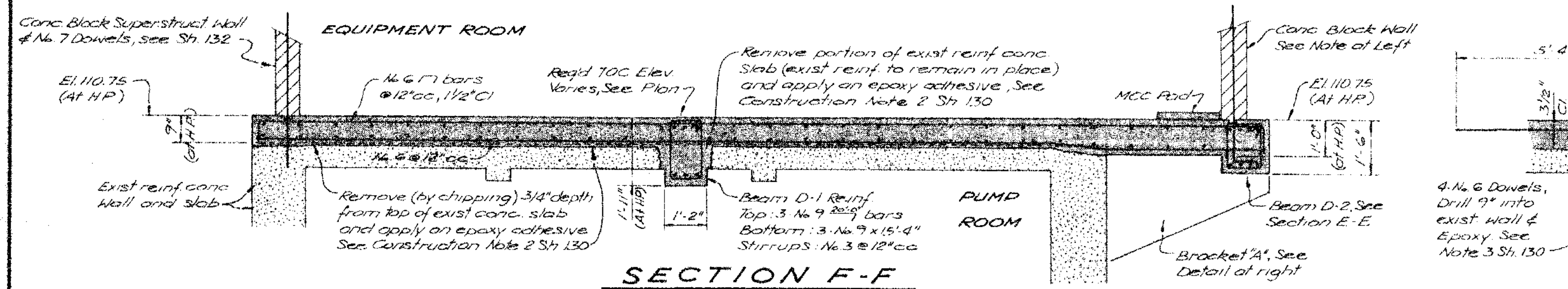


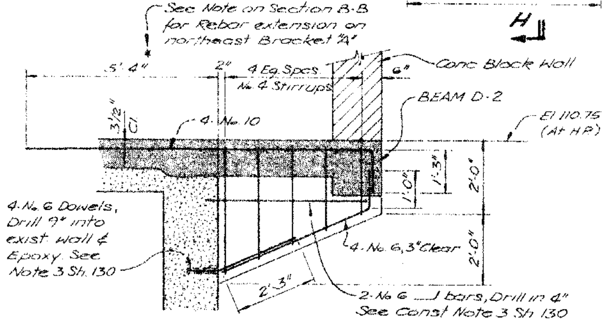
SECTION D-D



SECTION E-E



SECTION F-F



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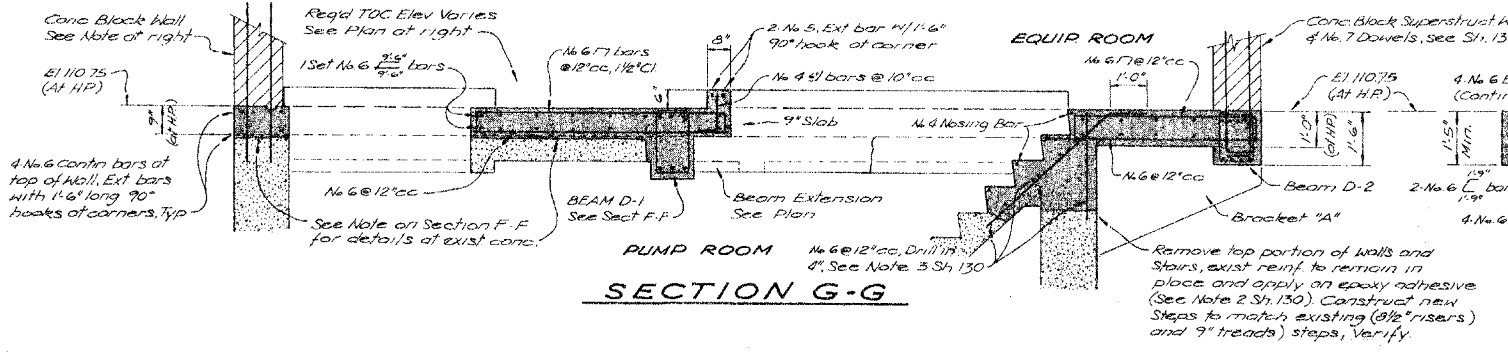
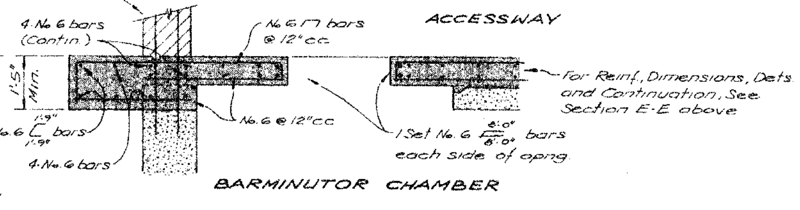
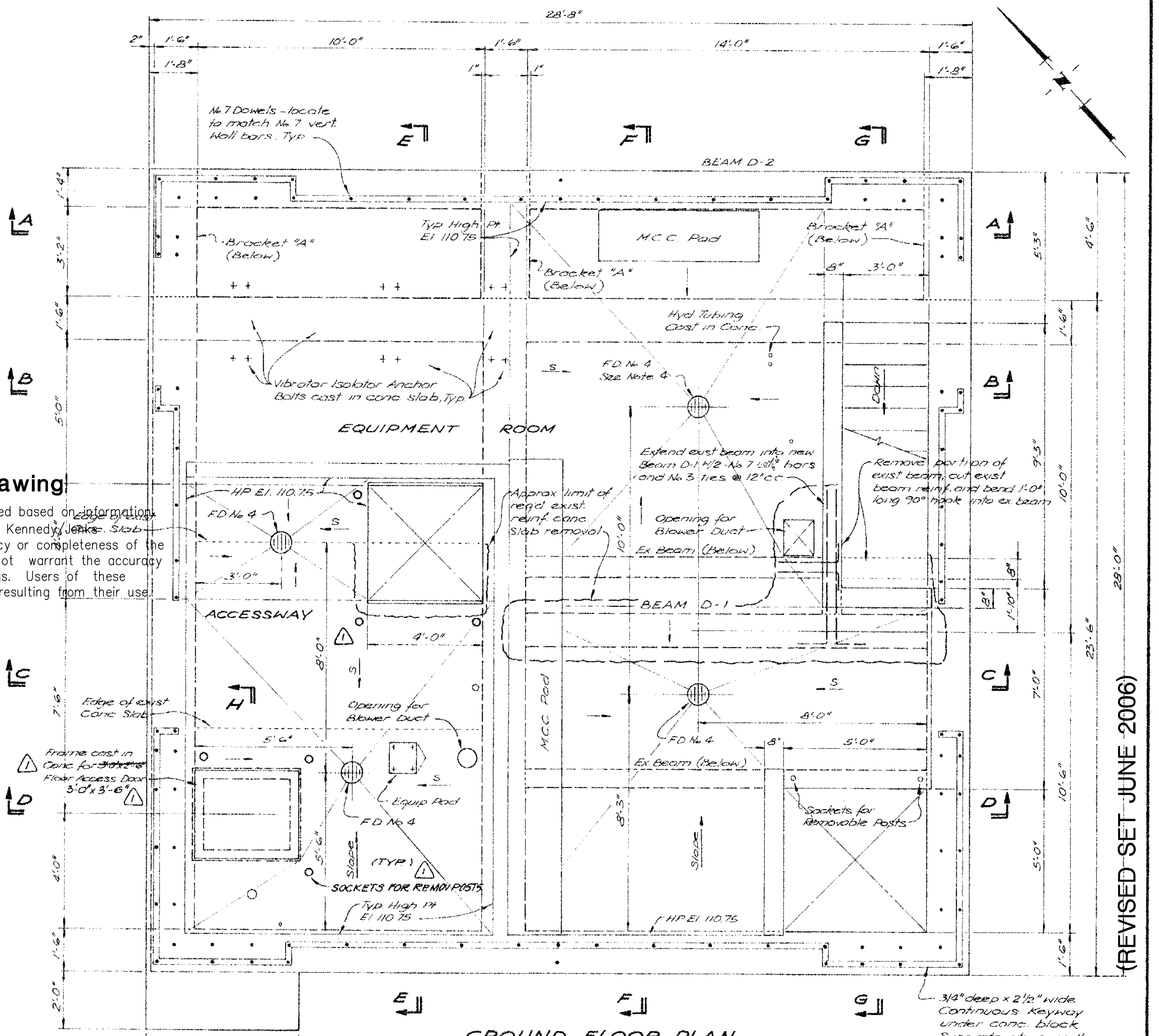


SECTION G-G



SECTION H-H



GROUND FLOOR PLAN

(REVISED SET JUNE 2006)

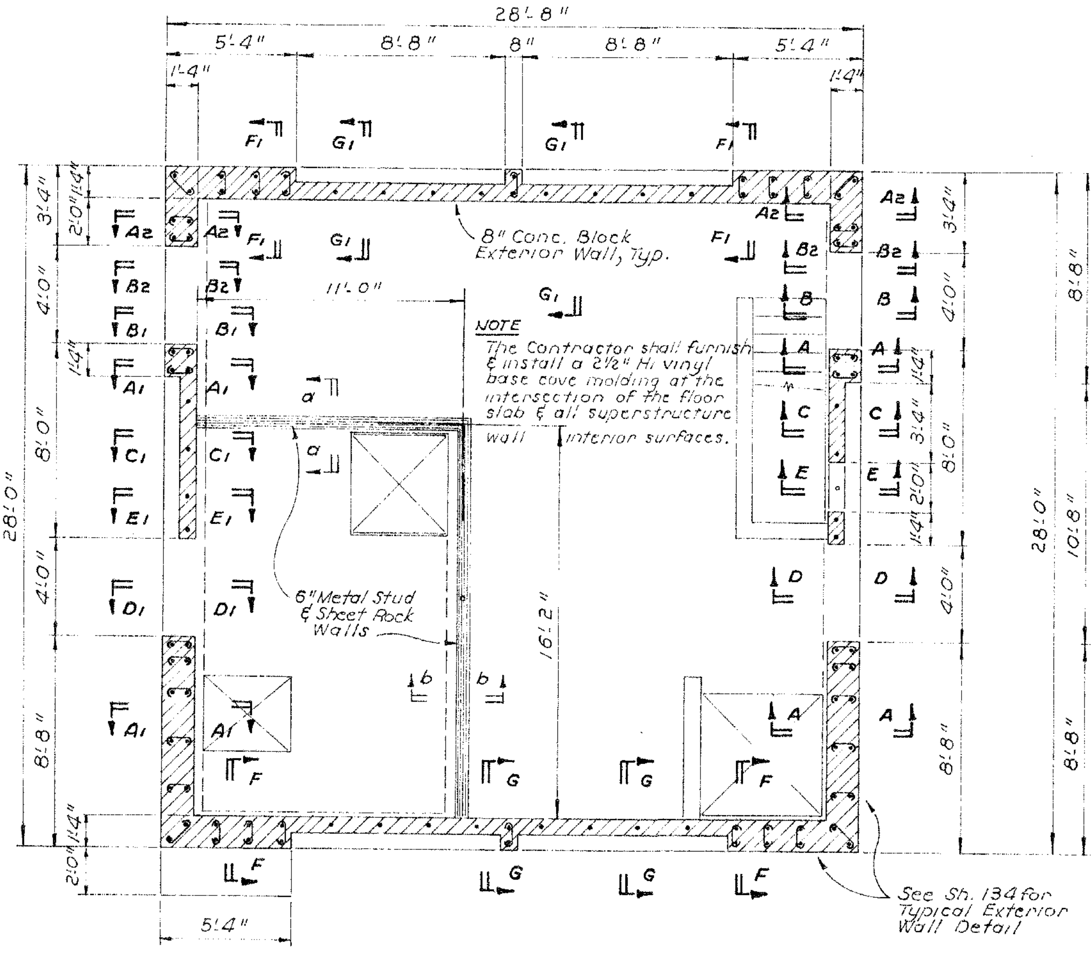
NOTES

1. The Pump Station Superstructure is detailed on Sheets 132 - 135
2. See Piperwork and Equipment drawings for required openings, bolts, pipework and equipment in the concrete structure.
3. The Falsework for the slab and Beams at Elevation 110.75 shall be adequate to support (in addition to the weight of the Slab and Beams and the loads applied by the construction operations) the weight of the interior stud walls above El 110.75. This Falsework shall be supported from the substructure walls below only and no construction loads shall be transmitted to the Suspended concrete floor slabs below. This falsework shall not be removed or released in less than 21 days after placing the slabs and beams. The falsework for the slabs and beams shall be released simultaneously, proceeding uniformly and gradually and working from midspan toward the supports.
4. The top of the concrete floor Slabs in the Equipment Room and Accessway shall slope ½" from the typical high points at El. 110.75 to the Floor Drains at El. 110.71. The top of the concrete shall be ramped at slab openings and concrete pads to provide drainage away from openings and/or ground pads. Floor Drains are noted on Sheet 126.

131 OF 141

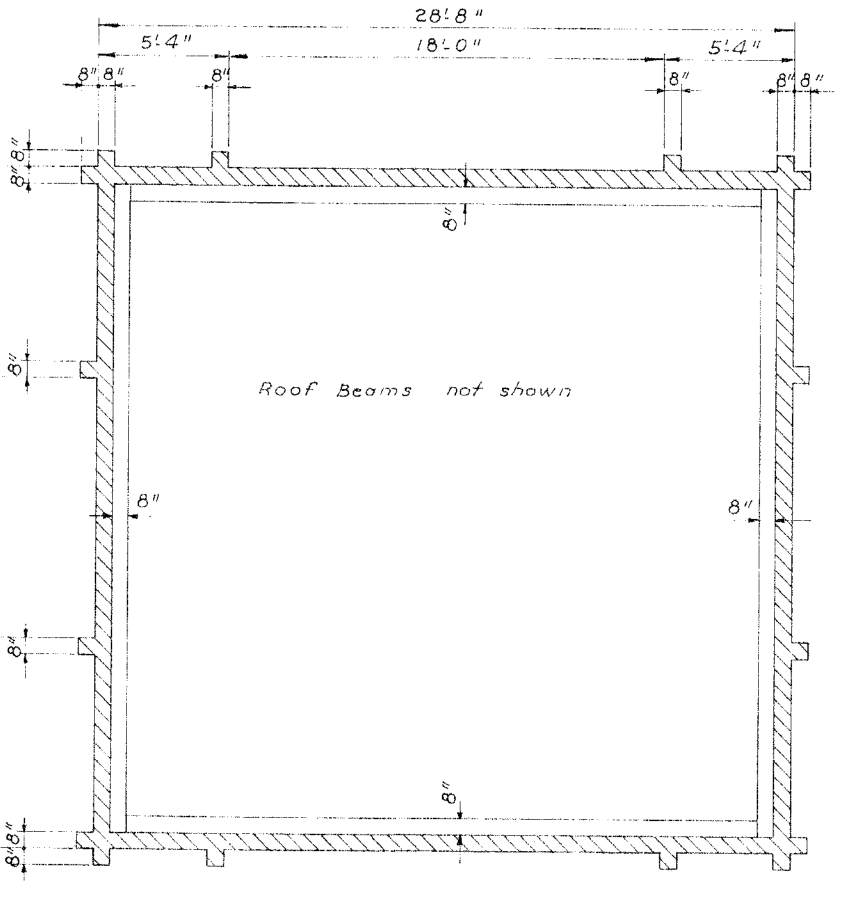
⚠ RECORD DRAWING, JUNE 1982

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	BELMONT PUMP STATION STRUCTURAL GROUND FLOOR PLAN & DETAILS
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: MR CGS — Scale: 3/8" = 1'-0" Des/Chkd by: DAB — Date: 8-77 / 9-79



SECTIONAL PLAN AT ELEV. 115.00

Scale: 1/4" = 1'-0"



SECTIONAL PLAN AT ELEV. 123.00

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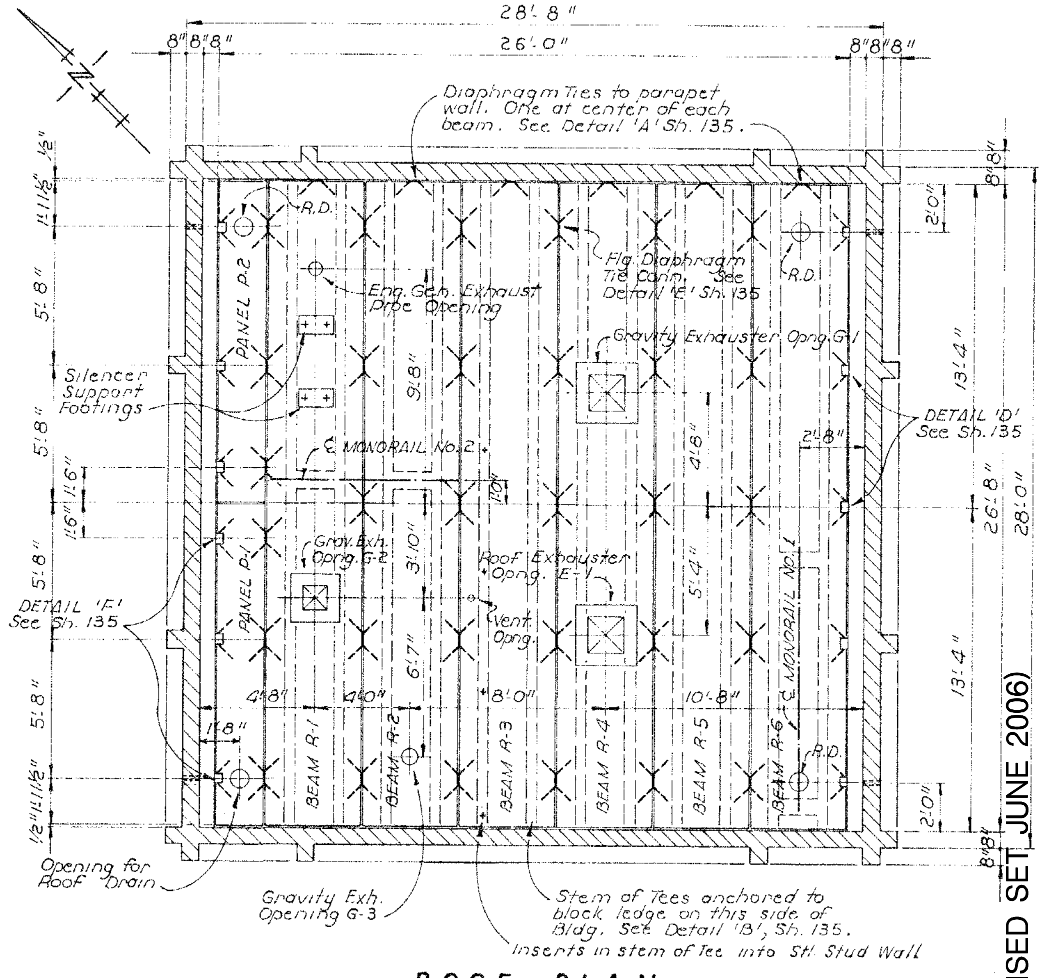
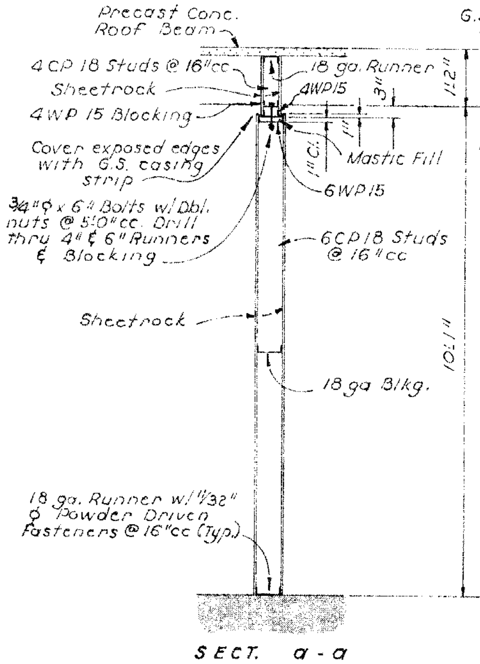


ROOF PLAN

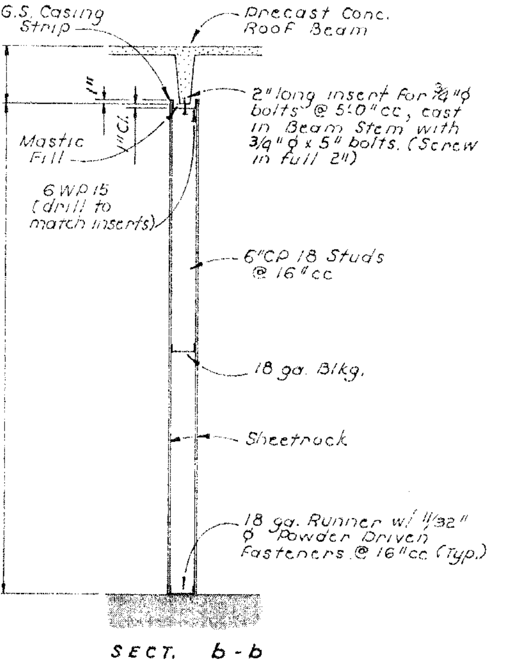
Scale: 1/4" = 1'-0"

(REVISED SET JUNE 2006)



SECT. a - a

Scale 1/2" = 1'-0"



SECT. b - b

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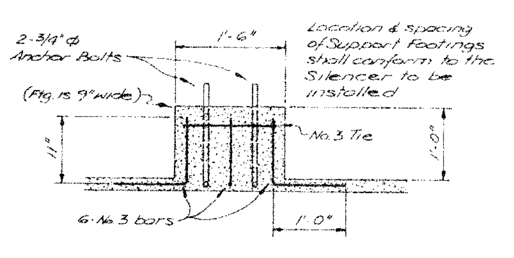
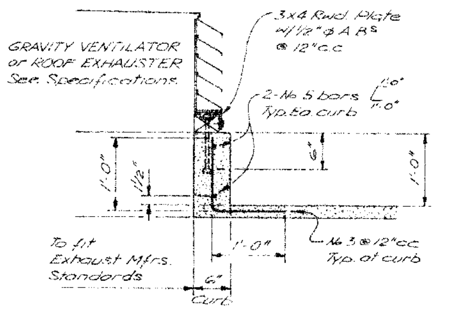


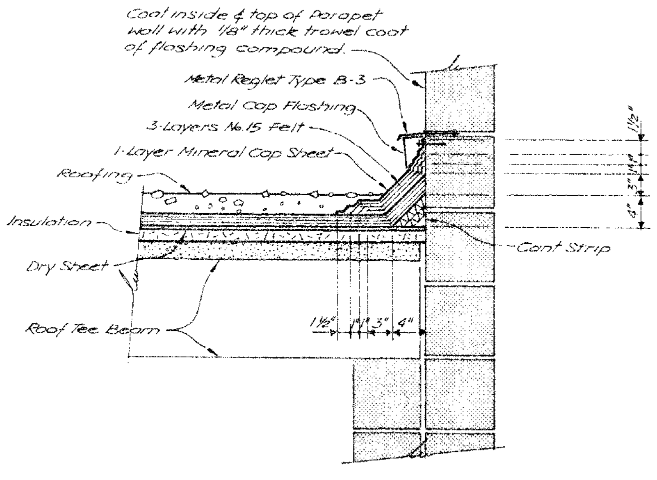
SILENCER SUPPT. FTG.

Scale 3/4" = 1'-0"



EXHAUST. OPNG. CURB DETAIL

Scale 3/4" = 1'-0"



PARAPET DETAIL

Scale. 1" = 1'-0"

ROOF NOTES

1. **ROOFING NOTE** — The CONTRACTOR shall apply a "20 year", asphalt rag felt, built-up roofing as detailed above. The roofing shall consist of an asphalt spot mopping 10#/square, 4-layers of 15# asphalt saturated felt, 3-hot asphalt mopping between layers 75#/square, asphalt flood coat 60#/square and 300#square of cinder rock together with all necessary flashing and sealing.

2. **BASE FLASHING** — Prime wall with asphalt primer to reglet line. Apply base flashing consisting of 3-layers of No. 15 asphalt felt and one layer of mineral surfaced cap sheet applied in asphalt. Nail upper edge of cap sheet to wall. Apply a 3 coarse plastic flashing consisting of a 4" strip of "Glasfab" and two coarses of flashing compound sealing the upper edge of base flashing. The exposed surface of the flashing system shall receive a trowel coat of flashing compound 1/8" thick.

3. See equipment manufacturers drawings, Roof Plan Sh 126, and the Roof Details this Sheet for required opening and curb sizes for roof exhausters and vents. All openings shall have an approved base flashing similar to that shown on the Parapet Detail this Sheet.

4. **ROOF INSULATION** — The CONTRACTOR shall apply a rigid board insulation over the precast concrete TEE BEAMS. The insulation shall be installed in accordance with the manufacturer's recommendations, but in no case shall the materials be less than the following: asphalt primer 8#/square, hot asphalt mopping at 25#/square to receive the rigid board insulation while hot, the insulation board, hot asphalt mopping at 25#/square over the board and apply the balance of the roofing as indicated above over the entire roof area. The insulation board shall be a rigid urethane bonded each face to an asphalt impregnated skin, see Specs., & shall be compatible with roofing materials to be installed. The rigid urethane insulation shall be applied over an insulation board material which has a 1/8" per foot slope for roof drainage as shown on Sh. 126. The insulation shall have a minimum of two vents as recommended by insulation and/or roofing manufacturers.

Record Drawing

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RECORD DRAWING, JUNE 1982

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	BELMONT PUMP STATION SUPERSTRUCTURE PLANS AND DETAILS
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: MR LFI CGS — Scale: AS NOTED Des/Chkd by: DAB — Date: 8-77 / 9-79

DOORS

DOOR ⟨1⟩ Shall be a 1 3/4" x 3'-8" x 7'-10" full flush, 16 Ga. steel door with full rigid urethane foam core, and shall be hung in a 16 Ga. x 2" x 5 3/4" double rabbeted steel frame to fit a 4'-0" x 8'-0" rough masonry opening. Door to have: Schlage C-51PD "Orbit" or Falcon lockset with 630 finish and 5" backset; LCN 4114 or Norton Closer, 630 finish; 1 1/2 pair McKinney TA2314 or Stanley ball bearing NRP butts, 630 finish; Quality 331 ES or Builders Brass door stop.

NOTE: ALL doors and frames shall be factory prime coated and job site spray painted with colors as selected by the Engineer.

LOUVERS

LOUVER ⟨A⟩ to fit a 4'-0" wide x 8'-0" high rough masonry opening.

LOUVER ⟨B⟩ to fit a 2'-0" wide x 2'-0" high rough masonry opening.

NOTE: All louvers shall have a dark bronze anodized finish, shall be of types and sizes shown, supplied with aluminum birdscreen in folded U aluminum frame, all anodized to match louver.

Louvers shall be 6" deep, with extruded aluminum blades Min. 0.081" thick, on 3 1/2" cc, integral downspouts to drain off water.

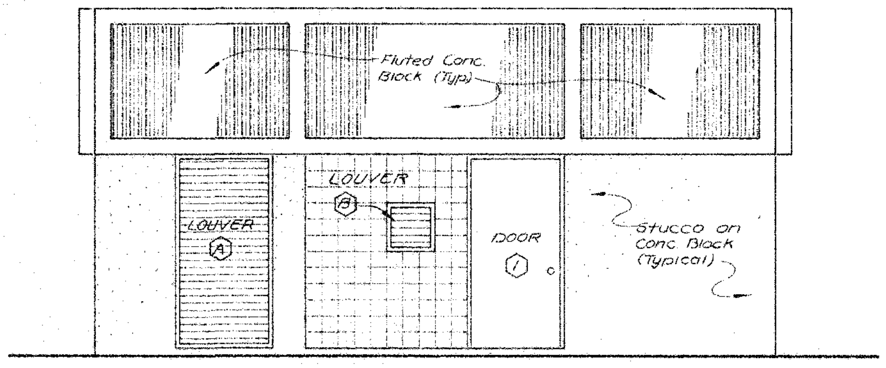
Louvers shall pass 625 fpm face velocity with less than 0.15" pressure drop, and bear the AMCA Certified Rating Seal.

EXTERIOR COLOR SCHEDULE

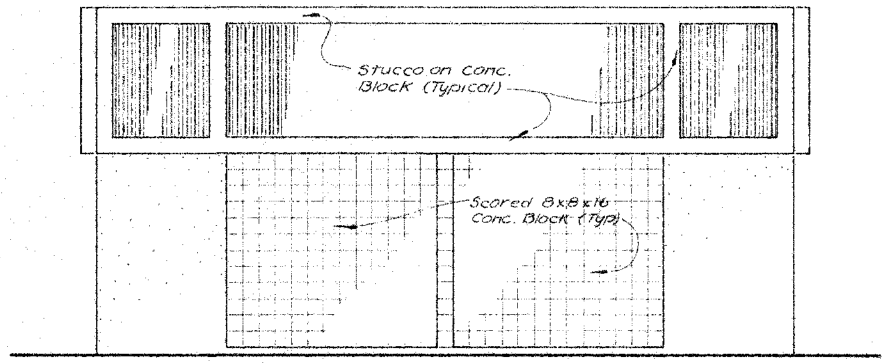
FLUTED CONC. BLOCK	BASALT N-14
SCORED CONC. BLOCK	BASALT N-14
STUCCO	NAVAJO WHITE
LOUVERS	BRONZE ANODIZED
DOORS	BURNT ORANGE

THE CONTRACTOR SHALL SUBMIT FOR APPROVAL SAMPLES & COLORS OF ALL UNITS PROPOSED FOR THIS PUMP STATION.

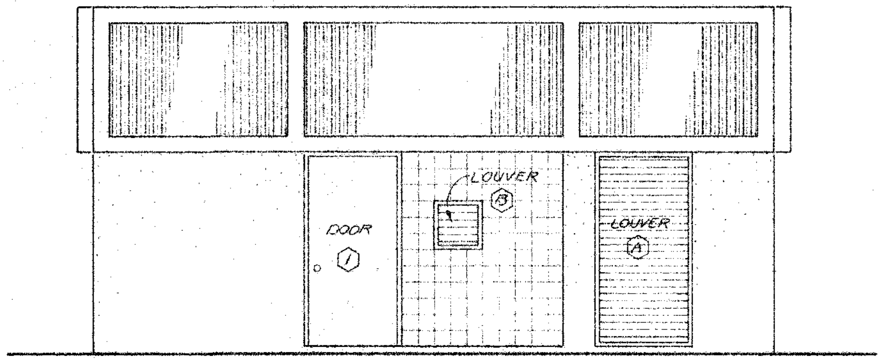
Record Drawing



NORTHWEST



SOUTHWEST & NORTHEAST



SOUTHEAST

EXTERIOR ELEVATIONS

(REVISED SET JUNE 2006)

RECORD DRAWING, JUNE 1982.

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA
SUBREGIONAL WASTEWATER WORKS
BELMONT PUMP STATION
SUPERSTRUCTURE
EXTERIOR ELEVATIONS & DETAILS
JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: LLK EB	Scale: AS NOTED
Des/Chkd by: DAB	Date: 8-77 / 9-79

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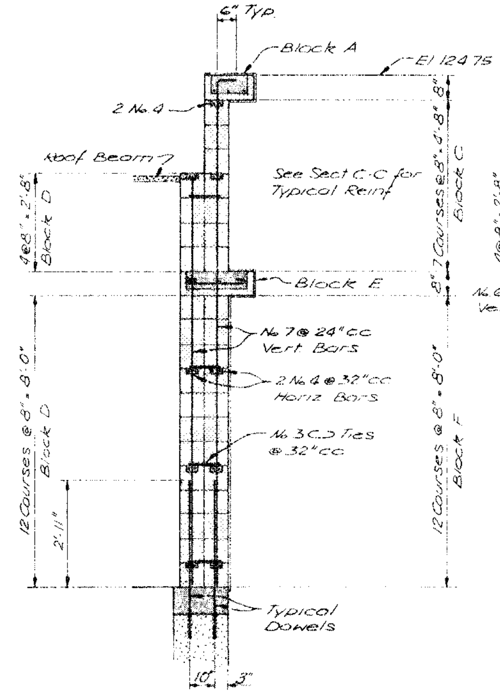
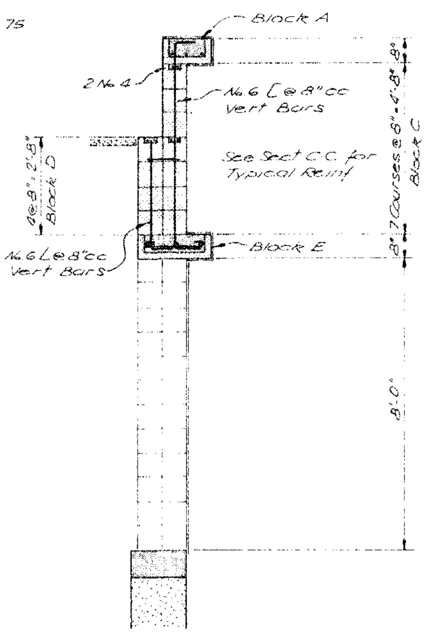


SECT. A - A



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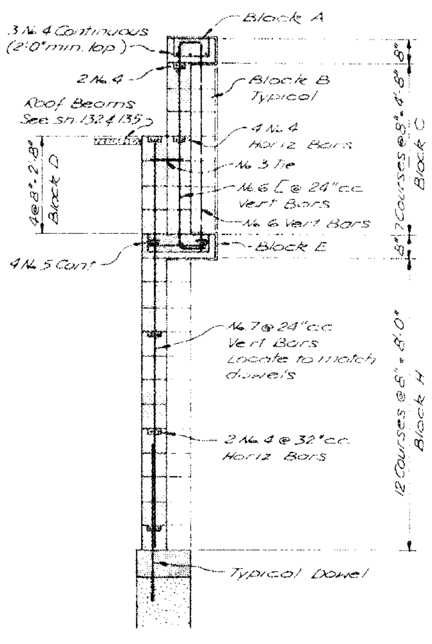

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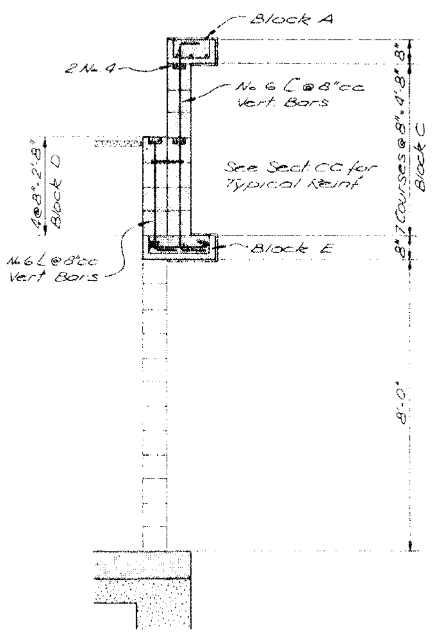

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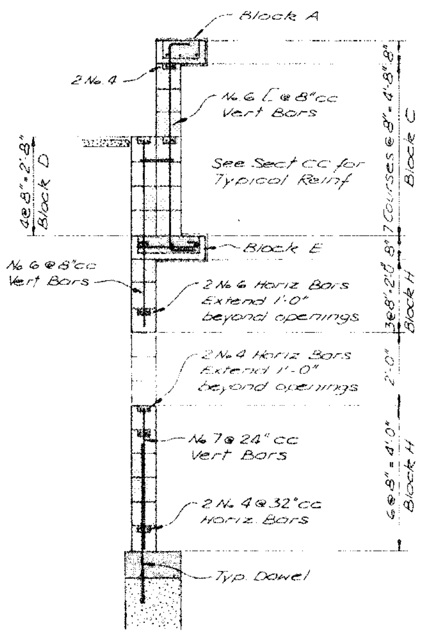

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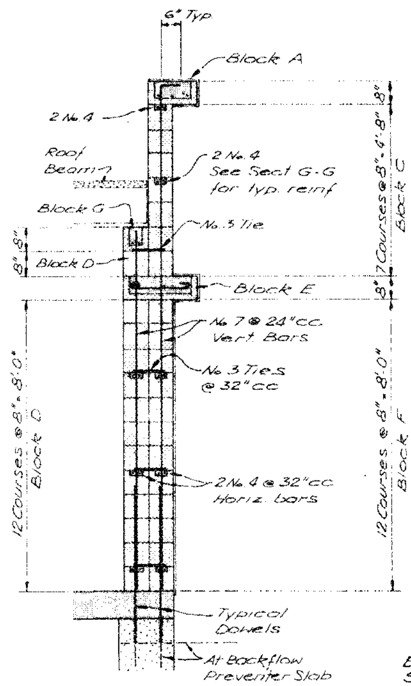

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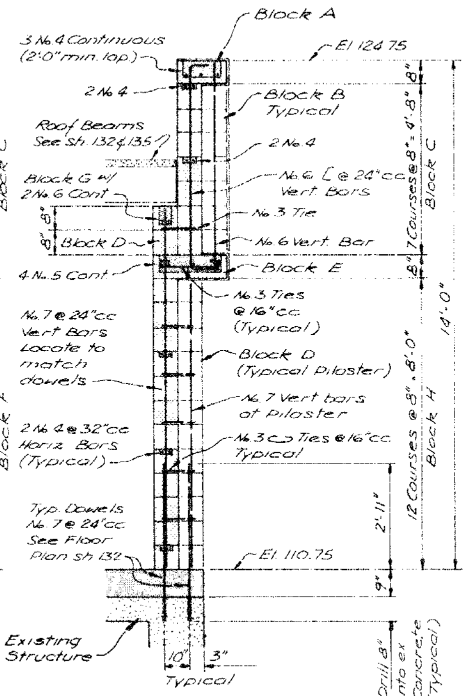

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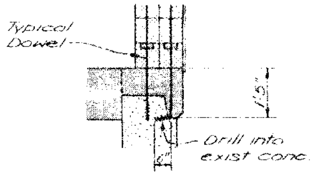

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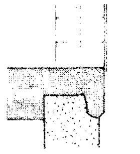

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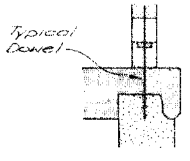

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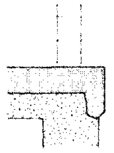

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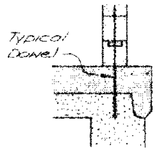

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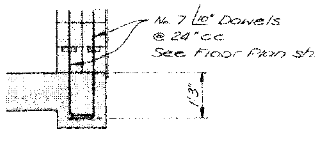

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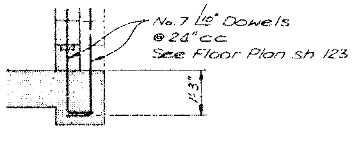
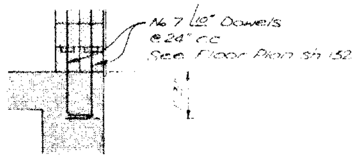
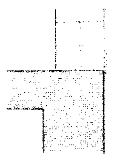


SECT. G1 - G1



SECT. A2 - A2



SECT. B2 - B2

CONCRETE BLOCK WALL NOTES

CONCRETE BLOCK EXTERIOR WALLS

The exterior walls of the Superstructure of this Pump Station shall be 8" concrete block construction using hollow masonry units as shown at the right and listed below, laid in a "common bond" pattern and poured solid with grout. The 3/8" mortar joints shall have a tooled, concave, weathered finish. See Specifications for additional requirements.

CONCRETE BLOCK WALL REINFORCING

The typical reinforcing shall be as follows, except where otherwise noted or shown on the list below and/or the Sections this sheet, and/or Plan Sheet 132

VERTICAL — Poured concrete studs reinforced with 2-Reinf. bars at each corner, at the ends of walls or pilasters, at each side of each opening, & one bar at a maximum spacing of 24" cc between, except at 8"cc above all openings.

HORIZONTAL — Poured concrete in bond beam units reinforced with two No. 4 bars at the top of the wall, above and below louver openings, and at a maximum spacing of 32"cc.

LAPS — All bars shall be lapped 40 diameters minimum at splices and corners, unless otherwise noted or shown.

CONCRETE BLOCK LIST

SEE SECTIONS THIS SH. AND EXTERIOR ELEVATIONS, SH. 133.

BLOCK "A" — 8"x8"x16" open center pilaster alternate masonry units. Reinforce with 3-No. 4 continuous bars as shown on Sects. and coat exterior surfaces (3 faces) with exterior cement plaster. The unsupported exposed portion of each block shall be anchored to the reinforcing steel using approved metal ties.

BLOCK "B" — 8"x8"x16" hollow masonry units. Reinforce with 1-No. 6 vertical bar as shown on Sects. and coat exterior surfaces (3 faces) with exterior cement plaster.

BLOCK "C" — 8"x8"x16" hollow masonry units with a split face / 4 flute exterior surface design. Reinforce with No. 6 vertical bars to match typical wall reinforcing and 2-No. 4 horizontal bars in bond beam units @ 32"cc as shown on Sects. See Roof Plan Sh. 132 and Roof Details Sh. 135 for required anchors cast in the block wall.

BLOCK "D" — 8"x8"x16" hollow masonry units with typical wall reinforcing and details. Tie to Block "C" & Block "F" Vert. bars with No. 3 ⊂⊃ ties, located as shown on Sections. Also used as Pilaster block w/ No. 7 Vert. bars & No. 3 ⊂⊃ ties.

BLOCK "E" — 8"x8"x24" open center pilaster alternate masonry unit. Reinforce with 4-No. 5 continuous bars and No. 3 ⊂⊃ ties @ 16"cc as shown at right and coat exterior surfaces (3 faces) with exterior cement plaster. Unsupported exposed portions of each block shall be anchored to the reinforcing steel using approved metal ties.

BLOCK "F" — 8"x8"x16" hollow masonry units with typical wall reinforcing. Coat exterior surface with exterior cement plaster. These blocks are located in each corner of the building extending 5'-4" on the Northeast & Southwest walls, & 8'-8" on the Southeast & Northwest walls.

BLOCK "G" — 8"x8"x8" U-Beam masonry units. Reinforce with 2-No. 6 bars; See Details Sheet 135 for required steel plate and anchor cast in block wall.

BLOCK "H" — 8"x8"x16" hollow masonry units with the exterior face center scored to produce an 8" square pattern. Reinforce with typical wall reinforcing.

EXTERIOR CEMENT PLASTER

The exterior cement plaster (on the exterior masonry walls) shall be a ½" minimum thickness cement plaster applied in two coats in accordance with Section 4708 of the 1976 Uniform Building Code. The texture and color of the finish coat shall be as directed by the ENGINEER.

CONCRETE MASONRY NOTES

1. All masonry units shall conform to ASTM Designation C 90 and shall have a minimum ultimate compressive strength of 2500 psi.
2. All mortar and grout shall have a 28 day minimum compressive strength of 2500 psi.
3. All masonry work, including grouting, shall conform to the 1976 Edition of the Uniform Building Code.

RECORD DRAWING, JUNE 1982

Record Drawing

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(REVISED SET JUNE 2006)

134 OF 141

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA
SUBREGIONAL WASTEWATER WORKS

BELMONT PUMP STATION
SUPERSTRUCTURE
EXTERIOR WALL DETAILS

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: LLK CGS
Scale: 3/8" = 1'-0"
Des/Chkd by: DAB
Date: 8-77 / 9-79

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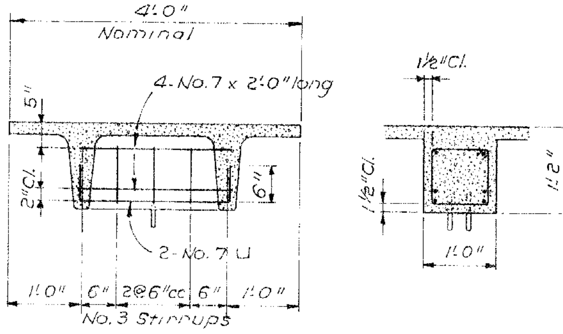
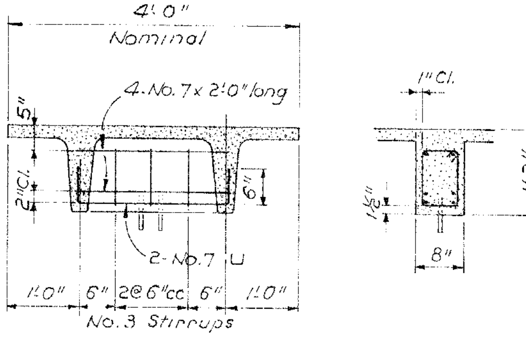


ELEVATION **SECTION**

DIAPHRAGM 'B'

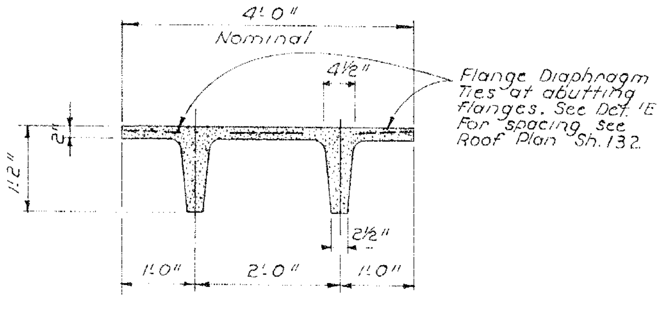
Scale: ¾" = 1'-0"



ELEVATION **SECTION**

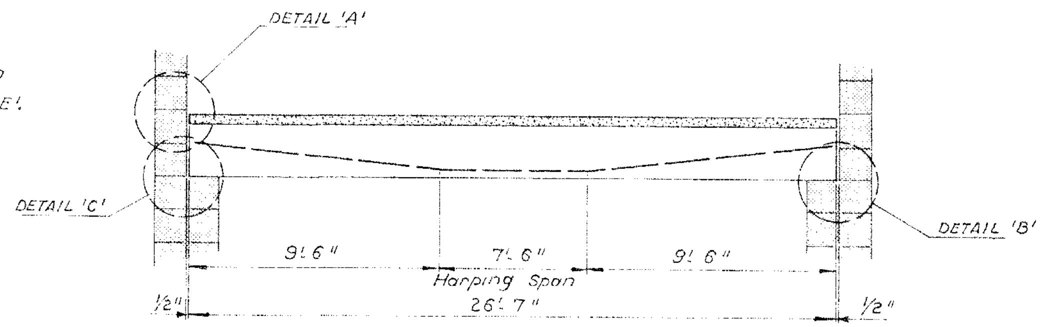
DIAPHRAGM 'A'

Scale: ¾" = 1'-0"

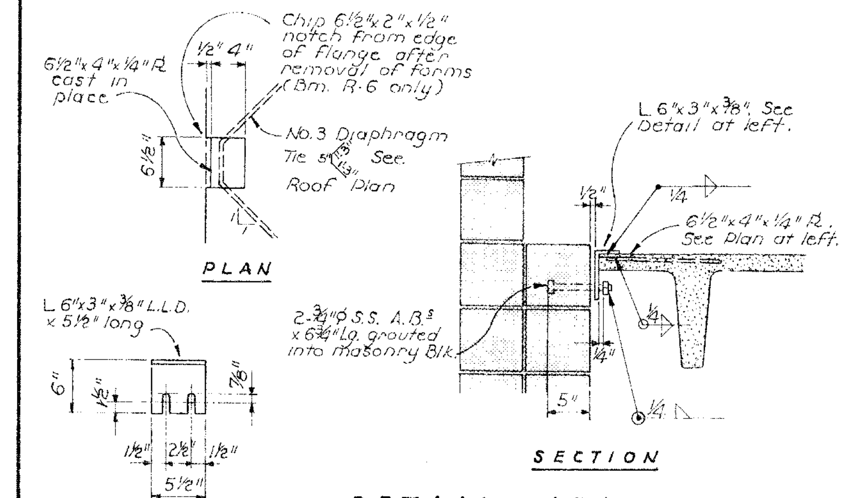


ROOF BEAM SECTION

Scale: ¾" = 1'-0"



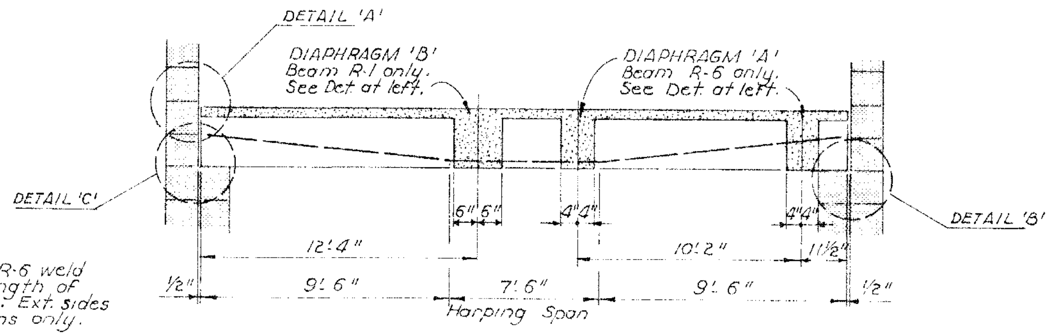
ROOF BEAMS R-3, R-4, R-5



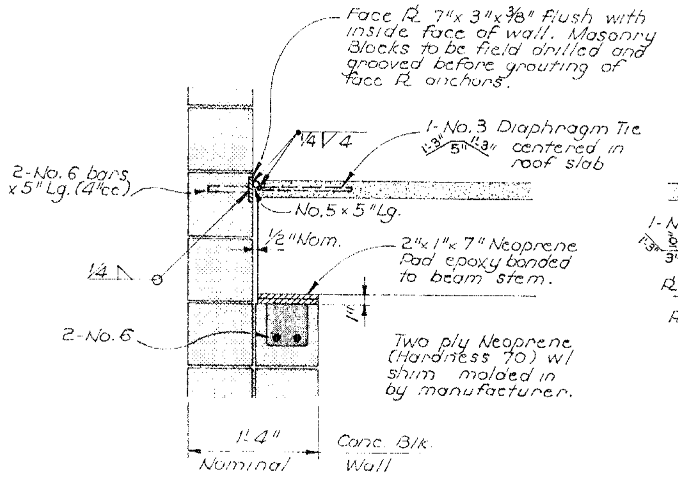
ANGLE ELEV. **SECTION**

DETAIL 'D'

Scale: 1" = 1'-0"

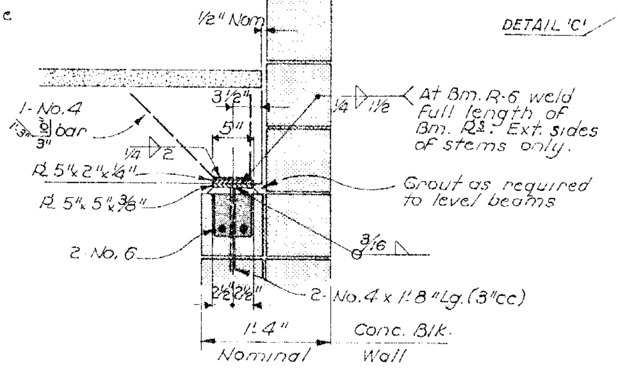


ROOF BEAMS R-1, R-2, R-6



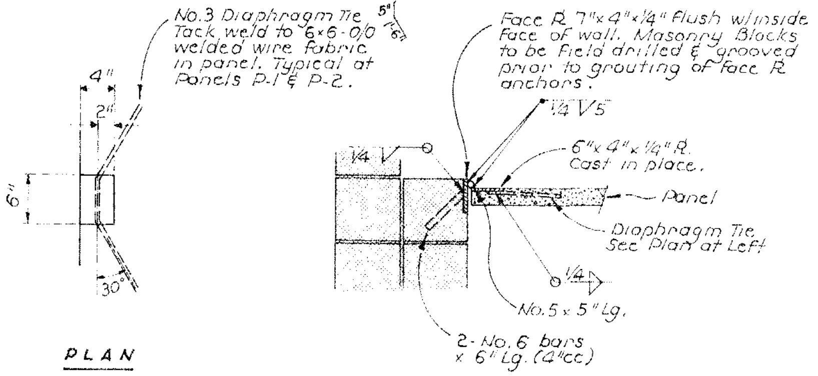
DETAIL 'A' (TOP)
DETAIL 'B' (BOTT.)

Scale: 1" = 1'-0"



DETAIL 'B'

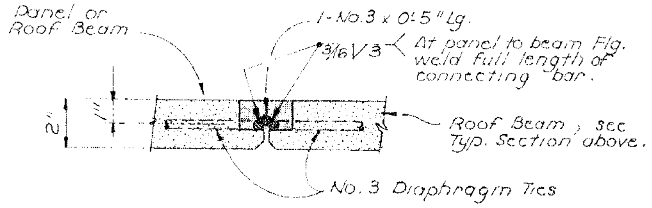
Scale: 1" = 1'-0"



PLAN **SECTION**

DETAIL 'F'

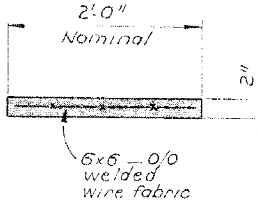
Scale: 1" = 1'-0"



FLANGE DIAPHRAGM TIE CONN.

DETAIL 'E'

Scale: 3" = 1'-0"



ROOF PANEL SECTION

Scale: 1" = 1'-0"

BEAM	BEAM D.L.	S.D.L.	U.L.L.	MONORAIL* EQUIV. U.L.L.	CAMBER
R-1	34 psf	11 psf	20 psf	53 psf	0.34"
R-2	" "	7 "	" "	" "	0.34"
R3, R-5	" "	7 "	" "	——	0.14"
R-4	" "	13 "	" "	——	0.18"
R-6	" "	7 "	" "	49 psf	0.30"

* INCLUDES EQUIV. U.D.L. DIAPHRAGMS

NOTES

1. All harping spans shown may be varied by the manufacturer to control camber and/or concrete stresses.
2. The values given for cambers are those required to offset the deflections resulting from superimposed dead and live loads. The Engineer should be notified for cases where the final camber, resulting from initial prestress, exceeds the given values by greater than 35%.
3. For location and details of Monorail anchors at Diaphragm, see Sh. 129.

(REVISED SET JUNE 2006)

Record Drawing

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RECORD DRAWING, JUNE 1982.

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

BELMONT PUMP STATION
SUPERSTRUCTURE
ROOF BEAM DETAILS

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: LFI MR	Scale: AS NOTED
Des./Chkd by: AGE	Date: 8-77/9-79

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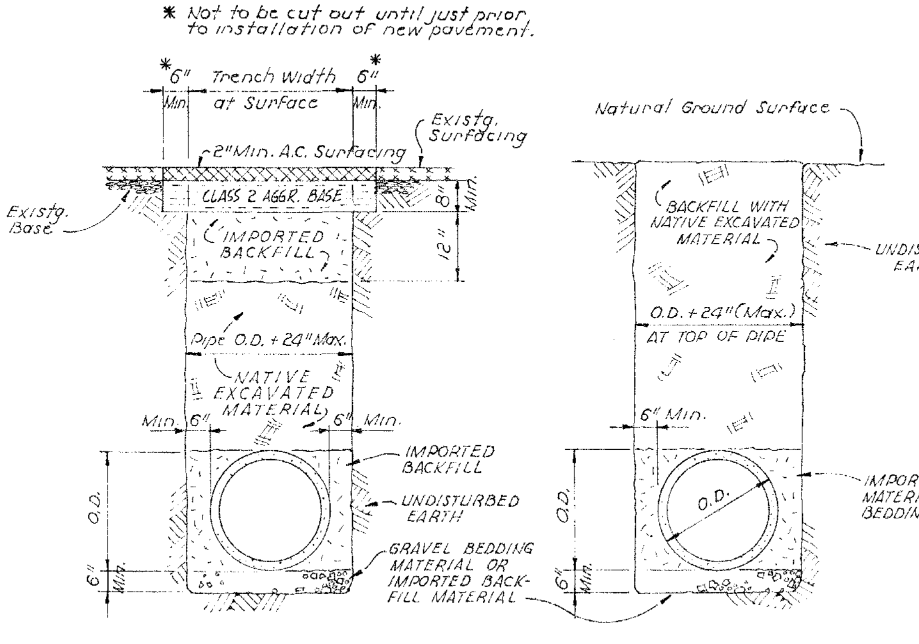
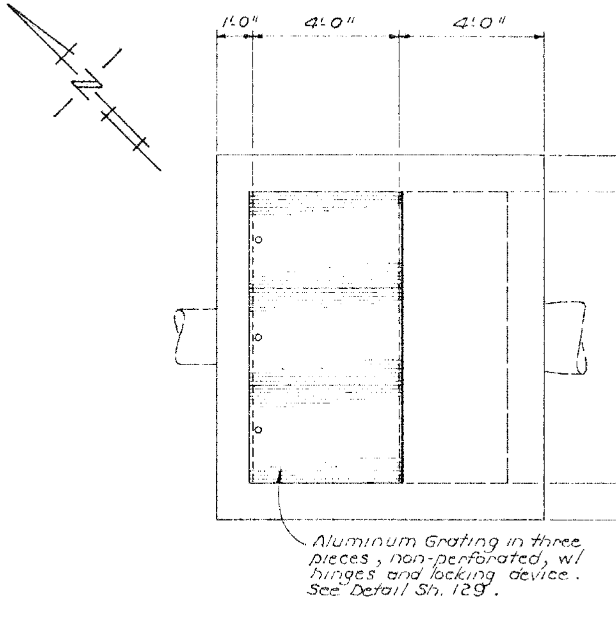


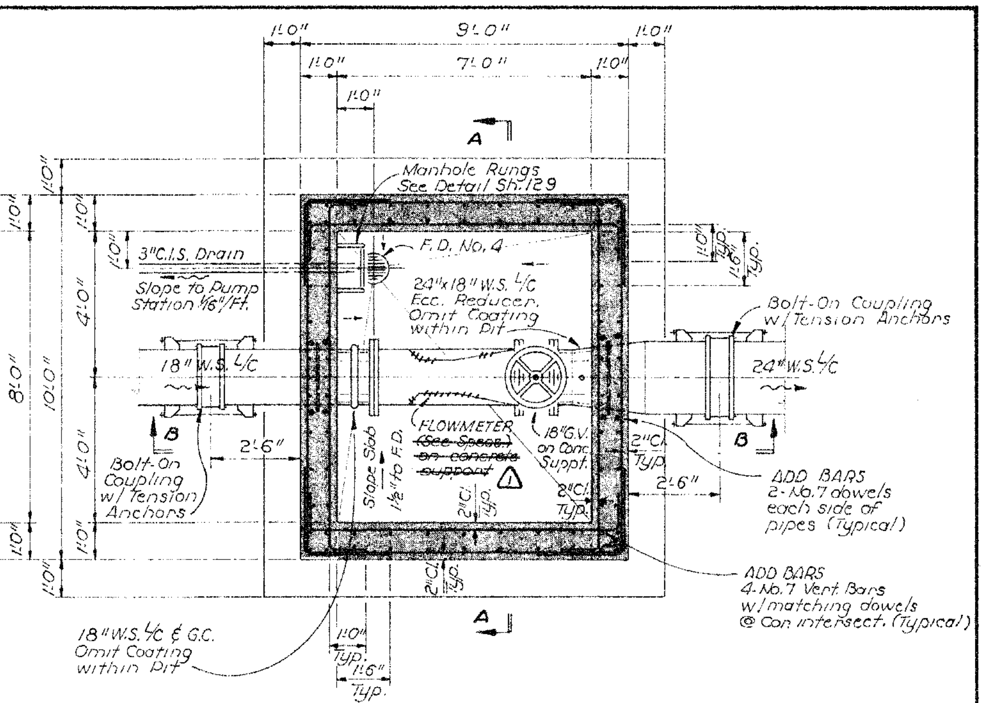
TYPICAL TRENCH SECTIONS

No Scale



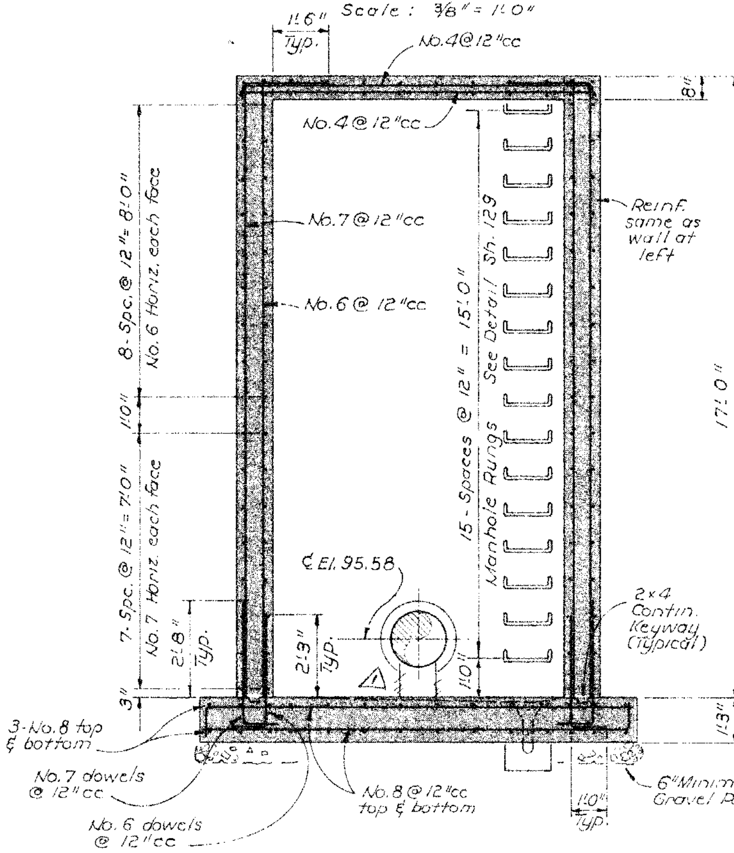
DECK PLAN

Scale: 3/8" = 1'0"



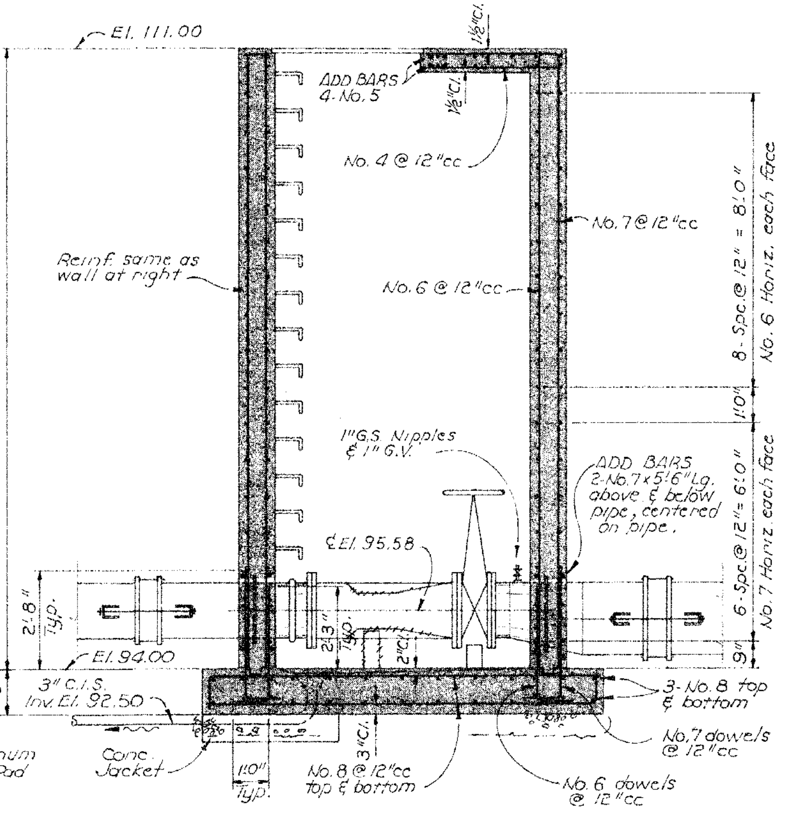
SECTIONAL PLAN

Scale: 3/8" = 1'0"



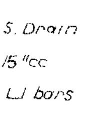
SECTION A - A

Scale: 3/8" = 1'0"



SECTION B - B

Scale: 3/8" = 1'0"



CONC. JACKET DETAIL

Scale: 3/8" = 1'0"

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(REVISED SET JUNE 2006)

⚠ RECORD DRAWING, JUNE 1982

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	BELMONT PUMP STATION FLOWMETER PIT PLANS, SECTIONS AND DETAILS
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: LLK — Scale: AS NOTED Des/Chkd by: DAB — Date: 8-77/9-79

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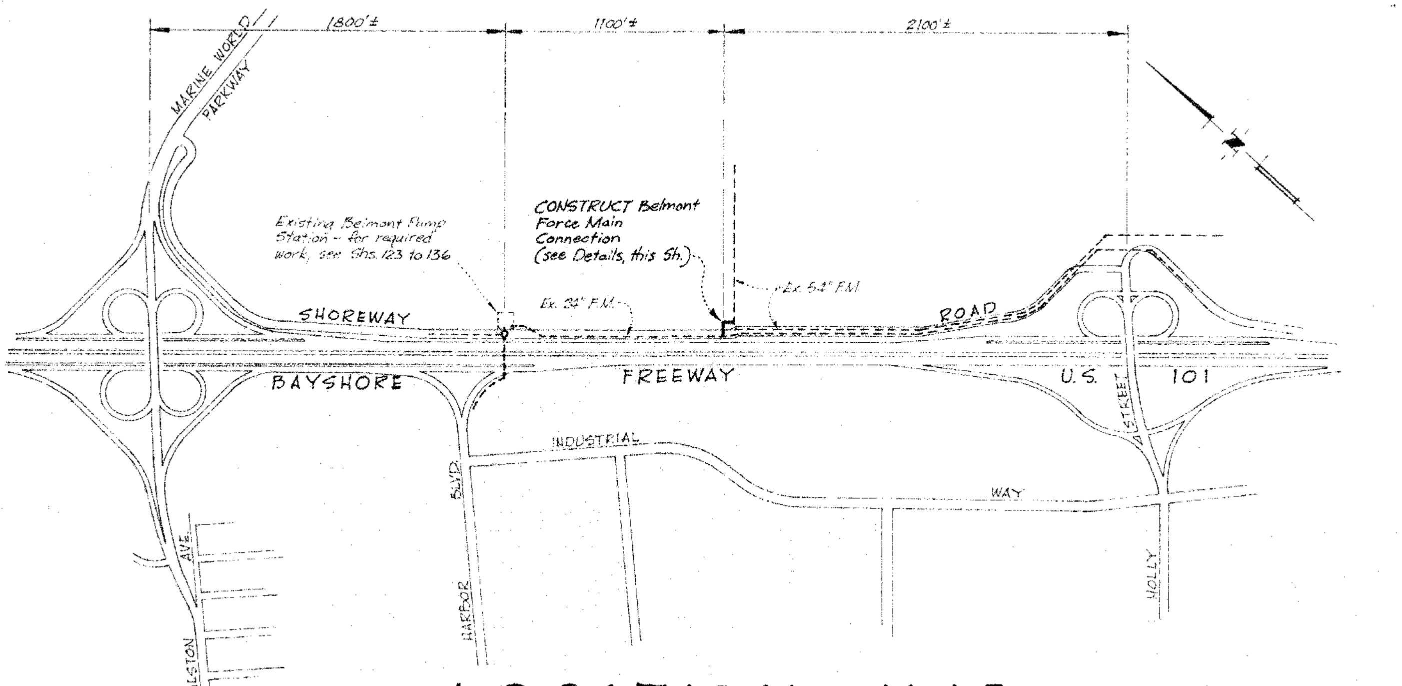
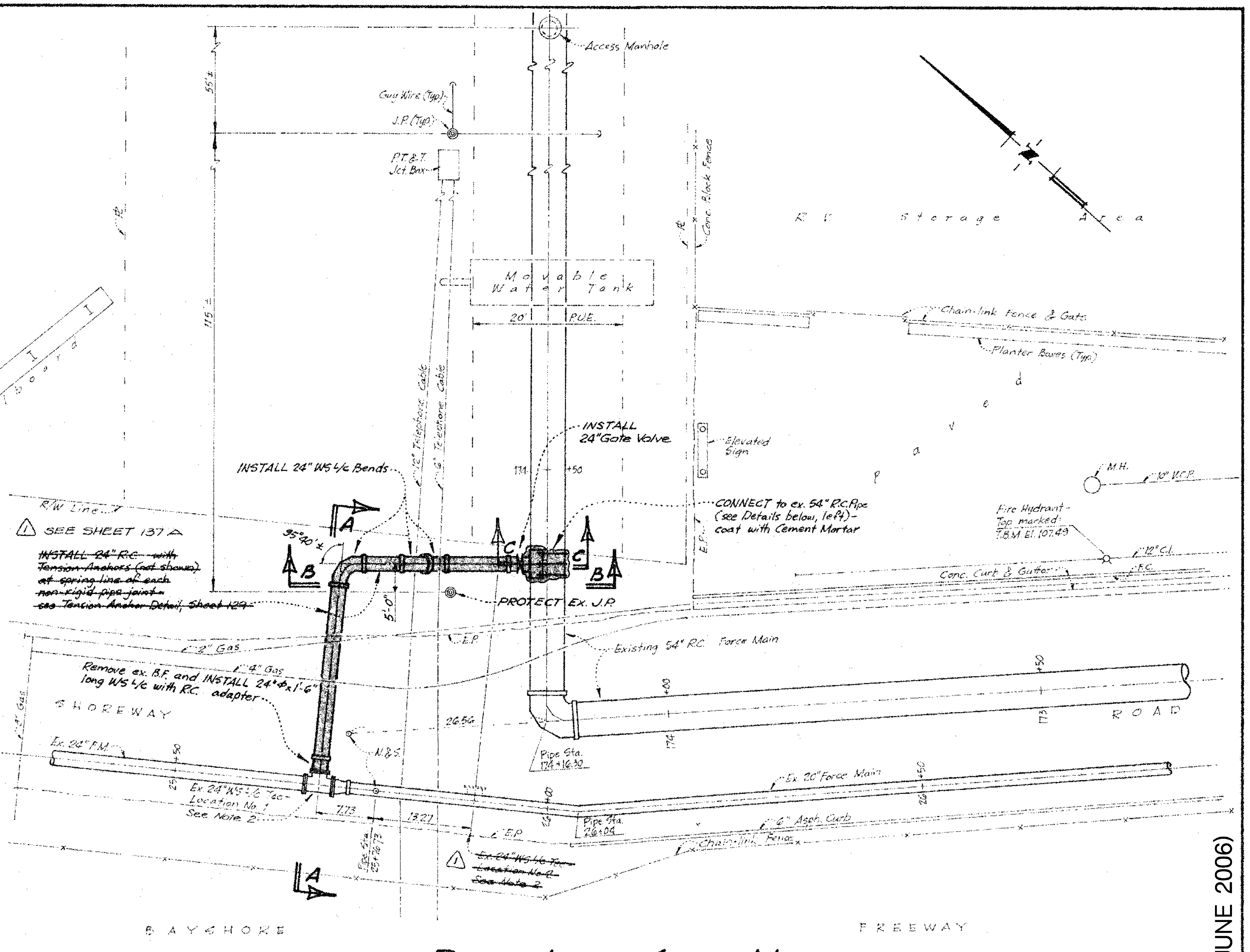


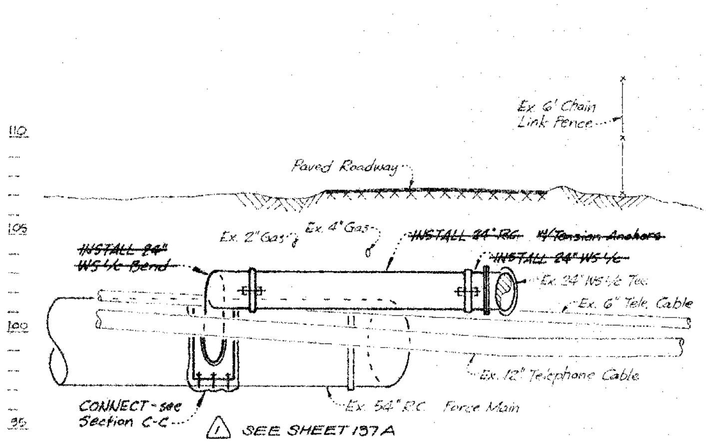
LOCATION MAP

Scale: 1" = 500'



P L A N

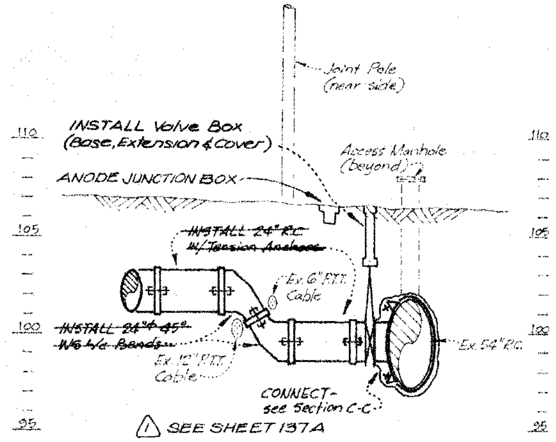
Scale: 1" = 10'



SEE SHEET 137 A

SECTION A-A

Scales – Horiz.: 1" = 10'
Vert.: 1" = 5'



SEE SHEET 137 A

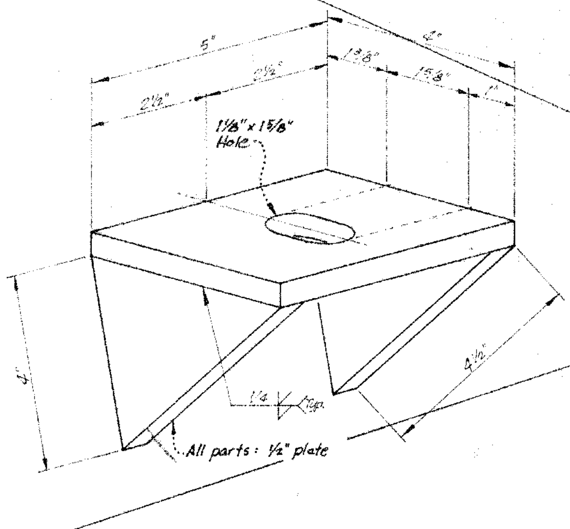
SECTION B-B

Scales – Horiz.: 1" = 10'
Vert.: 1" = 5'

NOTES

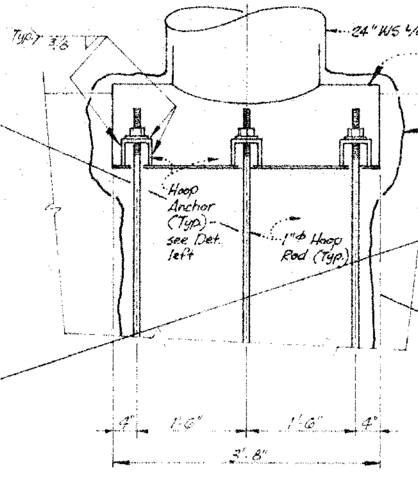
1. The Construction Notes shown on Sheet 123 which apply to the Belmont Pump Station Improvements shall also apply to the Belmont Force Main Connection Construction.

2. The Contractor shall uncover and expose the existing 24" and 54" Force Mains and the underground telephone cables and shall then layout the 24" Belmont Force Main Connection. The Contractor shall complete this layout work and shall submit it for approval prior to the fabrication of this pipework. The Contractor's attention is directed to the alternate locations of the existing 24" WS L/C Tee as shown on the Plan above. Location No. 1 is considered the more likely location.



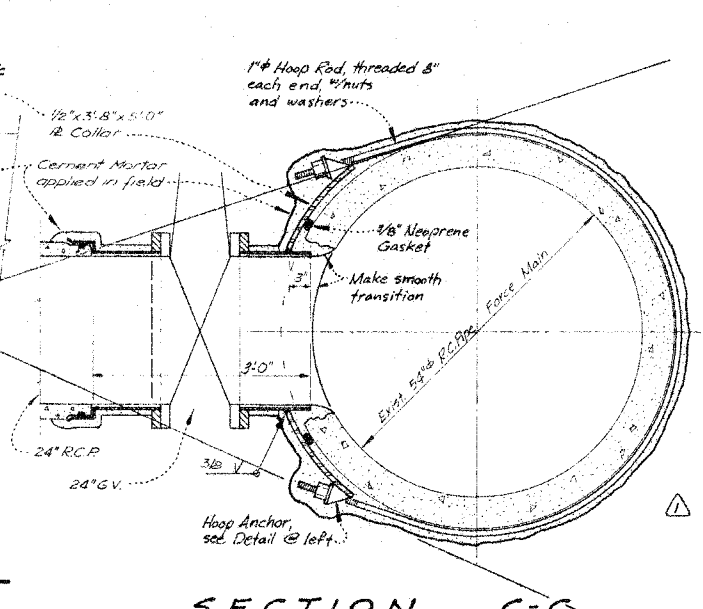
ANCHOR DETAIL

No Scale



PART ELEVATION

Scale: 3/4" = 1'-0"



SECTION C-C

Scale: 3/4" = 1'-0"

SEE SHEET 137 B

Record Drawing

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137 OF 141

RECORD DRAWING, JUNE 1982

(REVISED SET JUNE 2006)

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

BELMONT PUMP STATION
BELMONT FORCE MAIN CONNECTION
PLANS, SECTIONS AND DETAILS

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: CVB
Scale: AS NOTED
Des/Chkd by: DAB
Date: 8-77/9-79

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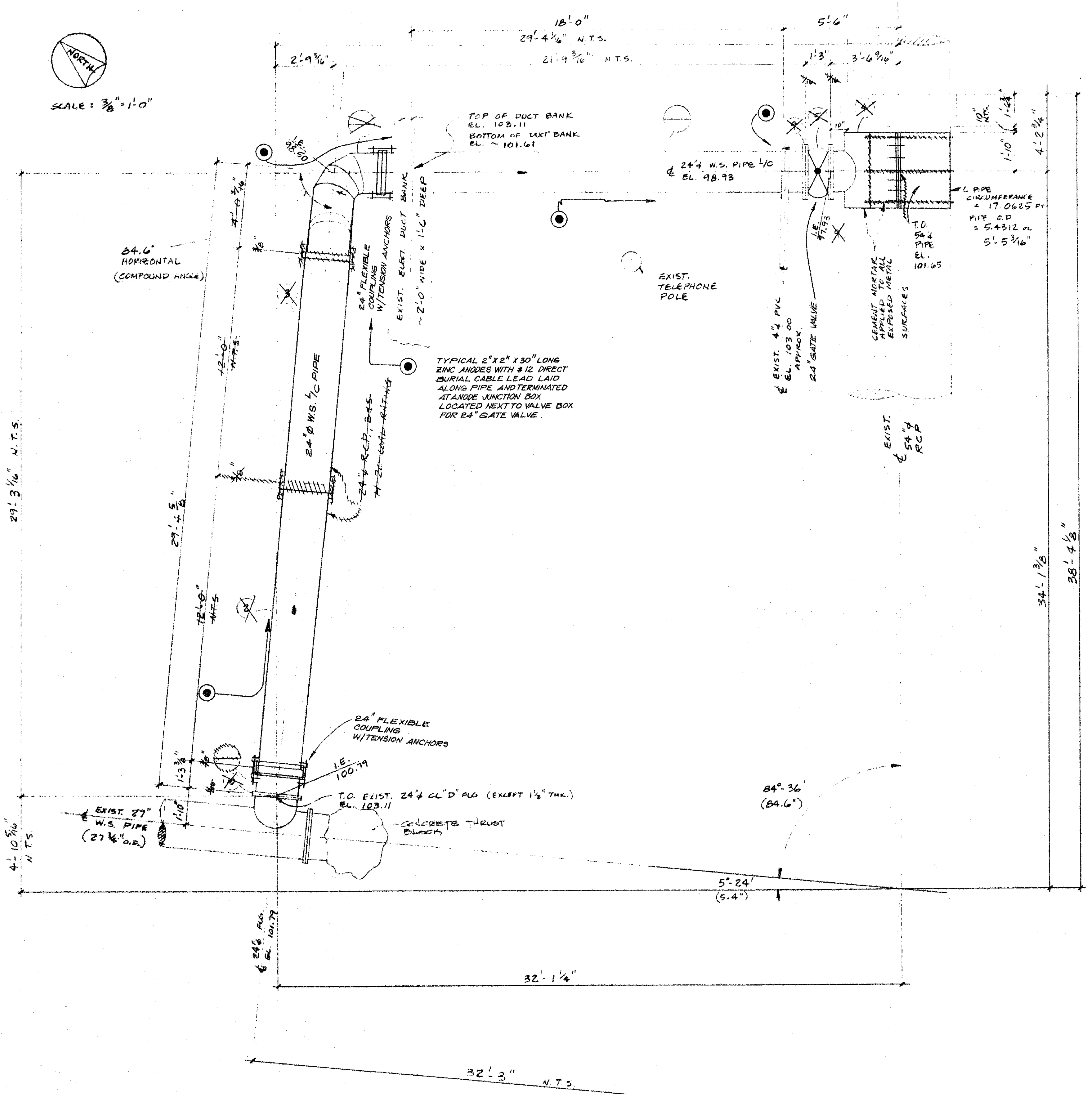
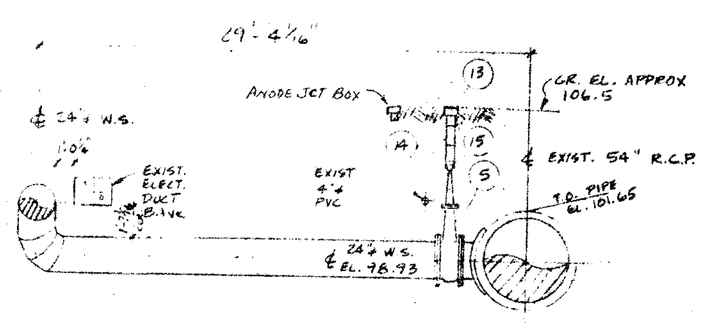
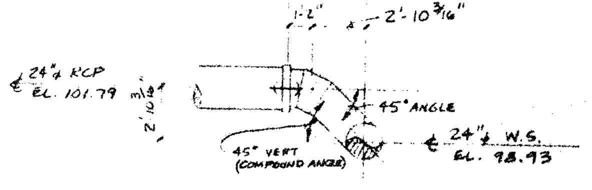


SHOREWAY ROAD
PLAN - ~~BELMONT STREET~~ PIPING



ELEVATION
SCALE 3/16"=1'-0"



ELEVATION
SCALE: 3/16"=1'-0"

Record Drawing

(REVISED SET JUNE 2006)

137A OF 141

⚠ RECORD DRAWING, JUNE 1982

SUBMITTED
JENKS & HARRISON DATE
APPROVED
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SOUTH BAYSIDE SYSTEM AUTHORITY
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BELMONT PUMP STATION
BELMONT FORCE MAIN CONNECTION
PLANS, SECTIONS AND DETAILS

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: CVB
Scale: AS NOTED
Des/Chkd by: DAB
Date: 8-77/9-79

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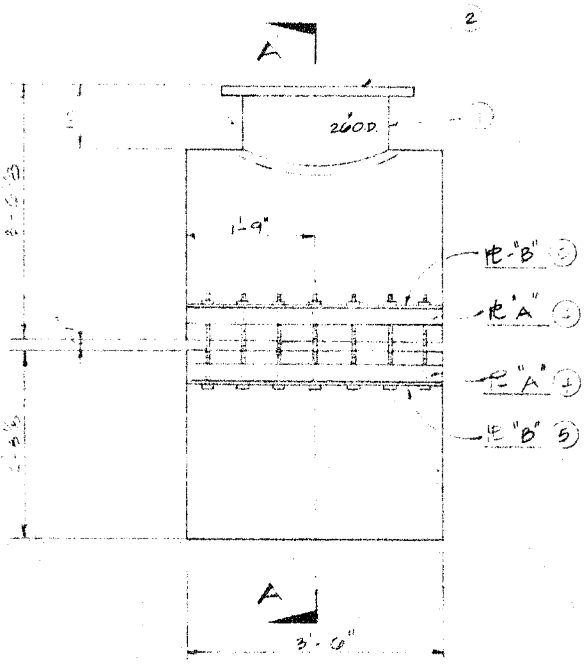
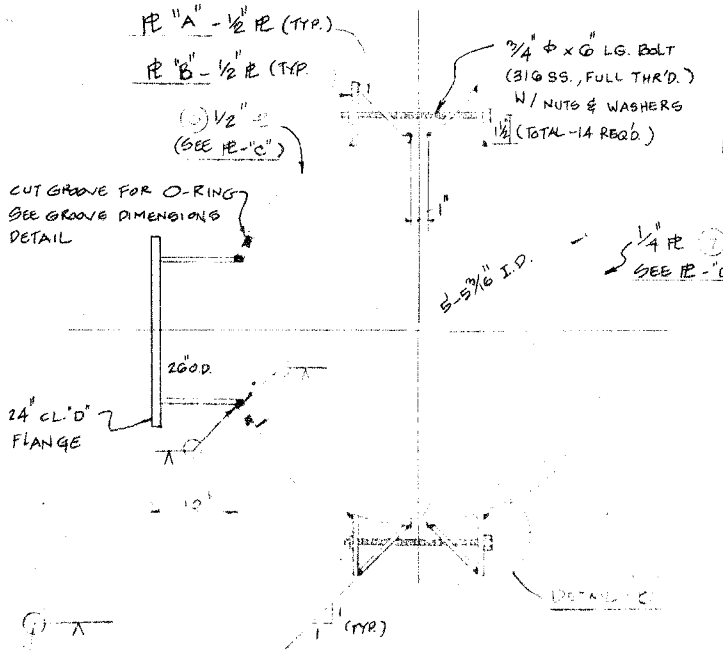
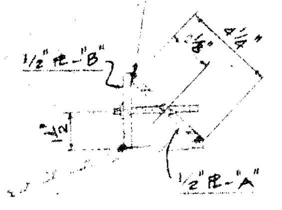


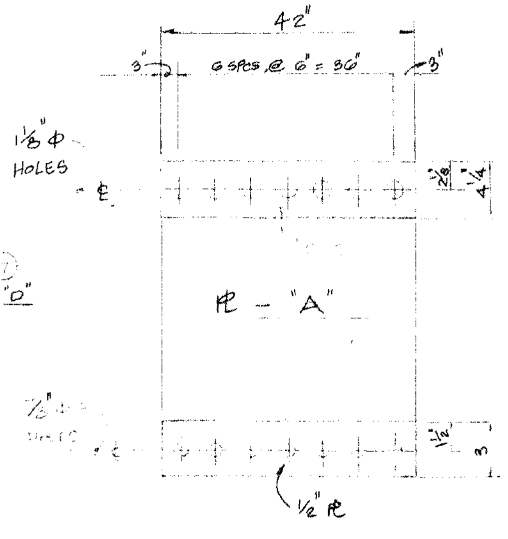
(1) REQ'D. M-455-4
CML — OUTLET ONLY
CTxC ~ CTxL



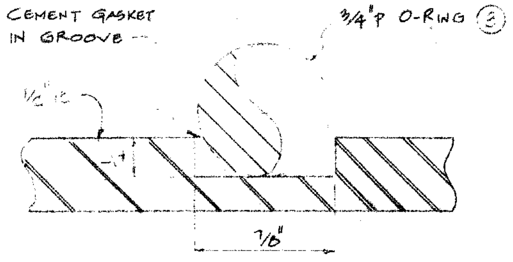
SECTION 'A-A'



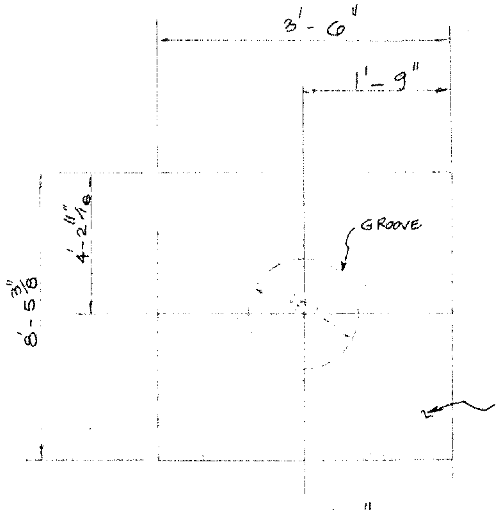
DETAIL - "B"
TYPICAL 4 PLCS.



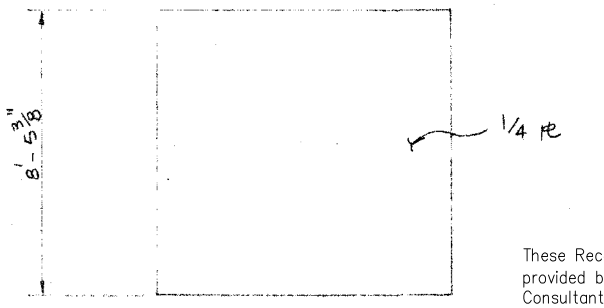
PL ~ 'B'



GROOVE DIMENSIONS - DETAIL
GROOVE I.D. = 28"



PL - "C"



PL - "D"

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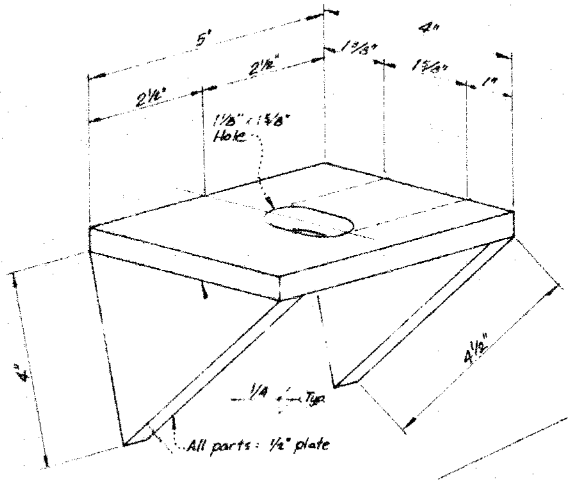
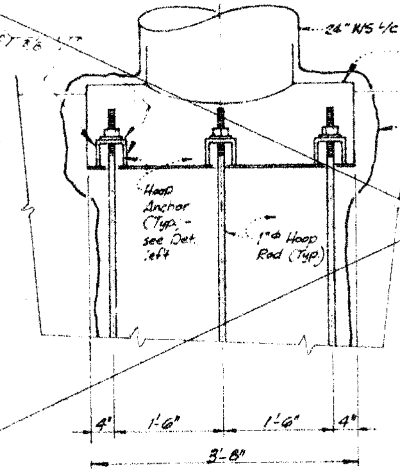
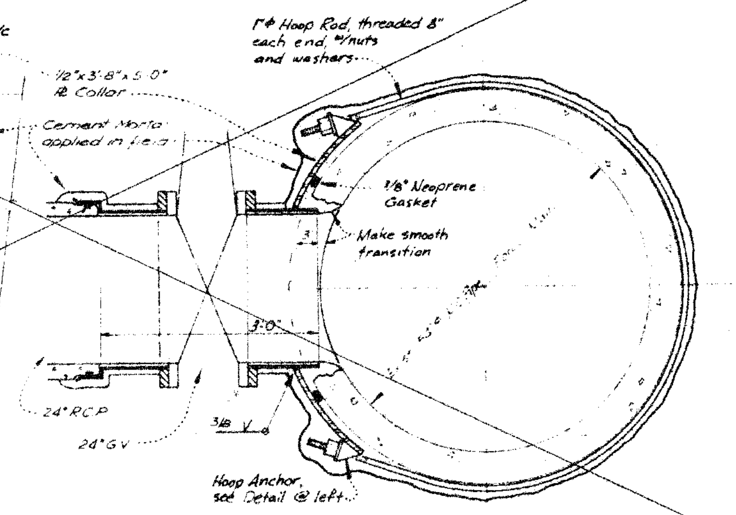
(REVISED SET JUNE 2006)



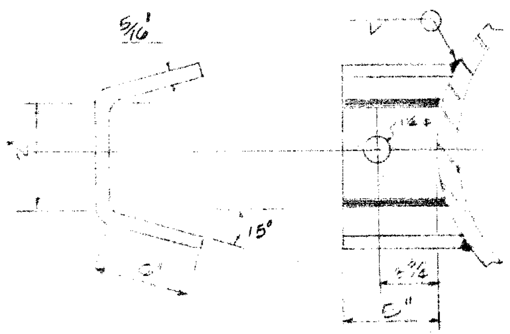
ANCHOR DETAIL
No Scale



PART
ELEVATION
Scale: 3/4" = 1'-0"



SECTION C-C
Scale: 3/4" x 1'-0"



24" HARNESS LUG DETAIL

137B
OF
141

⚠ RECORD DRAWING, JUNE 1982

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	BELMONT PUMP STATION BELMONT FORCE MAIN CONNECTION PLANS, SECTIONS AND DETAILS
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: CVB — Scale: AS NOTED Des/Chkd by: DAB — Date: 8-77/9-79

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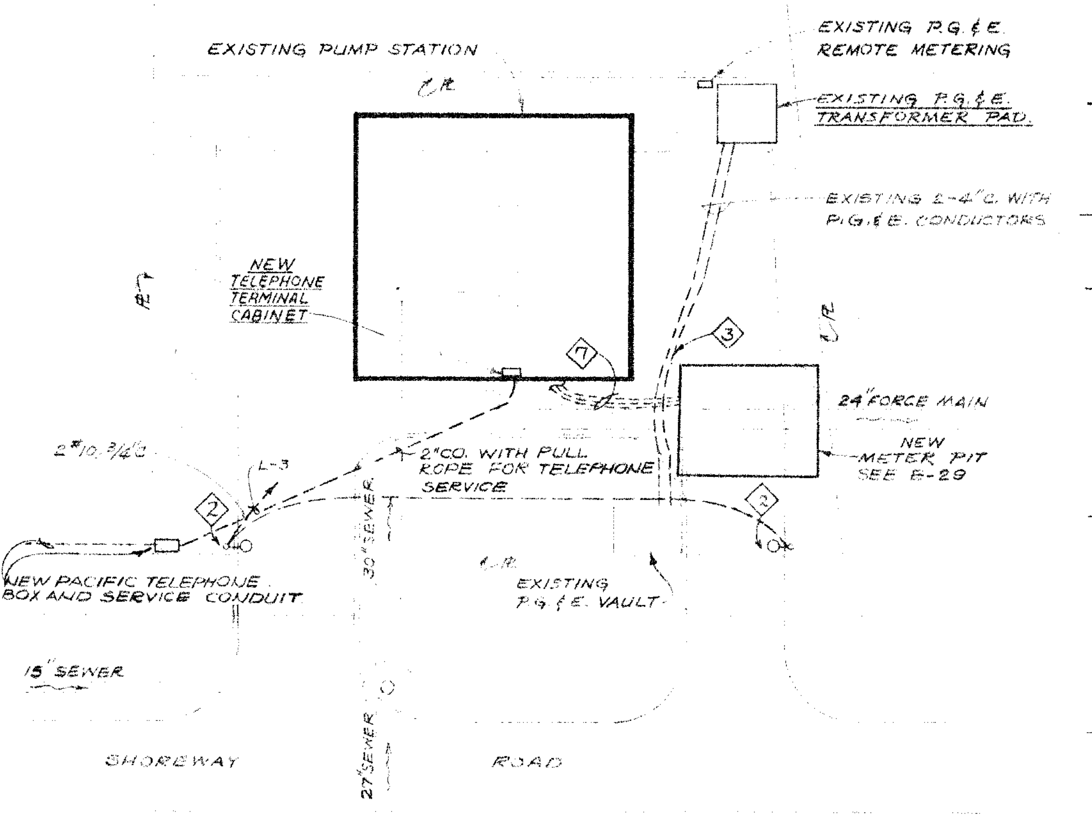


SITE PLAN

SCALE: 1" = 40'-0"

SHEET NOTES

◇1 REMOVE EXISTING FLOWMETER AND INSTALL NEW 120/208V PANEL "2L", SIMILAR TO EXISTING PANEL "L" IN THAT SECTION. PROVIDE NECESSARY TRIM, TO MATCH EXISTING.

◇2 RELOCATE EXISTING LIGHTING FIXTURES AND POLES. SEE DETAIL D/E-30 FOR NEW CONCRETE BASE. REMOVE ALARM BEACON.

◇3 RELOCATE EXISTING P.G.&E PRIMARY SERVICE FEEDERS. COORDINATE WITH P.G.&E.

◇4

◇5 REMOVE KIRK-KEY INTERLOCKING BETWEEN TWO CIRCUIT BREAKERS.

◇6 ADD ONE 20A/1P CIRCUIT BREAKER TO PANEL "L" CIRCUIT #13.

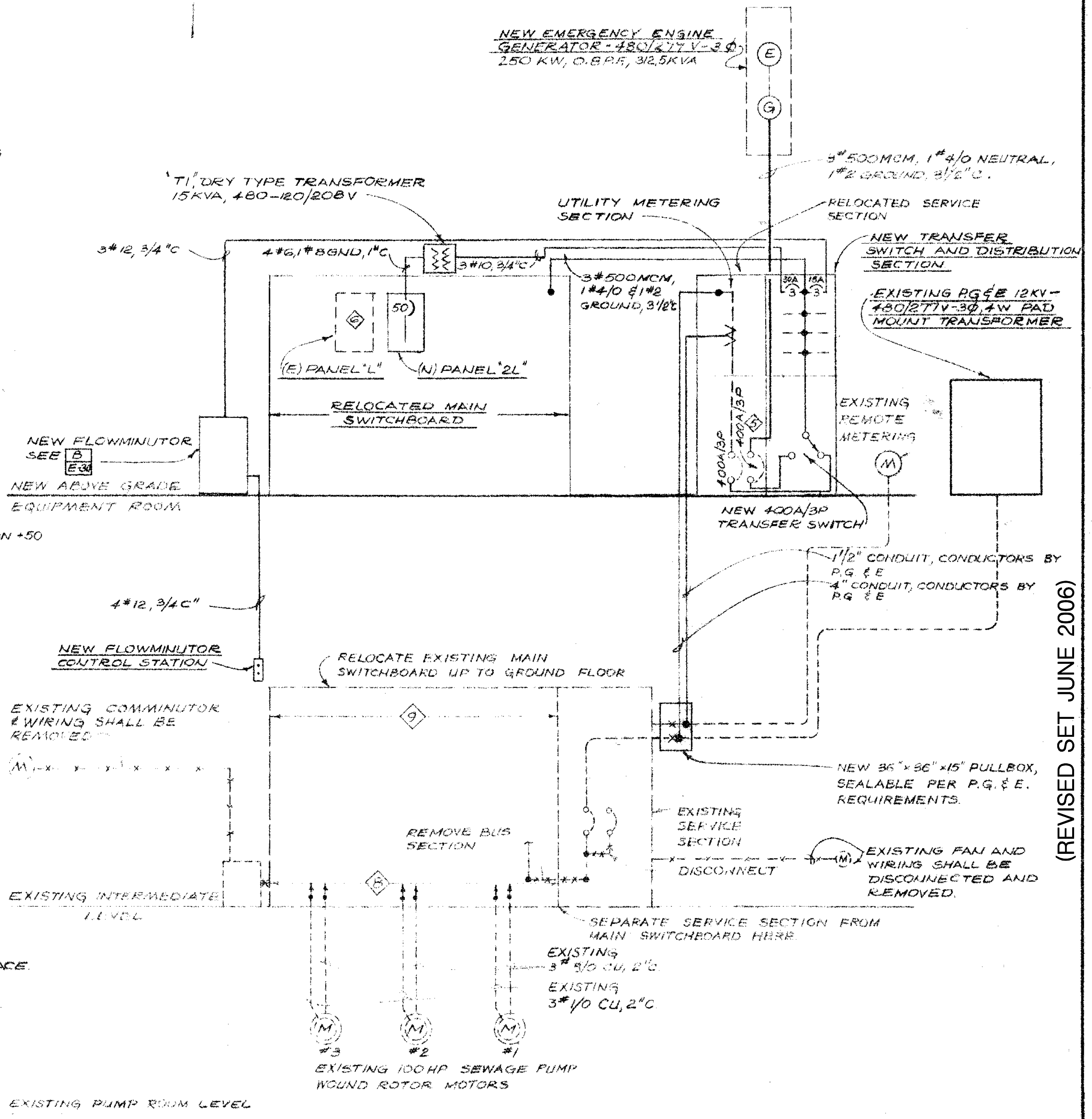
◇7 POWER AND INSTRUMENTATION FEEDERS FROM METER PIT TO MAIN BUILDING CONTINUED ON E-28 GROUND FLOOR, AND E-29 METER PIT PLAN.

◇8 REMOVE WIRES IN CONDUITS ENTERING SWITCHBOARD FROM BELOW, EXTEND CONDUITS UP THROUGH ROOF TO NEW SWITCHBOARD LOCATION AND INSTALL NEW WIRES. EXTEND BUBBLER PIPE UP THROUGH ROOF TO NEW SWITCHBOARD LOCATION.

◇9 INSTALL JUNCTION BOXES ON CONDUIT ENTERING EXISTING SWITCHBOARD FROM HAZARDOUS LOCATION. EXTEND THESE FEEDERS UP TO NEW SWITCHBOARD LOCATION. EXTEND OTHER OH CONDUITS UP THROUGH ROOF TO NEW SWITCHBOARD LOCATION AND INSTALL NEW WIRES.

LEGEND

(M)	EXISTING MOTOR OUTLET AND CONNECTION
Ⓜ	NEW MOTOR OUTLET AND CONNECTION
———	EXPOSED CONDUIT
⊖	MECHANICAL EQUIPMENT IDENTIFICATION TAG
⬡	LIGHTING FIXTURE IDENTIFICATION TAG.
—X— —X—	DISCONNECT AND REMOVE
Ⓕ	FLOW SWITCH
—B—	BUBBLER AIR PIPING
(LS)⊣	LEVEL SWITCH.
⊟	SECTION OR DETAIL IDENTIFICATION TAG.
Ⓣ	THERMOSTAT, +96"
SP	SWITCH WITH PILOT LIGHT +48"
ST	MANUAL MOTOR STARTER.
◇	SHEET NOTE IDENTIFICATION TAG.
— — —	CONDUIT RUN CONCEALED BELOW FLOOR OR GRADE.
○⊸	EXTERIOR LIGHTING STANDARD.
Ⓕ	AIR FLOW SWITCH.
▲	WALL MOUNTED TELEPHONE PER SPECIFICATION +50
FS	FLOAT SWITCH.
—◢—	CONDUIT SEAL.
○⊣	BUBBLER TUBE.
W.P.	WEATHERPROOF.
⊖=	RECEPTACLE, DUPLEX 15A, 3P, 120V.
S	SINGLE POLE WALL SWITCH +54"
U.O.N.	UNLESS OTHERWISE NOTED.
Ⓙ	JUNCTION BOX.
◇⌒	INDICATES EQUIPMENT CONNECTION.
L	LOCK-OUT STOP PUSHBUTTON.
(E)	EXISTING.
PH	PHOTOCELL.
○⊣	LIGHTING FIXTURE & OUTLET, WALL MTD
▭	FLUORESCENT FIXTURE & OUTLET, SURFACE.



SINGLE LINE DIAGRAM

(REVISED SET JUNE 2006)

138 OF 141

Record Drawing

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Alfred W. Marion
MARION, CERBATOS AND TOMASI
MECHANICAL AND ELECTRICAL ENGINEERS

RECORD DRAWING, JUNE 1982 E-27

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA
SUBREGIONAL WASTEWATER WORKS
BELMONT PUMP STATION
ELECTRICAL
SITE PLAN - LEGEND - DIAGRAM
JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: JW RB
Scale: AS NOTED
Des/Chkd by: AMM
Date: 8-77/9-79

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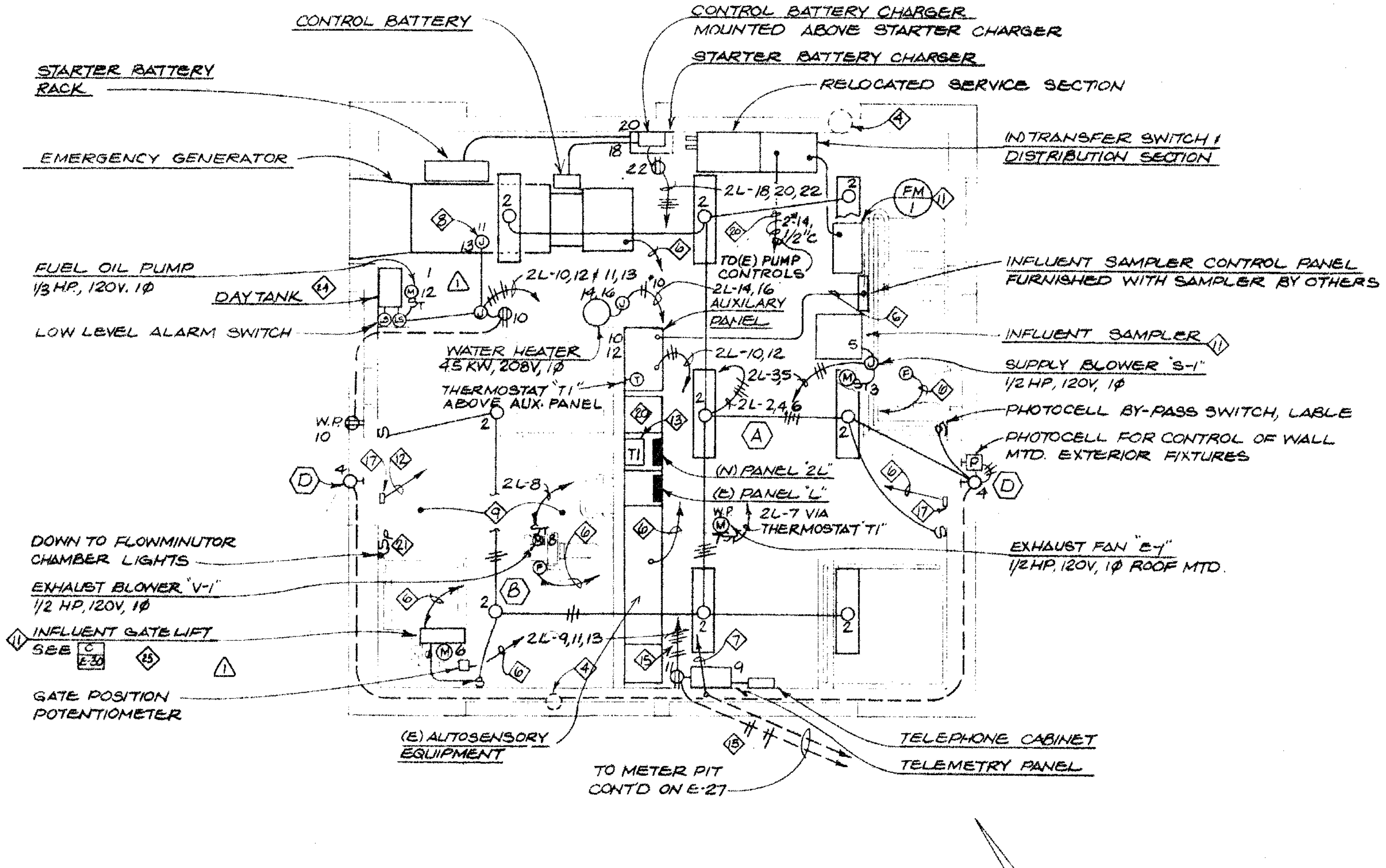
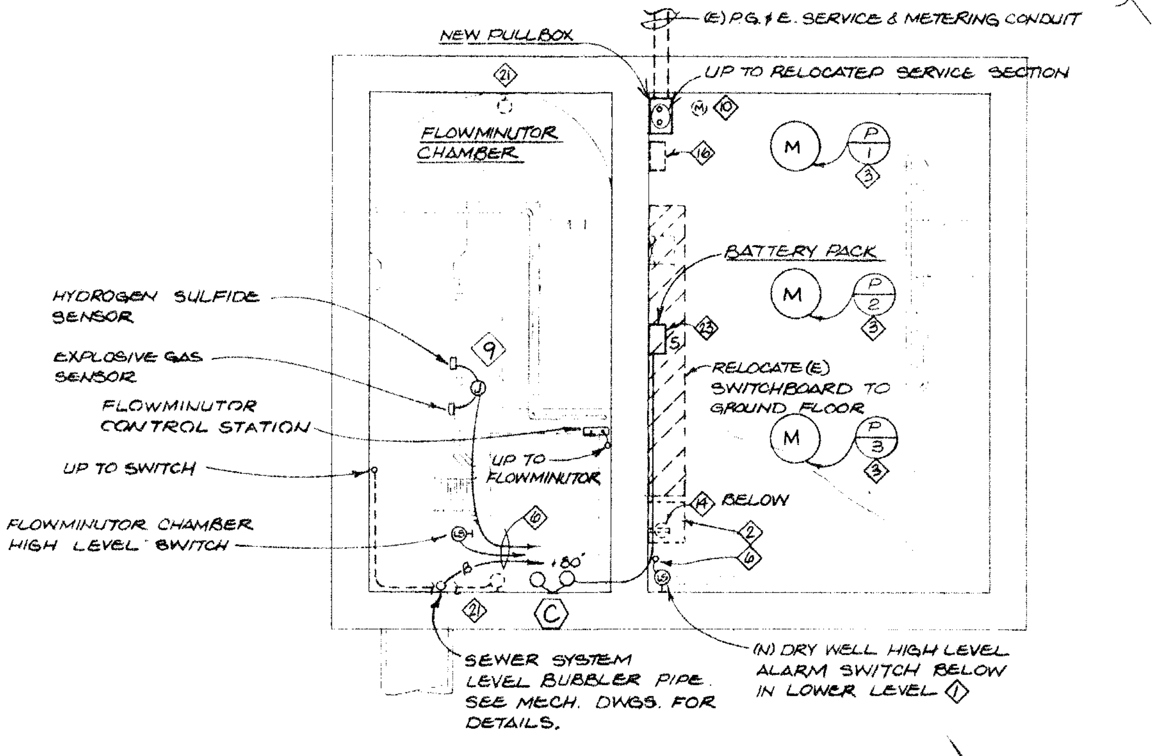


GROUND FLOOR PLAN

SCALE : 1/4"=1'-0"



INTERMEDIATE FLOOR PLAN.

SCALE: 1/4"=1'-0"

SHEET NOTES

1. SET SUMP HIGH LEVEL ALARM SWITCH TO OPERATE 2" BELOW TOP OF SUMP
2. DISCONNECT EXIST. COMMUNITOR HYDRAULIC PUMP UNIT. REMOVE CONDUIT AND WIRE.
3. EXISTING PUMPS TO REMAIN
4. EXISTING POST FIXTURES SHALL BE REMOVED AND BE RELOCATED, SEE SITE PLAN. DISCONNECT AND REMOVE WIRING BACK TO NEAREST J-BOX.
5.
6. TO AUXILARY PANEL, SEE A/E-29 B/E-29
7. TO FLOW METER IN AUXILARY PANEL.
8. GENERATOR HEATER. VERIFY EXACT LOCATION WITH GENERATOR SHOP DWG. 2KW, 208V-1Ø.
9. ALL MATERIALS IN THIS ROOM SHALL BE IN ACCORDANCE WITH N.E.C. ARTICLE #500 FOR CLASS I, DIVISION 1, HAZARDOUS LOCATION.
10. EXISTING VENTILATION FAN IS TO BE REMOVED. REMOVE CONDUIT AND WIRE.
11. PACKAGE UNIT, REFER TO MANUFACTURER'S INSTRUCTIONS.
12. TO INTRINSICALLY SAFE RELAY IN AUXILARY RELAY PNL. SEE B/E-29
13. WALL MOUNT TRANSFORMER "T1" ABOVE SWITCHBOARD.
14. RECIRCUIT (E) RECEPTACLE FOR SUMP PUMP IN LOWER LEVEL FROM 1L-4 TO 2L-1.
15. RUN SEPARATE NEUTRALS, DO NOT COMBINE.
16. DISCONNECT AND REMOVE EXIST. FLOW TRANSMITTER AND HAND OVER TO OWNER. REMOVE ALL EXPOSED CONDUIT, WIRING AND AIR PIPING.
17. FURNISH AND INSTALL MAGNETIC DOOR SWITCHES WITH MAGNET, FOR EACH DOOR EDWARDS #61, WITH NORMALLY OPEN (DOOR CLOSED) CONTACTS. SEE B/E-29
18.
19. FURNISH AND INSTALL NEW PANEL "2L" AND INSTALL IN EMPTY FLOW RECORDER SECTION
20. (E) PUMP CONTROLS SHALL BE MODIFIED BY AUTOCON REPRESENTATIVE SO AS TO SWITCH OFF PUMPS PRIOR TO TRANSFER SWITCH OPERATION, SO AS TO PREVENT HIGH INRUSH CURRENTS ON TRANSFER.
21. 2-EXISTING LIGHTS IN FLOWMINUTOR CHAMBER ARE PANEL SWITCHED. REWIRE SO THAT THEY ARE CONTROLLED BY NEW SWITCH WITH PILOT LIGHT BY DOOR.
22. 1/2" C.O. FROM NEW TELEPHONE CABINET TO GROUND PER TELEPHONE CO. RULES AND REGULATION.
23. CONNECT BATTERY PACK TO (E) CIRCUIT L-5 AT THIS LOCATION. CIRCUIT 5 IS FOR FLOWMINUTOR CHAMBER LTG. LOSS OF POWER WILL ENERGIZE BATTERY OPERATED LIGHT C.
24. ADDED SECOND FUEL OIL PUMP AND CONTROL LEVEL SWITCH TO DAY TANK ON CIRCUIT #1
25. SLUICE GATE OPERATOR 460V, 3Ø W/ W.P. DISCONNECT.

(REVISED SET JUNE 2006)

Record Drawing

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1 RECORDRAWING , JUNE 1982

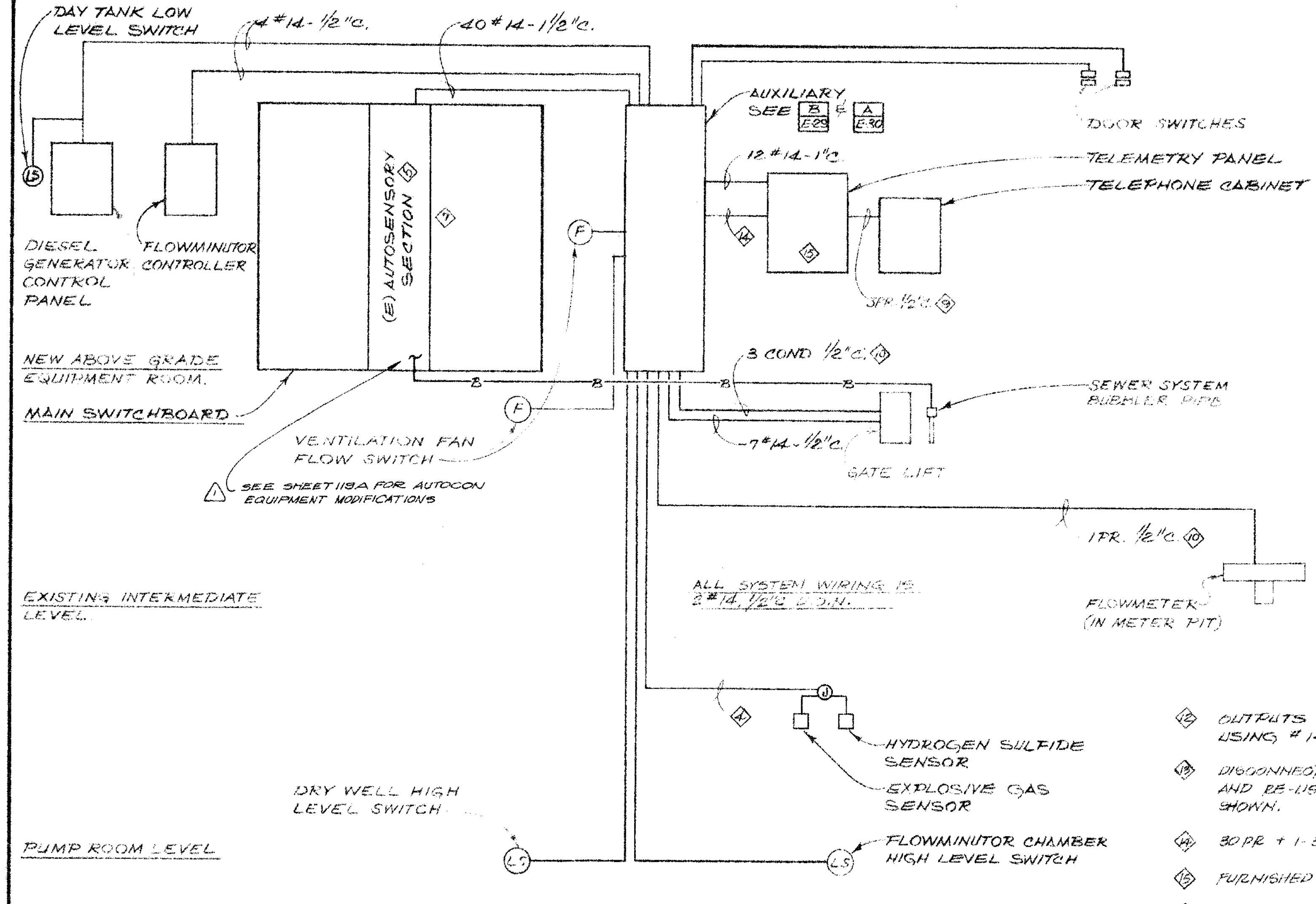
E-28

Alfred M. Marion
MARION, CERBATOS AND TOMASI
MECHANICAL AND ELECTRICAL ENGINEERS
361 OAK STREET
SAN FRANCISCO, CALIF. 94102
TEL. 863-7785

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA
SUBREGIONAL WASTEWATER WORKS
BELMONT PUMP STATION
ELECTRICAL
GROUND & INTERMEDIATE FLOOR PLANS
JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

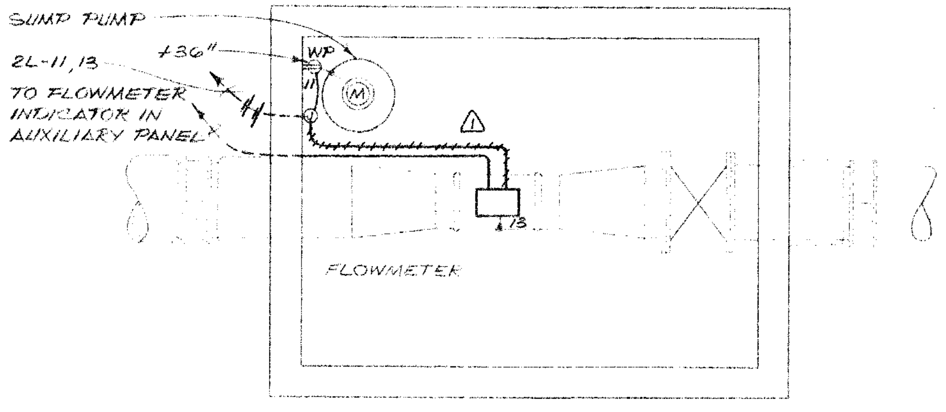
Drawn by:	JW RB	Scale:	AS NOTED
Des/Chkd by:	AMM	Date:	8-77/9-79



TELEMETRY SYSTEM RISER DIAGRAM

A/E29

NOT TO SCALE



METER PIT PLAN

SCALE: 3/8"=1'-0"

⑫ OUTPUTS FROM TELEMETRY SYSTEM, CONNECT USING # 14 WIRE.

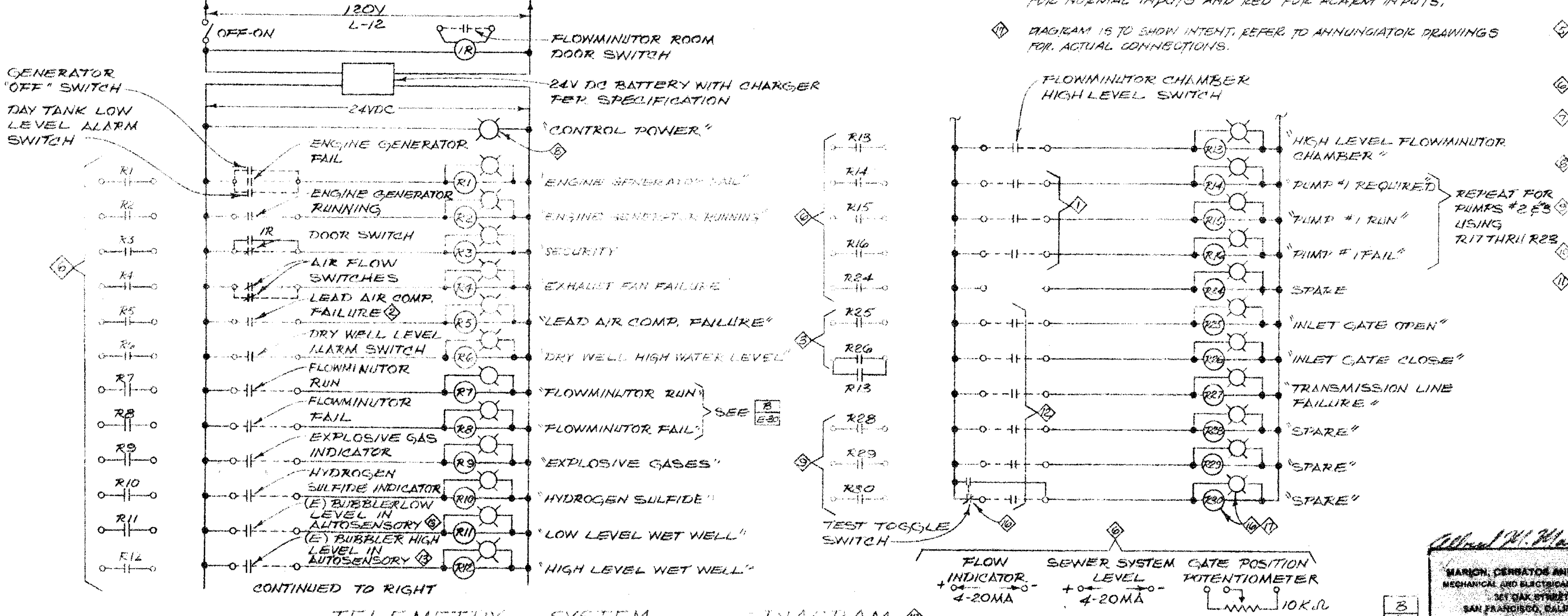
⑬ DISCONNECT EXISTING HIGH AND LOW LEVEL ALARM CIRCUIT AND RE-USE ALARM CONTACTS FOR TELEMETRY SYSTEM AS SHOWN.

⑭ 30 PR + 1-3 COND. 2 1/2"C.

⑮ FURNISHED BY OWNER, REFER TO AUTO CON DRAWINGS.

⑯ ANNUNCIATOR WINDOW WITH RELAY FOLLOWER AND THREE POSITION TEST TOGGLE SWITCH, TEST SWITCH IS SHOWN AT ONE LOCATION ONLY FOR CLARITY. BEZEL COLOR SHALL BE BLACK FOR NORMAL INPUTS AND RED FOR ALARM INPUTS.

⑰ DIAGRAM IS TO SHOW INTENT, REFER TO ANNUNCIATOR DRAWINGS FOR ACTUAL CONNECTIONS.



TELEMETRY SYSTEM DIAGRAM ⑰

B/E29

SHEET NOTES

① MODIFY EXISTING PUMP CONTROLS TO PROVIDE THESE CONTACTS.

② CONNECT TO (E) AIR COMPRESSOR CONTROLS SO THAT RELAY R5 IS ACTUATED ON LOSS OF AIR COMPRESSOR CONTROL POWER OR ACTUATION OF LEAD AIR COMPRESSOR FAILURE PRESSURE SWITCH.

③ TO INLET GATE CONTROL, SEE C/E30.

④ 1"C. CABLES ARE FURNISHED WITH SENSORS. VERIFY CONDUIT SIZE IS ADEQUATE BEFORE INSTALLING.

⑤ ADD TRANSDUCER FOR SEWER SYSTEM LEVEL BUBBLER PER SPECIFICATION INCLUDING GAGE AND ALL ACCESSORIES

⑥ CONNECT TO TELEMETRY PANEL, PER MANUFACTURER'S INSTRUCTIONS, USING TWISTED SHIELDED PAIR OR THREE CONDUCTOR.

⑦ CONNECT AUXILIARY PANEL TO EXISTING STARTERS, CONTROLS AND AUTOSENSORY AS INDICATED.

⑧ INSTALL INDICATING LIGHTS, WITH ENGRAVED NAMEPLATES, IN DOOR OF AUXILIARY PANEL.

⑨ NOT USED, PROVIDED FOR IN EQUIPMENT FURNISHED BY OWNER.

⑩ USE SAME SHIELDED CABLE AS FOR ⑥

⑪

(REVISED SET JUNE 2006)

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△1 RECORD DRAWING, JUNE 1982

E-29

MARION, CERGATOS AND TOMASI
MECHANICAL AND ELECTRICAL ENGINEERS
351 OAK STREET
SAN FRANCISCO, CALIF. 94102

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	BELMONT PUMP STATION ELECTRICAL TELEMETRY - METER PIT PLAN
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: JW, RB — Scale: AS NOTED Des/Chkd by: AMM — Date: 8-77/9-79

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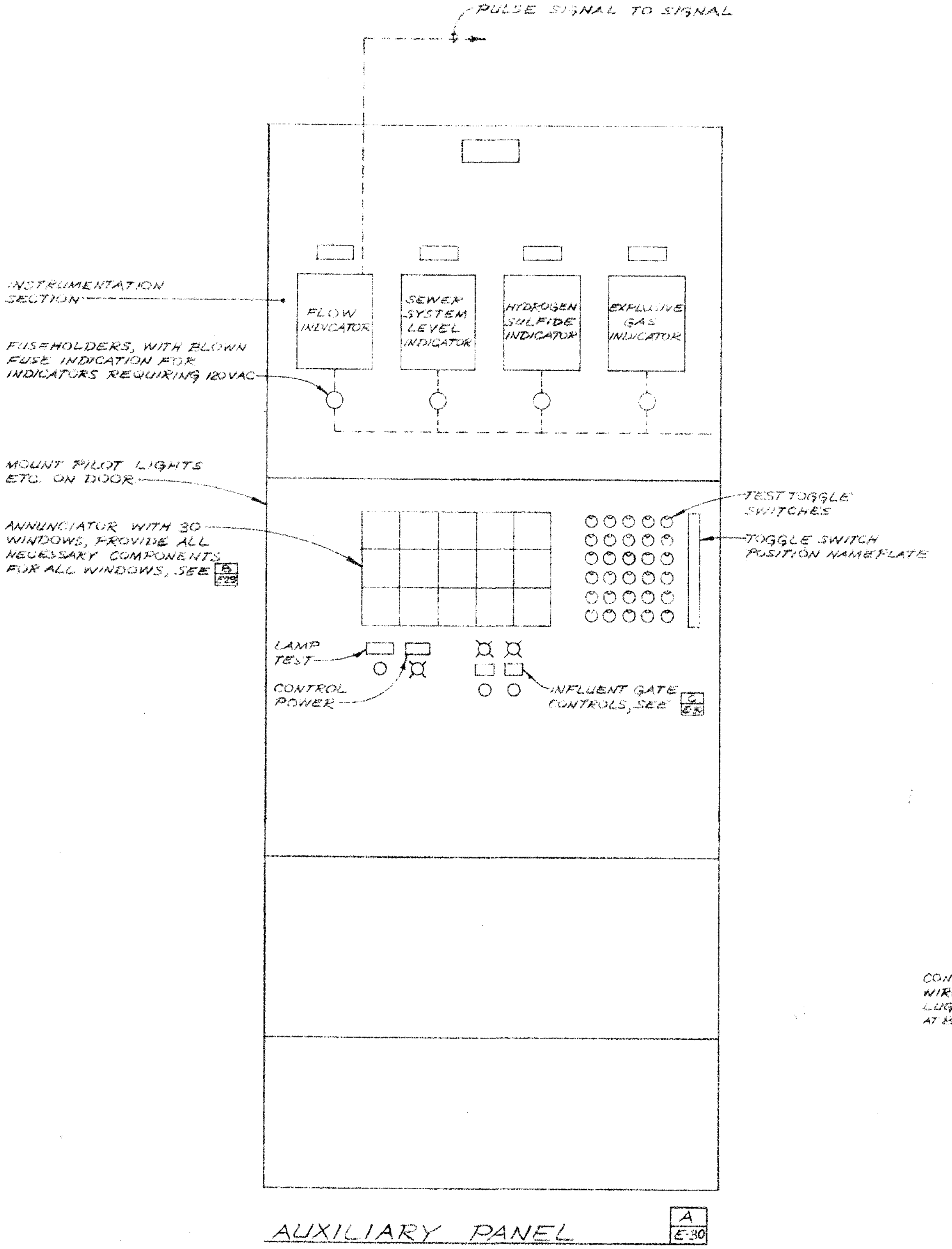
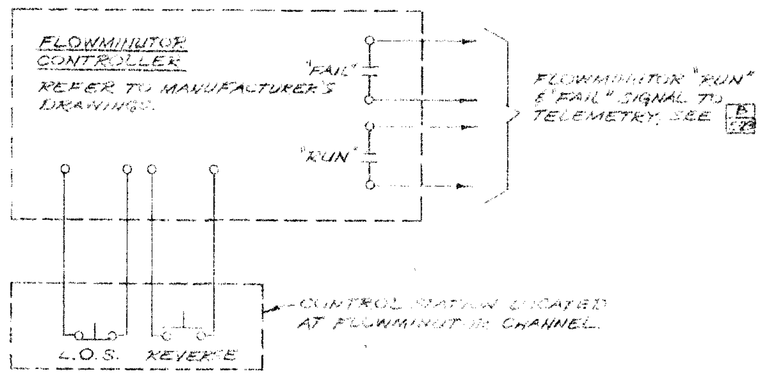


AUXILIARY PANEL A/E-30



FLOWMINUTOR CONTROL DIAGRAM B/E-30

Record Drawing

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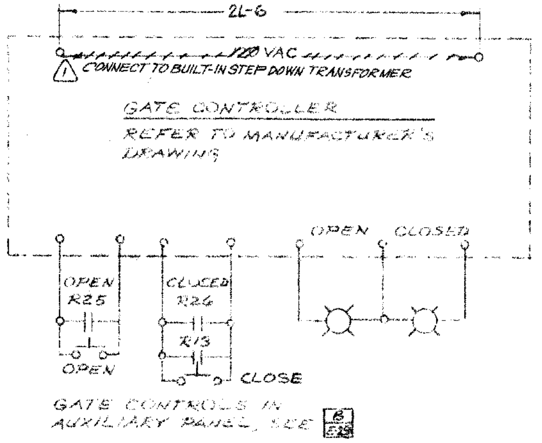


GATE CONTROL DIAGRAM C/E-30

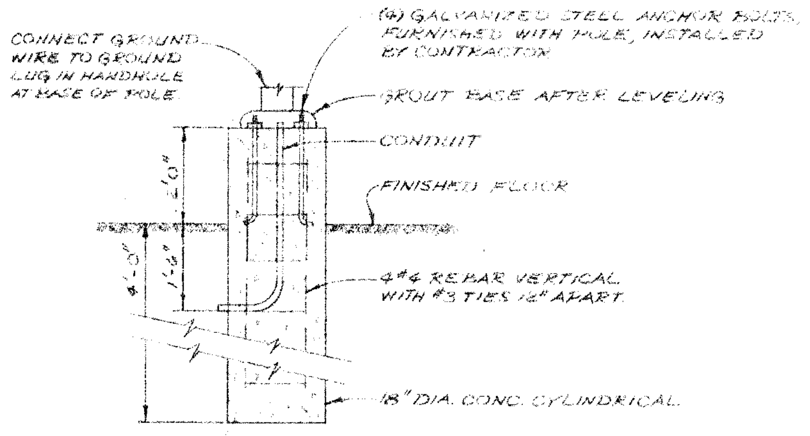
PANELBOARD SCHEDULE

PANEL	CIRCUIT DATA		MOUNT	TYPE	BUS
	CIRCUIT NO	BREAKER			
2L	1-10, 12, 15, 17, 22	20A/1P	IN (E) SW. BD	NLAB	100A, 120/208V, 3Ø, 4W.
	11-13	20A/2P			
	14-16	30A/2P			
	23, 24, 25, 27, 29	SPACE			
	MAIN 26, 28, 30	50A/3P			

FIXTURE SCHEDULE

TAG	MANUFACTURER'S CAT. NO	LAMP	VOLTS	MOUNTING
A	LAYBRITE #4N2R	2F40/CW	120V	SURFACE
B	CROUSE-HINDS #EVC-X2021	1-50W/PS30	120V	SURFACE
C	CHLORIDE #H2-2-12-44	2-44 W	12V	WALL
D	HUBBELL #S-810-120C	1-100WMH	120V	WALL

(REVISED SET JUNE 2006)



FIXTURE MOUNTING DETAIL D/E-30
NOT TO SCALE

MARION, CERBATOS AND TOMASI
MECHANICAL AND ELECTRICAL ENGINEERS
SAN FRANCISCO, CALIF. 94102

141 OF 141

⚠1 RECORD DRAWING, JUNE 1982

E-30

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

BELMONT PUMP STATION
ELECTRICAL
WIRING DIAGRAMS

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by:	JW RB	Scale:	NONE
Des./Chkd by:	AMM	Date:	8-77/9-79

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

PLANS
FOR THE CONSTRUCTION OF
UNIT NO. 3
PUMP STATIONS

(REVISED SET JUNE 2006)

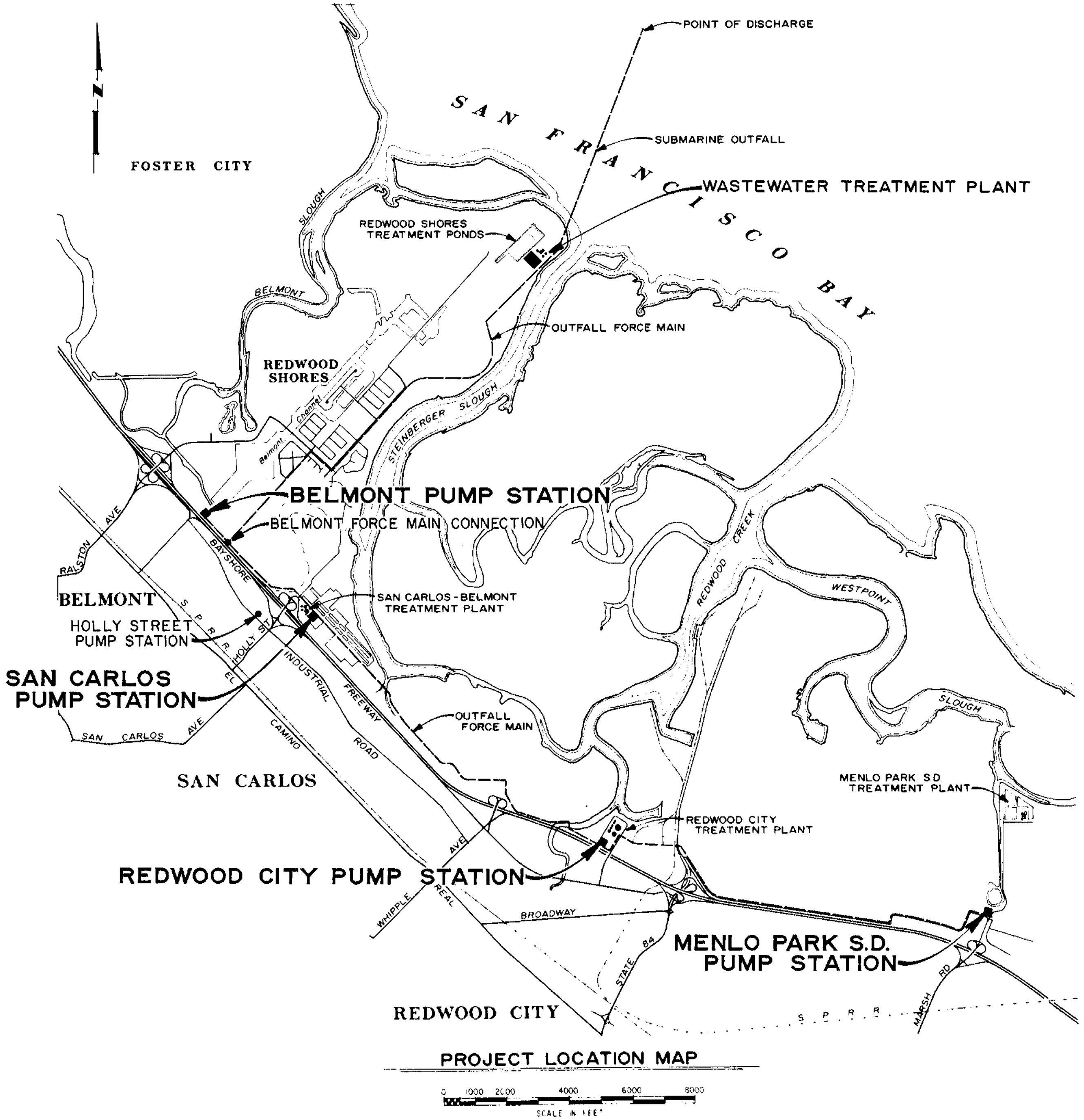
SOUTH BAYSIDE SYSTEM AUTHORITY
CHARLES R. ALLEN, SECRETARY

PARTICIPATING AGENCIES
CITY OF REDWOOD CITY
CITY OF SAN CARLOS
CITY OF BELMONT
MENLO PARK SANITARY DISTRICT

KENNEDY / JENKS ENGINEERS
PALO ALTO, CALIFORNIA

FORMERLY
JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS
PALO ALTO, CALIFORNIA

1980



PROJECT LOCATION MAP

DATUM

ALL ELEVATIONS SHOWN ARE BASED ON THE DATUM OF U.S. COAST AND GEODETIC SURVEY MEAN SEA LEVEL PLUS ONE HUNDRED FEET.
ELEVATION 100.00 PUMP STATION DATUM EQUALS ELEVATION 0.00 MEAN SEA LEVEL DATUM.

Record Drawing

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INDEX TO PLANS SUMMARY

(COMPLETE INDEX TO PLANS LISTED ON SHEET 2)

SHEET NUMBERS	SUBJECT
1	TITLE SHEET
2	INDEX TO PLANS
3	HYDRAULIC PROFILE
4 THRU 48	MENLO PARK S.D. PUMP STATION
49 THRU 61	REDWOOD CITY PUMP STATION
62 THRU 122	SAN CARLOS PUMP STATION
123 THRU. 141	BELMONT PUMP STATION △2
△2 5B	MENLO PARK S.D. PUMP STATION MISCELLANEOUS DETAILS
5C	MENLO PARK S.D. PUMP STATION METER PIT NO. 1 AND VALVE BOX NO. 2 DETAILS
8A	MENLO PARK S.D. PUMP STATION PIPEWORK & EQUIPMENT, INTERMEDIATE FLOOR PLAN, TOP PLAN
8B	MENLO PARK S.D. PUMP STATION PIPEWORK & EQUIPMENT VALVE BOX NO. 1
11A	MENLO PARK S.D. PUMP STATION SECTIONS
△3 66A	SAN CARLOS PUMP STATION, BOOSTER STATION OVERFLOW, PLANS, SECTIONS, AND DETAILS

1 OF 141

△1 *RECORD DRAWING JUNE 1982*

REV. NO.	DATE	PROJECT NAME
△2	NOV 2007	WEST BAY SANITARY DISTRICT FLOW EQUALIZATION PROJECT 1990, K/J 895229.00
△3	AUG 1999	BOORSTER STATION OVERFLOW PROJECT 1999, K/J 985061.20

SUBMITTED
John H. Jenks
JENKS & HARRISON DATE

APPROVED
Frank J. Allings
REDWOOD CITY DATE

APPROVED
George Cook
SAN CARLOS DATE

APPROVED
James P. DeChaine
BELMONT DATE

APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

PROJECT LOCATION MAP
AND
INDEX TO PLANS SUMMARY

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by:	SLH	Scale:	AS NOTED
Des/Chkd by:	JHJ	Date:	8-77 / 9-79

SH. NO.	TITLE
1.	PROJECT LOCATION MAP AND INDEX TO PLANS SUMMARY
2.	INDEX TO PLANS
3.	WASTEWATER TRANSPORT SYSTEM - SCHEMATIC HYDRAULIC PROFILE

MENLO PARK S.D. PUMP STATION

	SH. NO.	TITLE
	4.	SITE PLAN
	5.	PLANT LAYOUT
	6.	PIPEWORK & EQUIPMENT - ROOF PLAN AND DETAILS
	7.	——————— - GROUND FLOOR PLAN
	8.	——————— - INTERMEDIATE FLOOR PLAN
	9.	——————— - PUMP ROOM PLAN
	10.	——————— - SECTION A-A
	11.	——————— - SECTION B-B AND C-C
	12.	——————— - SYSTEM SCHEMATICS
	13.	——————— - MONORAIL AND MISC. DETAILS
	14.	——————— - MISCELLANEOUS DETAILS
	15.	STRUCTURAL - PUMP ROOM & WET WELL PLANS
	16.	———— - INTERMEDIATE FLOOR PLAN & DETAILS
	17.	———— - GROUND FLOOR PLAN
	18.	———— - SECTION A-A
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	21.	———— - SECTION F-F
	22.	———— - SECTION G-G
	23.	———— - SECTION H-H THRU L-L
	24.	———— - MOTOR ROOM BEAM DETAILS
	25.	———— - GROUND FLOOR BEAM DETAILS
	26.	———— - TYPICAL REINFORCING STEEL DETAILS
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	28.	————— - ROOF PLAN AND DETAILS
	29.	————— - EXTERIOR ELEVATIONS & DETAILS
	30.	————— - EXTERIOR WALL DETAILS
	31.	————— - ROOF BEAM DETAILS
	32.	DIESEL FUEL SYSTEM - PLANS, SECTIONS AND DETAILS
	33.	SEWERS AND FORCE MAIN - PLAN AND PROFILES
	34.	FLOWMETER PIT - PLANS AND SECTIONS
	35.	JUNCTION BOX - PLANS AND SECTIONS
	36.	MANHOLE DETAILS AND TRENCH SECTIONS
	37.	GRADING AND PAVING - PLAN AND SECTIONS
	38.	LANDSCAPING - PLANTING & IRRIGATION PLANS
	39.	LOG OF BORINGS - KEY MAP AND SAMPLE DATA
E-1	40.	ELECTRICAL - SITE PLAN - LEGEND
E-2	41.	———— - GROUND FLOOR PLAN
E-3	42.	———— - INTERMEDIATE FLOOR PLAN
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E-6	45.	———— - SINGLE LINE DIAGRAM
E-7	46.	———— - TELEMETRY SYSTEM DIAGRAMS
E-8	47.	———— - SCHEDULES AND AUXILIARY PANEL
E-9	48.	———— - DETAILS AND DIAGRAMS
△1	*5A.*	———— - *DISCHARGE FORCE MAIN DETAILS*
△1	*35A.*	———— - *JUNCTION BOX MODIFICATIONS*

REDWOOD CITY PUMP STATION

	SH. NO.	TITLE
	49.	SITE PLANS
	50.	PIPEWORK & EQUIPMENT - PLANS
	51.	——————— - SECTIONS
	52.	——————— - HYPOCHLORITE SYSTEM DETAILS
	53.	——————— - MISCELLANEOUS DETAILS
	54.	STRUCTURAL - HYPOCHLORITE STORAGE FACILITIES
	55.	FORCE MAIN - PLANS, SECTIONS AND DETAILS
	56.	FLOWMETER PIT - PLANS AND SECTIONS
E-10	57.	ELECTRICAL - SITE PLAN, PLANS AND LEGEND
E-11	58.	———— - GROUND FLOOR & MOTOR ROOM PLANS
E-12	59.	———— - DIAGRAM, PROGRAM & SCHEDULE
E-13	60.	———— - TELEMETRY SYSTEM DIAGRAMS
E-14	61.	———— - DETAILS AND DIAGRAMS
△1	*55A.*	———— - *FORCE MAIN CONNECTION DETAILS*

SAN CARLOS PUMP STATION

	SH. NO.	TITLE
	62.	SITE PLAN
	63.	PLANT LAYOUT
	64.	PIPEWORK & EQUIPMENT - ROOF PLAN AND DETAILS
	65.	——————— - GROUND FLOOR PLAN
	66.	——————— - INTERMEDIATE FLOOR PLAN
	67.	——————— - PUMP ROOM PLAN
	68.	——————— - SECTION A-A
	69.	——————— - SECTION B-B AND C-C
	70.	——————— - SECTION D-D
	71.	——————— - SECTION E-E
	72.	——————— - VENTILATION DETAILS
	73.	——————— - SYSTEM SCHEMATICS
	74.	——————— - MONORAIL AND MISC. DETAILS
	75.	——————— - MISCELLANEOUS DETAILS
	76.	STRUCTURAL - PUMP ROOM & WET WELL PLANS
	77.	———— - INTERMEDIATE FLOOR PLANS
	78.	———— - GROUND FLOOR PLANS
	79.	———— - SECTION A-A
	80.	———— - SECTION B-B
	81.	———— - SECTION C-C
	82.	———— - SECTION D-D
	83.	———— - SECTION E-E
	84.	———— - SECTION F-F
	85.	———— - SECTION G-G AND H-H
	86.	———— - SECTION J-J, K-K AND L-L
	87.	———— - SECTION M-M, N-N AND P-P
	88.	———— - SECTION Q-Q, R-R AND S-S
	89.	———— - BARMINUTOR CHANNEL DETAILS
	90.	———— - STAIRWAY DETAILS
	91.	———— - MISCELLANEOUS DETAILS
	92.	———— - MOTOR ROOM BEAM DETAILS
	93.	———— - PILASTER AND BEAM DETAILS
	94.	———— - GROUND FLOOR BEAM DETAILS
	95.	———— - TYPICAL REINFORCING STEEL DETAILS
	96.	SUPERSTRUCTURE - SECTIONAL PLANS AND SECTIONS
	97.	————— - ROOF PLAN AND DETAILS
	98.	————— - EXTERIOR ELEVATIONS & DETAILS
	99.	————— - EXTERIOR WALL DETAILS
	100.	————— - ROOF BEAM DETAILS
	101.	DIESEL ENGINE AND FUEL SYSTEM - MISCELLANEOUS DETAILS
	102.	SEWERS AND FORCE MAIN - PLAN AND PROFILES
	103.	INFLUENT FORCE MAIN - PLAN AND PROFILE
	104.	VALVE PIT - PLANS, SECTIONS AND DETAILS
	105.	MISCELLANEOUS DETAILS AND TRENCH SECTIONS
	106.	GRADING AND PAVING - PLAN AND SECTIONS
	107.	LANDSCAPING - PLANTING & IRRIGATION PLANS
	108.	LOG OF BORINGS - KEY MAP AND SAMPLE DATA
	109.	HOLLY STREET PUMP STATION - SITE PLANS AND PROFILES
	110.	————————— - FLOWMETER PIT DETAILS
E-15	111.	ELECTRICAL - SITE PLAN - LEGEND
E-16	112.	———— - GROUND FLOOR PLAN
E-17	113.	———— - INTERMEDIATE FLOOR PLAN
E-18	114.	———— - PUMP ROOM PLAN
E-19	115.	———— - ROOF PLAN
E-20	116.	———— - BUILDING SECTION
E-21	117.	———— - SINGLE LINE DIAGRAM
E-22	118.	———— - TELEMETRY DIAGRAMS
E-23	119.	———— - SCHEDULES AND DETAILS
E-24	120.	———— - DIAGRAMS
E-25	121.	———— - DETAILS AND DIAGRAMS
E-26	122.	———— - HOLLY STREET PUMP STATION
△1	*102A.*	———— - *FORCE MAIN DETAILS*
△1	*104A.*	———— - *VALVE PIT DETAILS*
△1	*119A.*	———— - *BALL VALVES & BOOSTER PUMP CONTROL*

BELMONT PUMP STATION

	SH. NO.	TITLE
	123.	SITE PLAN
	124.	PLANT LAYOUTS
	125.	EXISTING CONDITION - PLANS AND SECTIONS
	126.	PIPEWORK & EQUIPMENT - PLANS AND DETAILS
	127.	——————— - SECTIONS AND DETAILS
	128.	——————— - SYSTEM SCHEMATICS
	129.	——————— - MISCELLANEOUS DETAILS
	130.	STRUCTURAL - INTERMEDIATE FLOOR PLAN & DETAILS
	131.	———— - GROUND FLOOR PLAN & DETAILS
	132.	SUPERSTRUCTURE - PLANS AND DETAILS
	133.	————— - EXTERIOR ELEVATIONS & DETAILS
	134.	————— - EXTERIOR WALL DETAILS
	135.	————— - ROOF BEAM DETAILS
	136.	FLOWMETER PIT - PLANS, SECTIONS AND DETAILS
	137.	BELMONT FORCE MAIN CONNECTION - PLANS, SECTIONS AND DETAILS
E-27	138.	ELECTRICAL - SITE PLAN - LEGEND - DIAGRAM
E-28	139.	———— - GROUND AND INTERMEDIATE FLOOR PLANS
E-29	140.	———— - TELEMETRY - METER PIT PLAN
E-30	141.	———— - WIRING DIAGRAMS
△1	*137A.*	———— - *FORCE MAIN CONNECTION & CATHODIC PROTECTION*
△1	*137B.*	———— - *FORCE MAIN CONNECTION DETAILS*

(REVISED SET JUNE 2006)

Record Drawing

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2 OF 141

△1 *RECORD DRAWING, JUNE 1982*

REV. NO.	DATE	PROJECT NAME
△2	NOV 2007	WEST BAY SANITARY DISTRICT FLOW EQUALIZATION PROJECT 1990, K/J 895229.00

SUBMITTED
JENKS & HARRISON DATE

APPROVED
REDWOOD CITY DATE

APPROVED
SAN CARLOS DATE

APPROVED
BELMONT DATE

APPROVED
MENLO PARK S.D. DATE

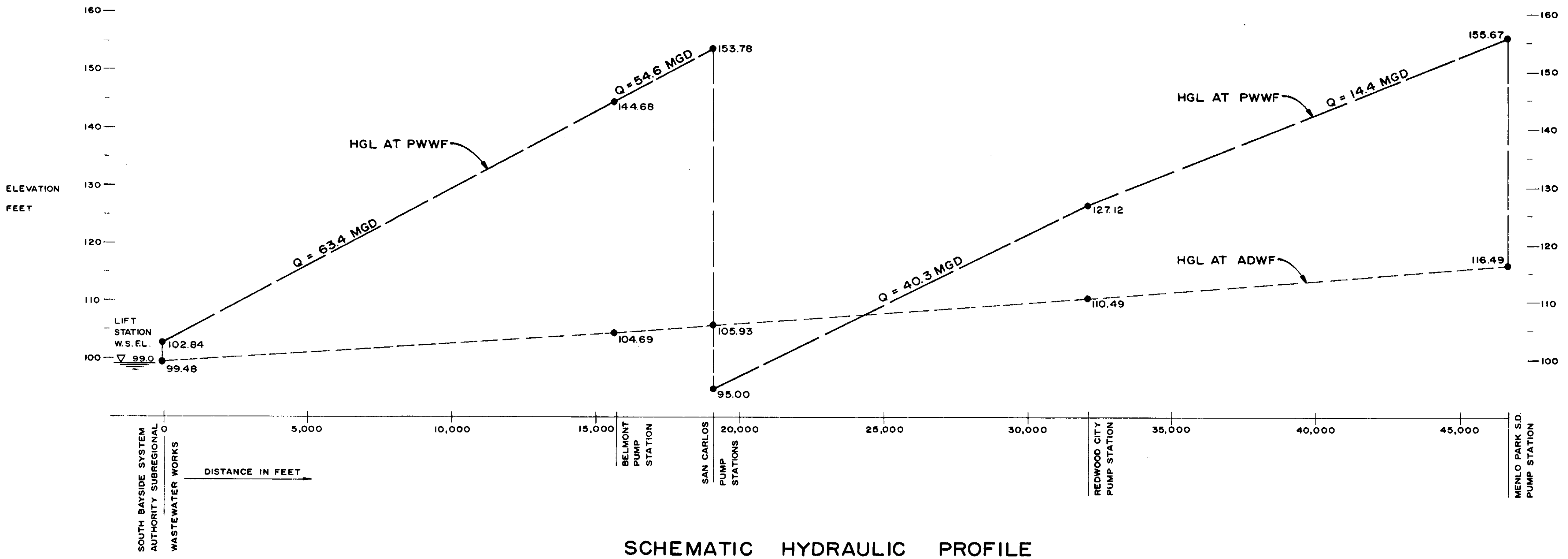
SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

INDEX TO PLANS

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by:	SLH	Scale:	NONE
Des/Chkd by:	DAB	Date:	8-77/9-79



SCHEMATIC HYDRAULIC PROFILE

(REVISED SET JUNE 2006)

Record Drawing

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3 OF 141

△1 RECORD DRAWING , JUNE 1982

REV. NO.	DATE	PROJECT NAME
△2	NOV 2007	WEST BAY SANITARY DISTRICT FLOW EQUALIZATION PROJECT 1990, K/J 895229.00

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA
SUBREGIONAL WASTEWATER WORKS

WASTEWATER TRANSPORT SYSTEM
SCHEMATIC HYDRAULIC PROFILE

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: SLH
Des/Chkd by: BMW
Scale: NONE
Date: 8-77/9-79

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LEGEND

PIPE TYPES

ABS.	ACRYLONITRILE - BUTADIENE - STYRENE
AC.	ASBESTOS CEMENT
Al.	ALUMINUM
B.I.	BLACK IRON
C.C.	CONCRETE CYLINDER
C.I.S.	CAST IRON SOIL
C.M.	CORRUGATED METAL
C.P.V.C.	CHLORINATED P.V.C.
Cu	COPPER
D.I.	DUCTILE IRON
F.R.P.	FIBERGLASS REINFORCED PLASTIC
G.S.	GALVANIZED STEEL
Pe.	POLYETHYLENE
P.V.C.	POLY VINYL CHLORIDE
R.C.	REINFORCED CONCRETE
R.C. T/G	REINFORCED CONCRETE, TONGUE & GROOVE JOINT
R.P.M.	REINFORCED PLASTIC MORTAR
V.C.	VITRIFIED CLAY
W.S.	WELDED STEEL

COATINGS & LININGS

C.L.	CEMENT MORTAR LINED
E.L.	EPOXY LINED
G.L.	GLASS LINED
G.L./E.C.	GLASS LINED, EPOXY COATED
L/C	CEMENT MORTAR LINED & COATED
P.C.	PLASTIC COATED

VALVES ETC.

B.C.V.	BALL CHECK VALVE
B.V.	BUTTERFLY VALVE
C.O.	CLEANOUT
C.V.	CHECK VALVE
F.D.	FLOOR DRAIN
G.C.	GROOVED COUPLING
G.V.	GATE VALVE
H.B.	HOSE BIBB
P.D.V.	PLUG DRAIN VALVE
P.V.	PLUG VALVE
S.G.	SLIDE (SLUICE) GATE

PIPING

EXISTING NEW

DRAIN
FUEL OIL
HYPOCHLORITE
COMPRESSED AIR
NO. 1 WATER (POTABLE)
NO. 2 WATER (NON-POTABLE)
NATURAL GAS

NOTE

THE CONTRACTOR SHALL COMPILE, AND TRANSMIT TO THE ENGINEER, ACCURATE RECORDS OF THE "AS BUILT" LOCATIONS OF ALL YARD PIPEWORK WHICH HE INSTALLS AS PART OF THIS PROJECT.

ALL PIPE RUNS UNDER CONCRETE SLABS SHALL BE ENCASED IN 6" MIN. REINFORCED CONCRETE JACKETS.

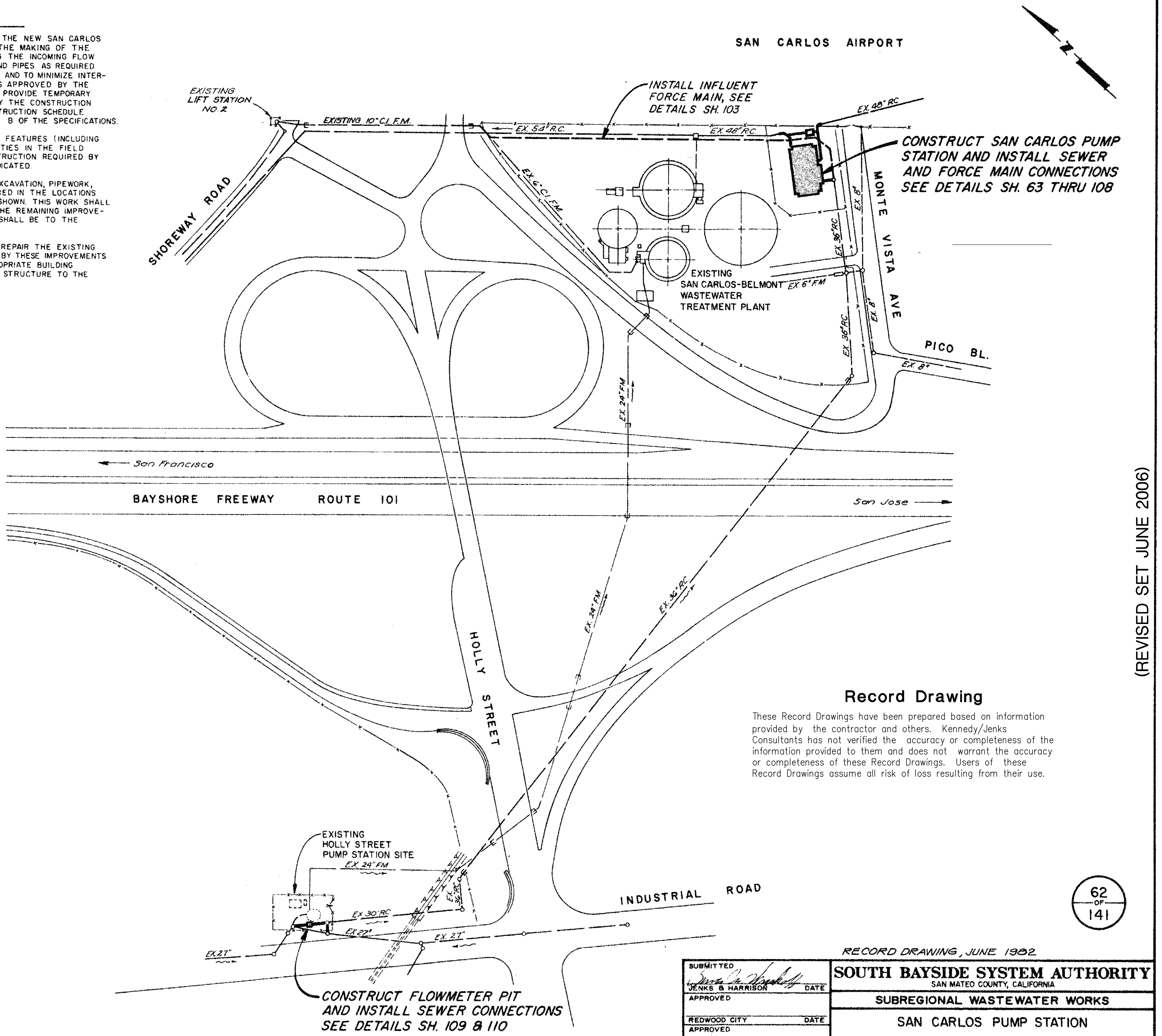
CONSTRUCTION NOTES

1. THE CONTRACTOR SHALL COMMENCE THE NEW SAN CARLOS PUMP STATION TIE-IN FOLLOWING THE MAKING OF THE NECESSARY PROVISIONS FOR HANDLING THE INCOMING FLOW AND DEWATERING THE STRUCTURE AND PIPES AS REQUIRED TO CONFORM TO NORMAL OPERATIONS AND TO MINIMIZE INTERRUPTIONS OF NORMAL OPERATIONS, AS APPROVED BY THE ENGINEER. THE CONTRACTOR SHALL PROVIDE TEMPORARY PUMPING AND PIPING AS REQUIRED BY THE CONSTRUCTION OF THESE IMPROVEMENTS. THE CONSTRUCTION SCHEDULE SHALL BE AS DESCRIBED IN SECTION B OF THE SPECIFICATIONS.

2. THE CONTRACTOR SHALL VERIFY ALL FEATURES (INCLUDING DIMENSIONS) OF THE EXISTING FACILITIES IN THE FIELD PRIOR TO THE FABRICATION OR CONSTRUCTION REQUIRED BY THE ALTERATIONS AND ADDITIONS INDICATED.

3. THE CONTRACTOR SHALL REMOVE EXCAVATION, PIPEWORK, CONCRETE AND PAVEMENT AS REQUIRED IN THE LOCATIONS INDICATED AND TO THE DIMENSIONS SHOWN. THIS WORK SHALL BE DONE IN SUCH A MANNER THAT THE REMAINING IMPROVEMENTS SHALL NOT BE DAMAGED AND SHALL BE TO THE SATISFACTION OF THE ENGINEER.

4. THE CONTRACTOR SHALL PATCH AND REPAIR THE EXISTING PIPEWORK STRUCTURES AS REQUIRED BY THESE IMPROVEMENTS BY THE USE OF SUITABLE AND APPROPRIATE BUILDING MATERIALS TO MATCH THE EXISTING STRUCTURE TO THE SATISFACTION OF THE ENGINEER.



Record Drawing

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(REVISED SET JUNE 2006)

RECORD DRAWING, JUNE 1982

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
SITE PLAN

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by:	RTY	Scale:	1"=100'
Des/Chkd by:	BMW	Date:	8-77 / 9-79

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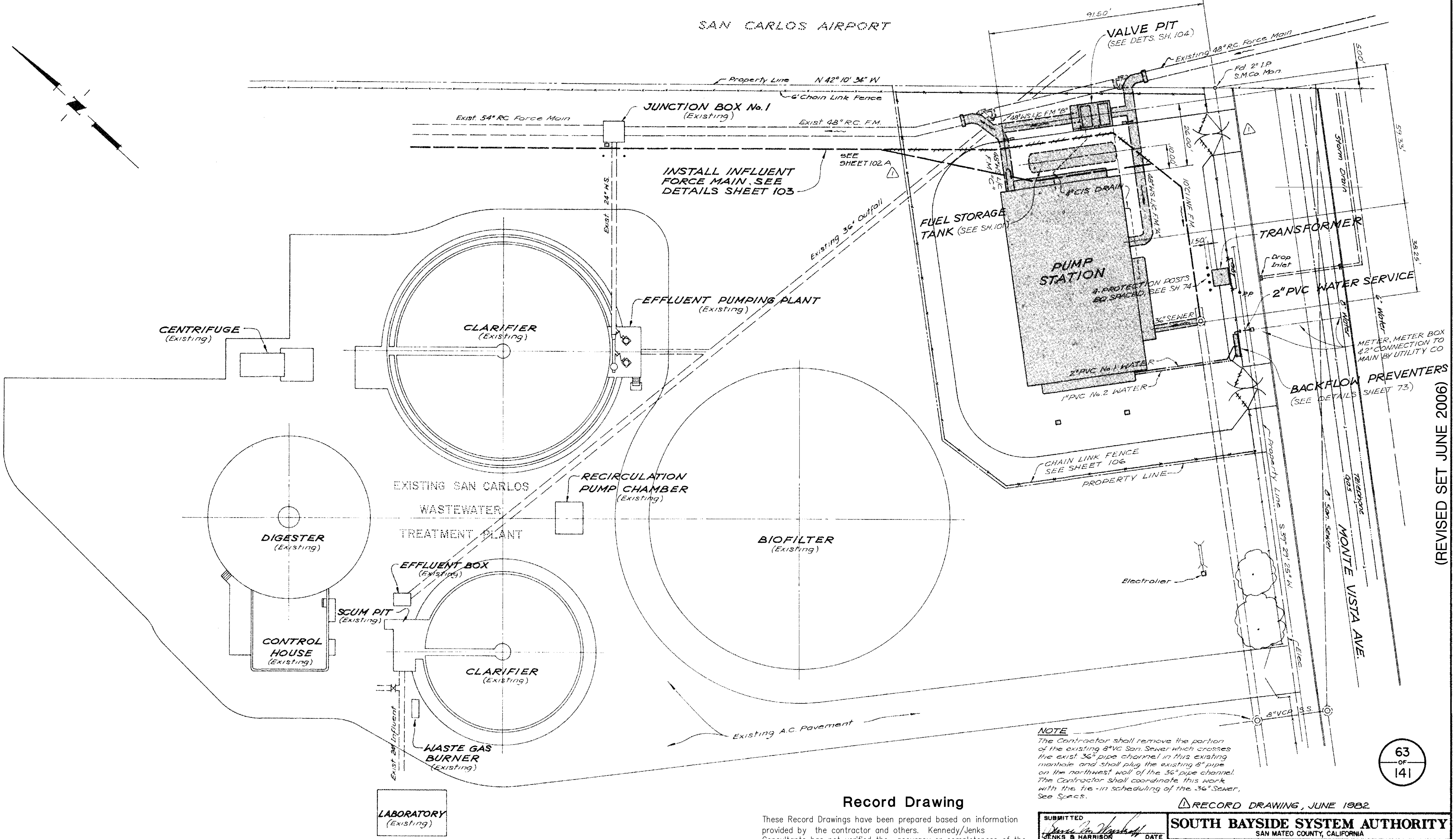
(REVISED SET JUNE 2006)



NOTE

The Contractor shall remove the portion of the existing 8" VC San. Sewer which crosses the exist. 36" pipe channel in this existing manhole and shall plug the existing 8" pipe on the northwest wall of the 36" pipe channel. The Contractor shall coordinate this work with the tie-in scheduling of the 36" Sewer, See Specs.

⚠ RECORD DRAWING, JUNE 1982

Record Drawing

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SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
PLANT LAYOUT

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: CGS
Des/Chkd by: DAB
Scale: 1" = 20'
Date: 8-77 / 9-79

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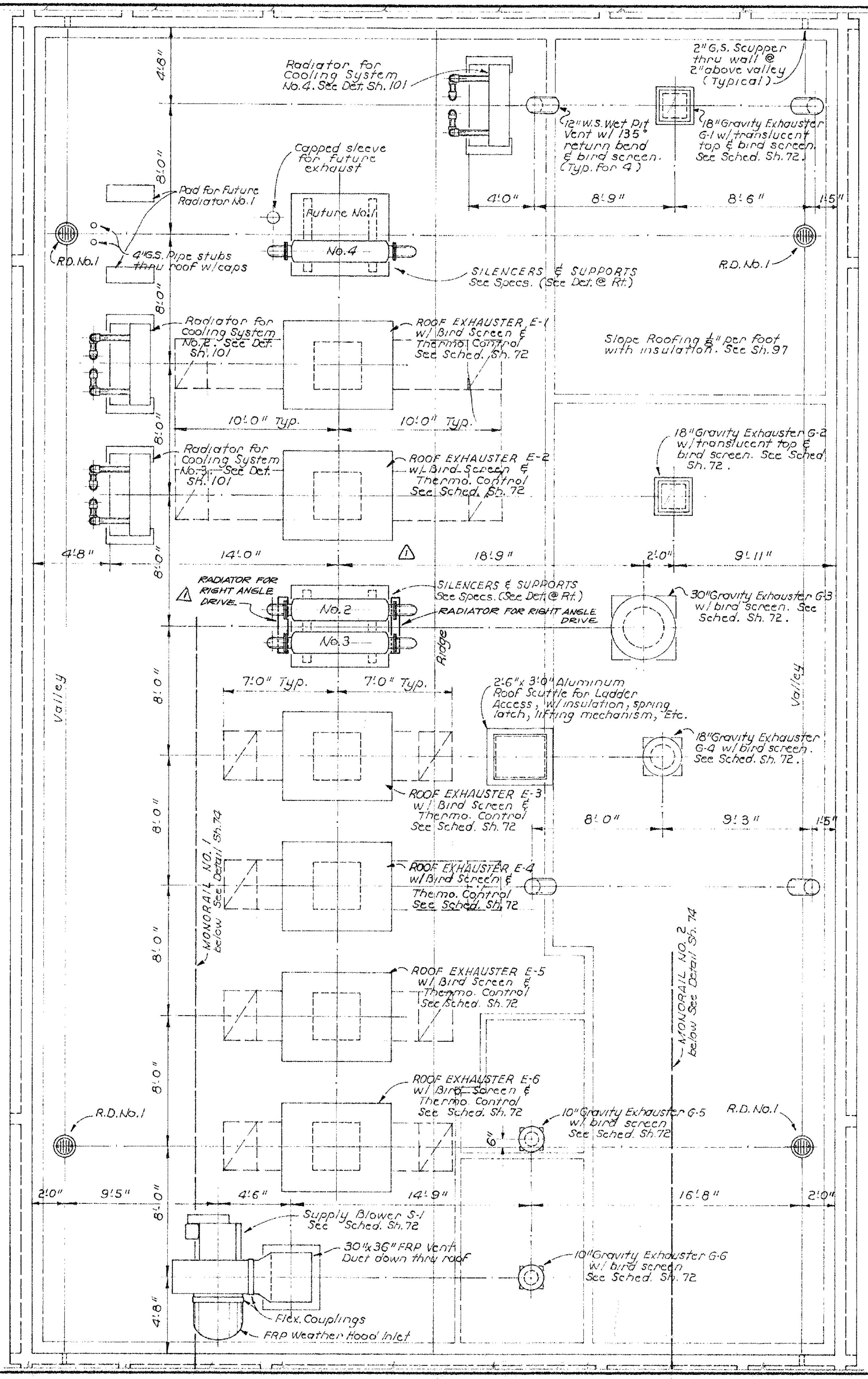

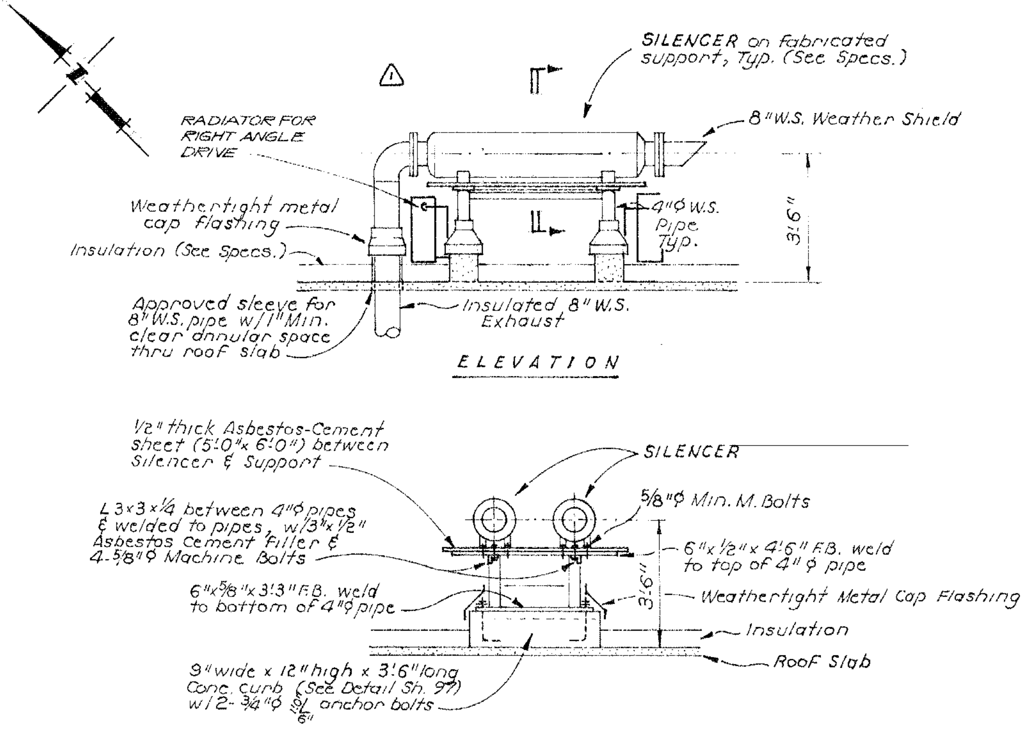

SILENCER SUPPORT DETAILS

Scale: 3/8" = 1'0"

ROOF DRAIN

R.D. No. 1 = 2" C.I. Bottom Outlet Body with 124 Sq. In. C.I. Dome

(REVISED SET JUNE 2006)

Record Drawing

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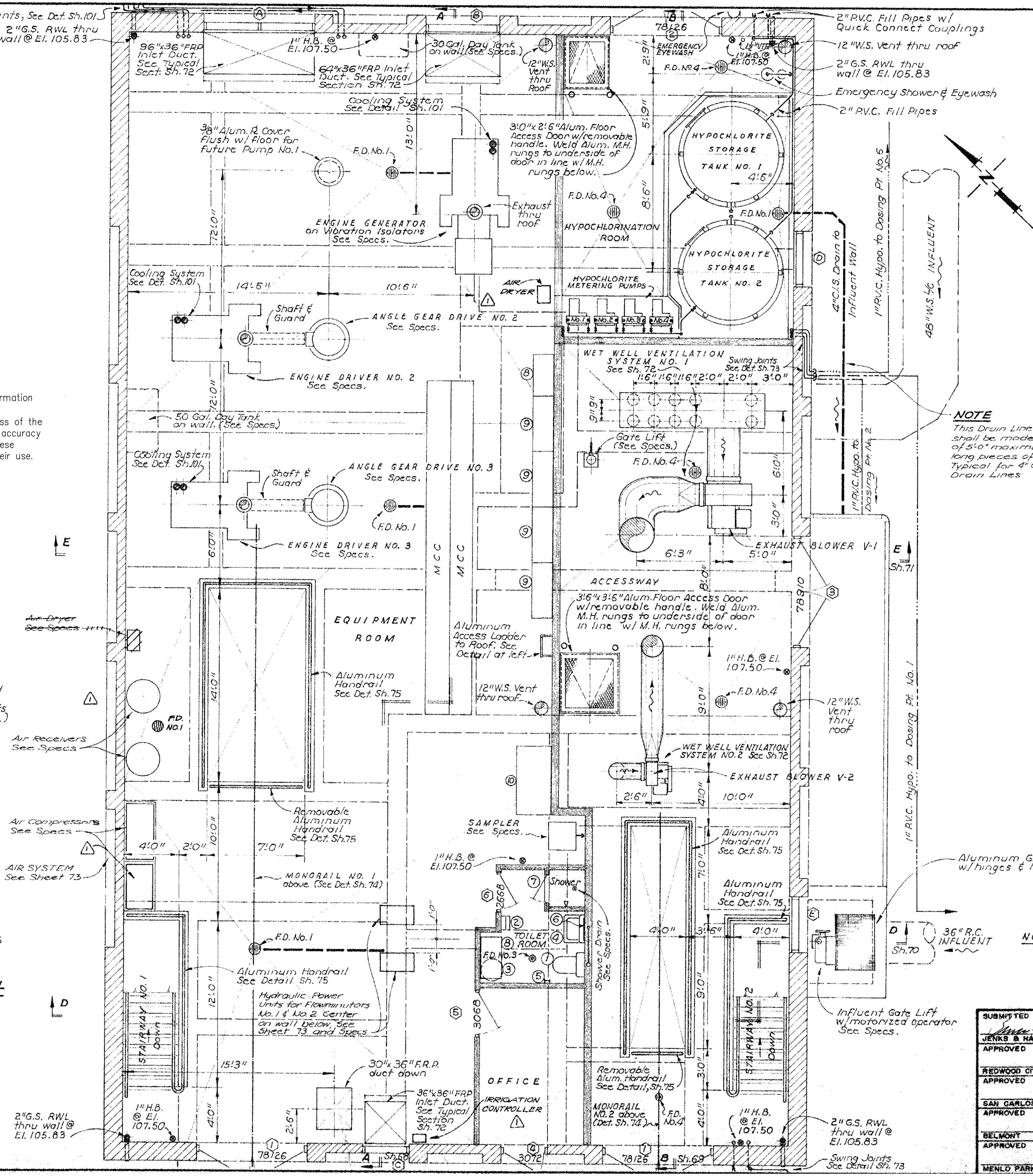
NOTE SEE ROOF PLAN SH. 97 FOR STRUCTURE DIMENSIONS

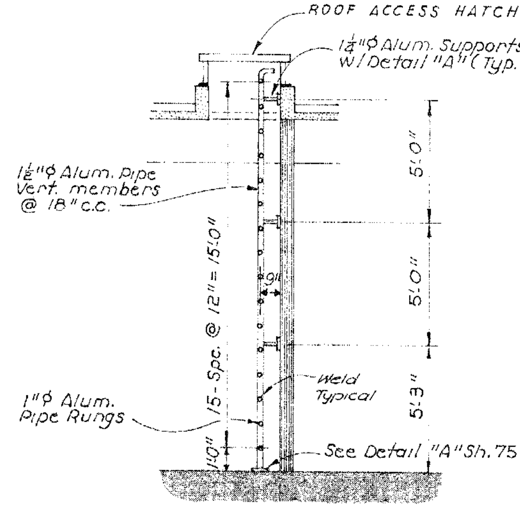
64 OF 141

⚠ RECORD DRAWING , JUNE 1982

SUBMITTED Bruce M. Mayerhoff JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED	SUBREGIONAL WASTEWATER WORKS
REDWOOD CITY DATE APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION PIPEWORK AND EQUIPMENT ROOF PLAN AND DETAILS
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED	Drawn by: L L K LFI — Scale: 1/4" = 1'-0"
MENLO PARK S.D. DATE	Des/Chkd by: DAB — Date: 8-77 / 9-79



Record Drawing



ACCESS LADDER DETAIL

NOTES

1. Furred walls shall consist of metal studs @ 16" cc with Req'd. plates, etc. & ½" sheetrock covering, taped & painted, see Sh. 96.

2. See Sh. 98 for Door & Louver Schedule.

3. FINISH SCHEDULE

EQUIPMENT ROOM :

Concrete Block & Plaster Walls & Concrete Ceiling :
Two coats Latex Masonry Paint, Flat.

Concrete Floor:
Color Hardener

ACCESSWAY & HYPOCHLORINATION ROOM :
Finishes same as Equip. Rm.

OFFICE :

Concrete Block & Plaster Walls & Plaster Ceiling :
Two coats Latex Mas~~onry Paint, Flat~~.

Concrete Floor:
1/8"x12"x12" Vinyl Asbestos Tile Flooring.

TOILET ROOM :

Plaster Walls & Plaster Ceiling :
Two coats Latex Enamel, Satin.

Concrete Floor :
1/8"x12"x12" Vinyl Asbestos Tile Flooring.

Shower :
Walls: ½"x3"x6" Ceramic Tile
Floor & Base: ½"x6"x6" Quarry Tile over waterproof Shower Pan

4. FIXTURE AND EQUIPMENT LIST
See Specifications for description

① Water Closet
② Towel Dispenser
③ Water Heater
④ Lavatory
⑤ Paper Holder
⑥ Mirror (24"x18")
⑦ Shower Door
⑧ Storage Cabinet (2-Ea.)
⑨ Shelving (4-Ea.)
⑩ Workbench

5. FLOOR DRAINS

F.D. No. 1 = 4" C.I. Bottom Outlet body w/ adjustable collar and 10" Min. ⌀ deep set D.I. Tractor Grate

F.D. No. 2 = 6" C.I. Bottom Outlet body w/ adjustable collar and 10" Min. ⌀ deep set D.I. Tractor Grate

F.D. No. 3 = 2" C.I. Bottom Outlet body w/ adjustable collar and 8"⌀ Min. anti-tilt D.I. Grate

F.D. No. 4 = 3" C.I. Bottom Outlet body w/ adjustable collar and 8"⌀ Min. anti-tilt D.I. Grate

(REVISED SET JUNE 2006)

NOTE SEE DIMENSIONAL PLAN SH. 78 FOR STRUCTURE DIMENSIONS

65 OF 141

△1 RECORD DRAWING, JUNE 1982

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION PIPEWORK AND EQUIPMENT GROUND FLOOR PLAN
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: LLK LFI — Scale: 1/4"=1'-0" Des/Chkd by: DAB — Date: 8-77/9-79

Record Drawing

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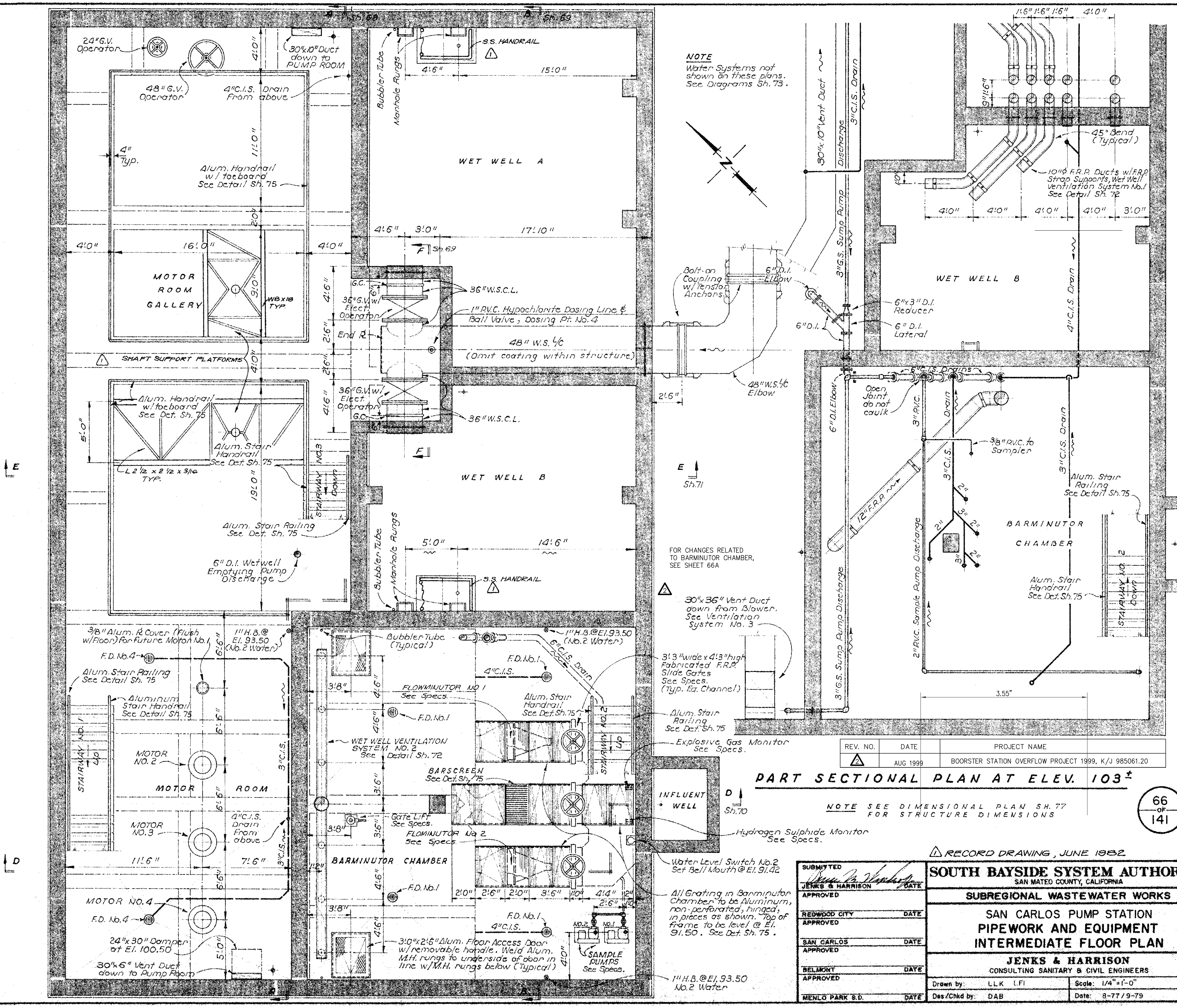

FOR CHANGES RELATED TO BARMINUTOR CHAMBER, SEE SHEET 66A

REV. NO.	DATE	PROJECT NAME
2	AUG 1999	BOORSTER STATION OVERFLOW PROJECT 1999, K/J 985061.20

PART SECTIONAL PLAN AT ELEV. 103±

NOTE SEE DIMENSIONAL PLAN SH. 77 FOR STRUCTURE DIMENSIONS

1 RECORD DRAWING, JUNE 1982

(REVISED SET JUNE 2006)

66 of 141

SUBMITTED JENKS & HARRISON	DATE
APPROVED REDWOOD CITY	DATE
APPROVED SAN CARLOS	DATE
APPROVED BELMONT	DATE
APPROVED MENLO PARK S.D.	DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
PIPEWORK AND EQUIPMENT
INTERMEDIATE FLOOR PLAN

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by:	LLK LFI	Scale:	1/4"=1'-0"
Des/Chkd by:	DAB	Date:	8-77/9-79

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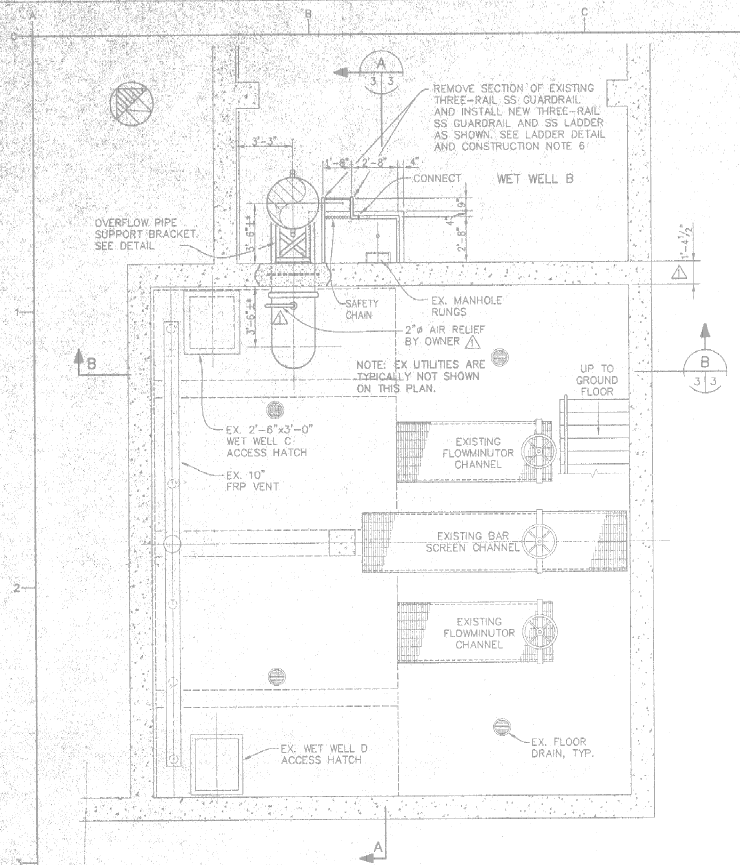
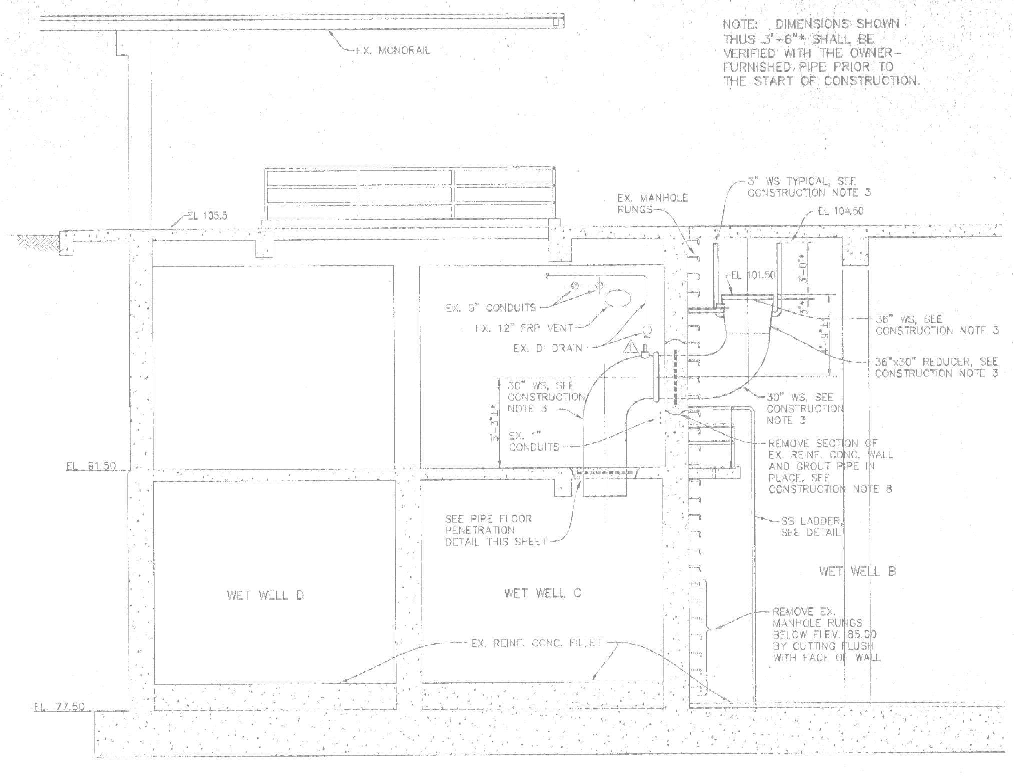


BARMINUTOR CHAMBER PLAN

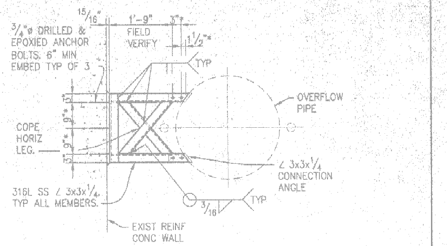
0 3 6
1/4"=1'-0"



NOTE: DIMENSIONS SHOWN THUS 3'-6"* SHALL BE VERIFIED WITH THE OWNER-FURNISHED PIPE PRIOR TO THE START OF CONSTRUCTION.

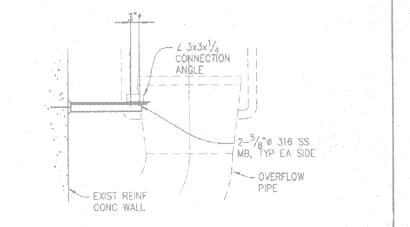
SECTION A 3|3

0 3 6
1/4"=1'-0"



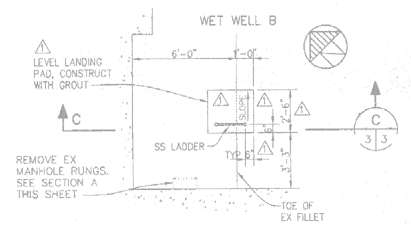
PLAN – SUPPORT BRACKET DETAIL

0 3
1/2"=1'-0"



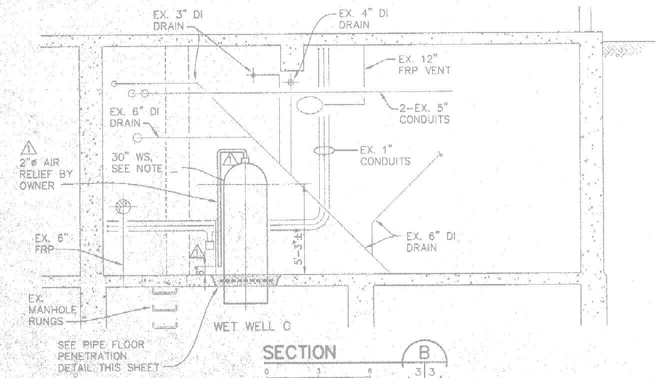
ELEVATION – SUPPORT BRACKET DETAIL

0 3
1/2"=1'-0"



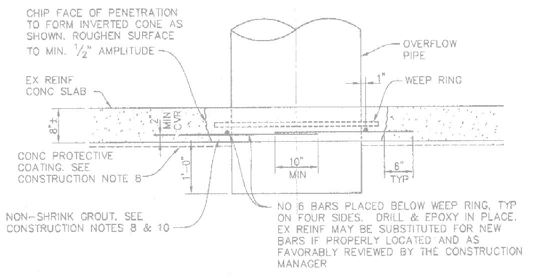
WET WELL B PLAN

0 3 6
1/4"=1'-0"



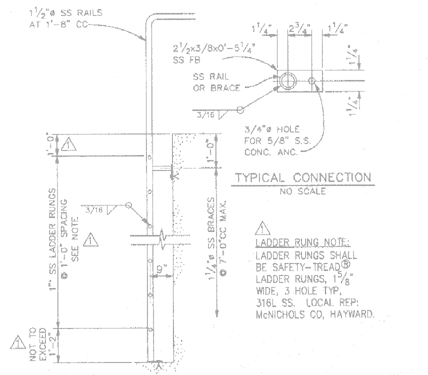
SECTION B 3|3

0 3 6
1/4"=1'-0"



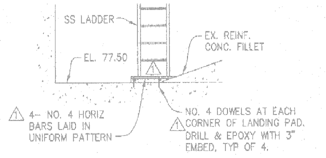
PIPE FLOOR PENETRATION DETAIL

0 2
3/4"=1'-0"



STAINLESS STEEL LADDER DETAIL

NO SCALE



SECTION C 3|3

0 3 6
1/4"=1'-0"

Record Drawing

These Record Drawings have been prepared based on information provided by the contractor and others. Kennedy/Jenks Consultants has not verified the accuracy or completeness of the information provided to them and does not warrant the accuracy or completeness of these Record Drawings. Users of these Record Drawings assume all risk of loss resulting from their use.

USE OF DOCUMENTS

THIS DOCUMENT, INCLUDING THE INCORPORATED DESIGNS, IS AN INSTRUMENT OF SERVICE FOR THIS PROJECT AND SHALL NOT BE USED FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF KENNEDY/JENKS CONSULTANTS.

NO.	REVISION	DATE	BY
1	RECORD DRAWING	NOVEMBER 1999	DLE

SCALES

0 — 1"
0 — 25mm
IF THIS BAR IS NOT DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY.

DESIGNED JEM/DLE
DRAWN ROO/LLK
CHECKED JEM

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA
SUBREGIONAL WASTEWATER WORKS
Kennedy/Jenks Consultants
PALO ALTO, CALIFORNIA

BOOSTER STATION OVERFLOW
PLANS, SECTIONS, AND DETAILS

FILE NAME
JOB NO. 985061.20
DATE AUGUST 1999
SHEET 3 OF 3

66A
of
141

USE OF DOCUMENTS

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RECORD DRAWING

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SCALES

0 — 1"
0 — 25mm
IF THIS BAR IS NOT DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY.

RD NO.	REMARKS	DATE	BY

RD NO.	REMARKS	DATE	BY
2	BOOSTER STATION OVERFLOW PROJECT 1999, K/J 985061.20	NOV 2008	DB

SUBMITTED
KENNEDY/JENKS DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

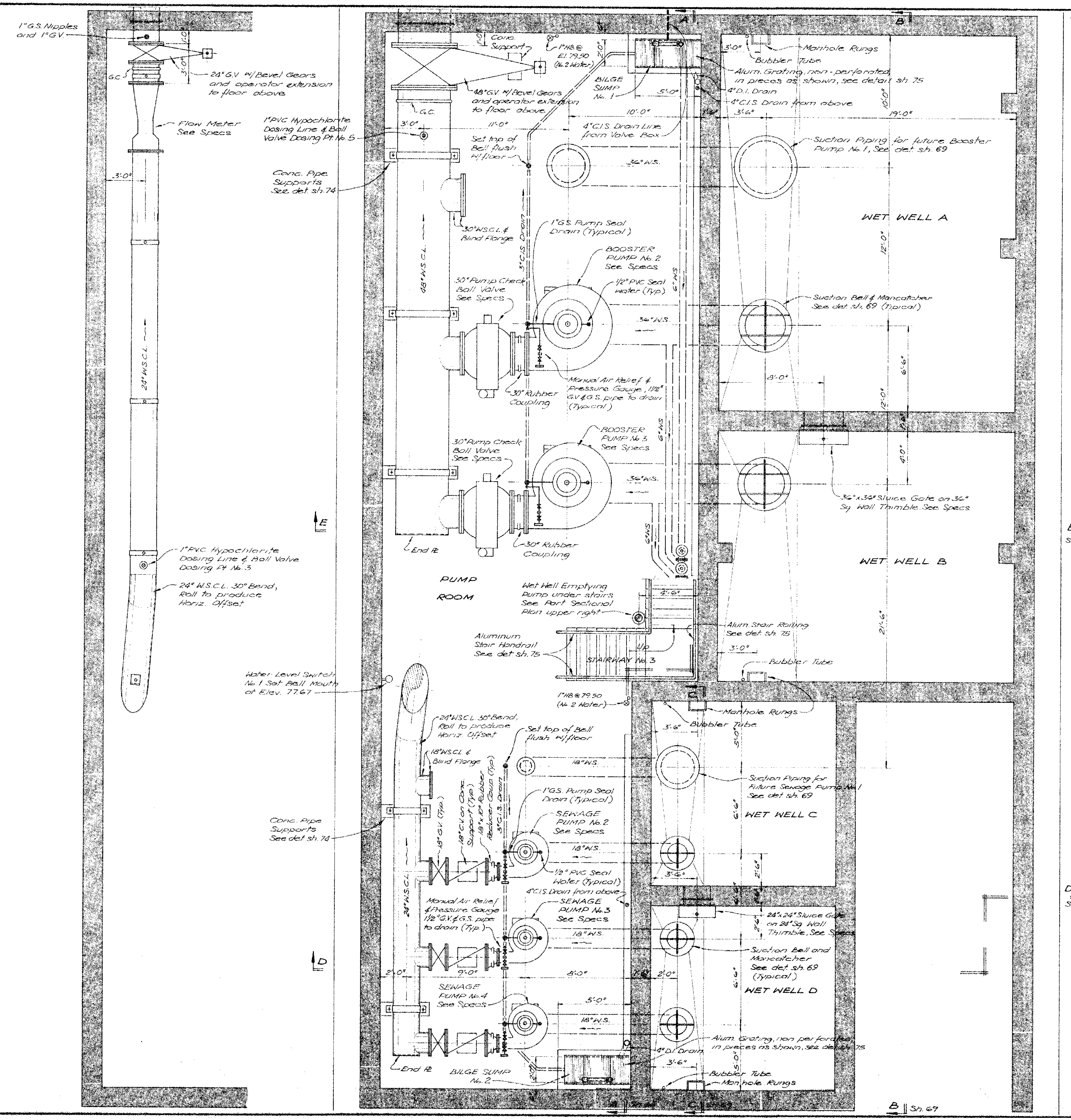
SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION

BOOSTER STATION OVERFLOW PLANS, SECTIONS, AND DETAILS

Kennedy/Jenks Consultants
PALO ALTO, CALIFORNIA

Drawing by: XXX
Des/Chkd by: XXX
Scale: XXX
Date: XXX



Record Drawing

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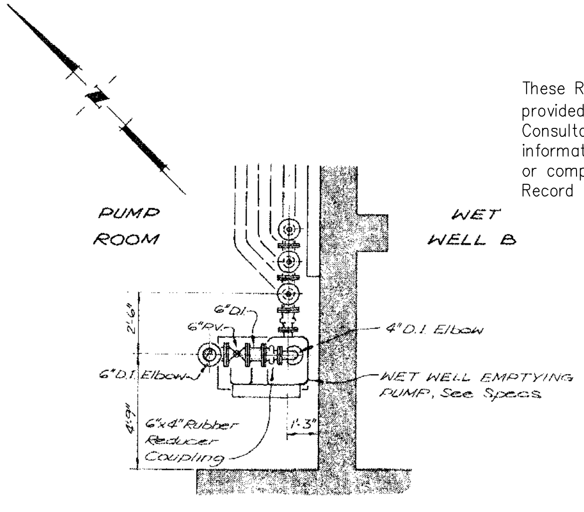
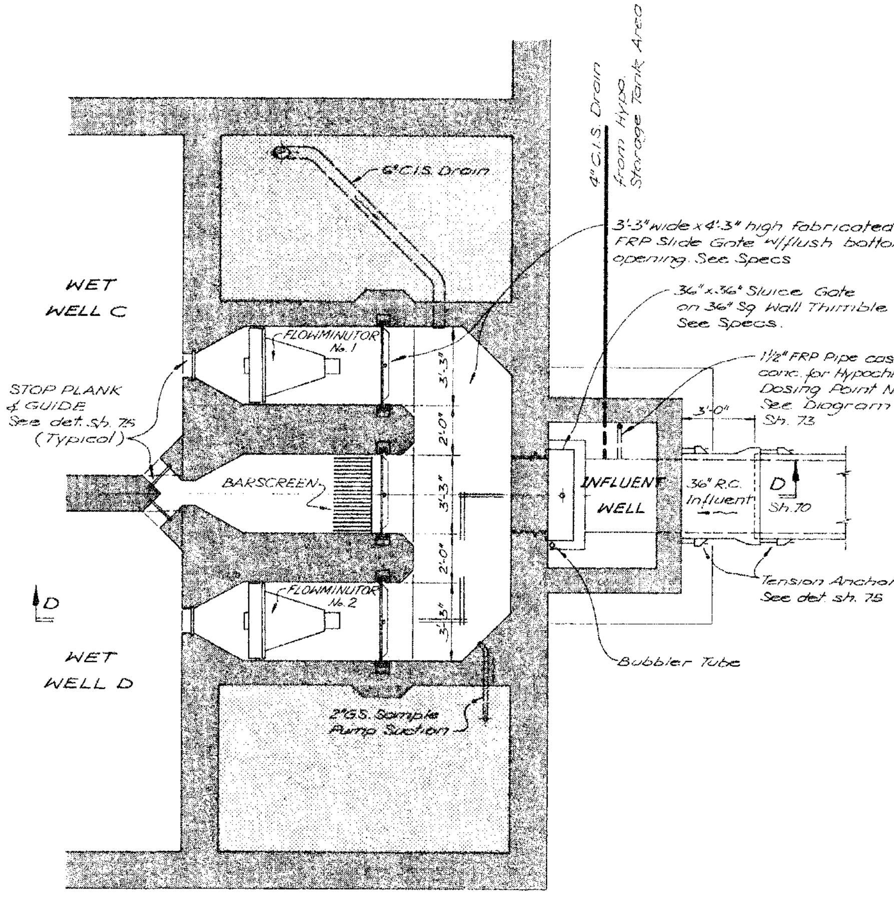


PART SECTIONAL PLAN



BARSCREEN CHAMBER PART SECTIONAL PLAN EL. 89±

(REVISED SET JUNE 2006)

NOTE: See Dimensional Plan sh. 76 for Structure dimensions.

67 OF 141

RECORD DRAWING, JUNE 1982

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
PIPEWORK AND EQUIPMENT
PUMP ROOM PLAN

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: LLK CGS
Scale: 1/4"=1'-0"
Des/Chkd by: DAB
Date: 8-77/9-79

Record Drawing

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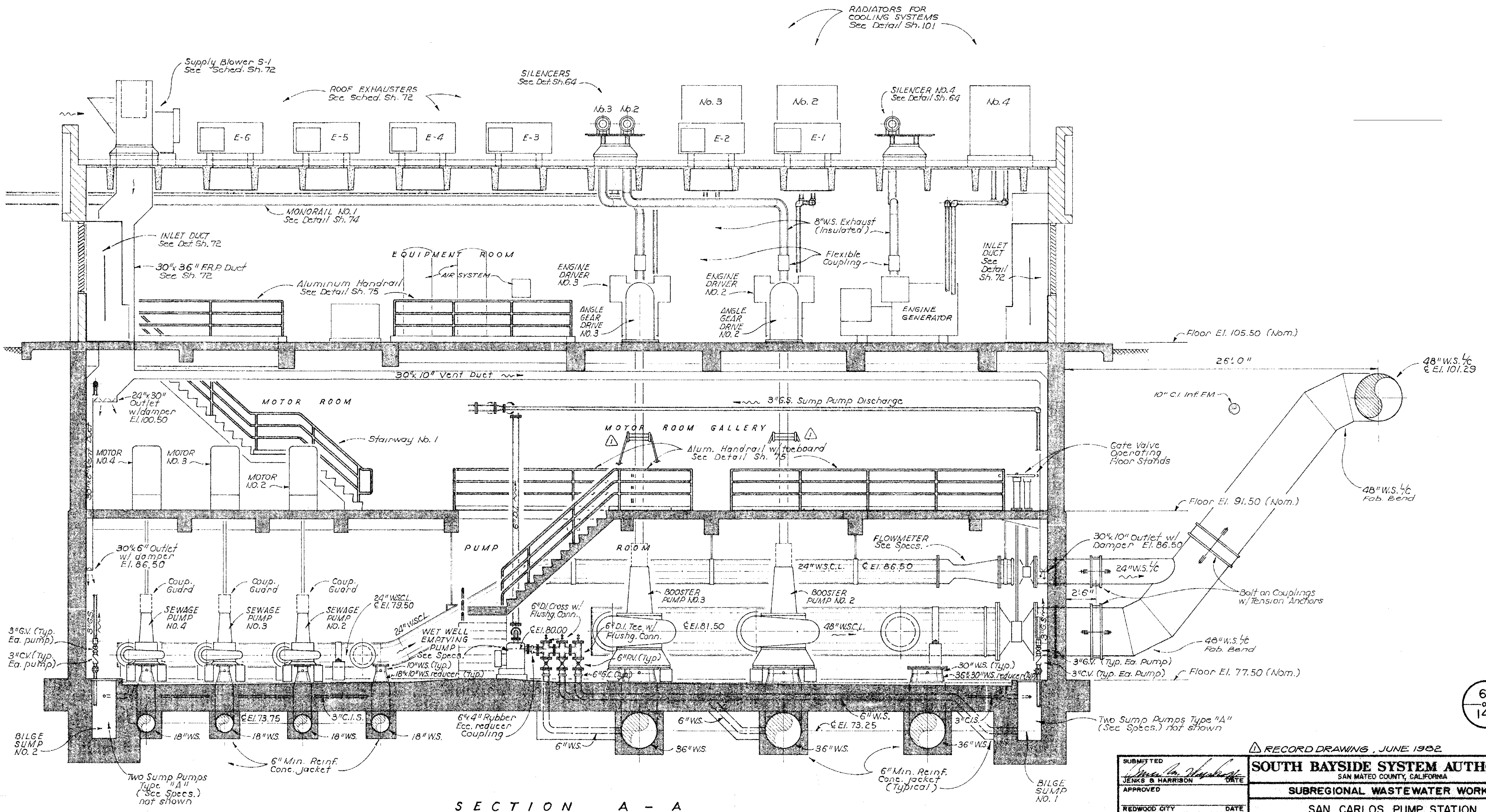

SECTION A - A

(REVISED SET JUNE 2006)

68 OF 141

⚠ RECORD DRAWING, JUNE 1982

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED	SUBREGIONAL WASTEWATER WORKS
REDWOOD CITY DATE APPROVED	SAN CARLOS PUMP STATION PIPEWORK AND EQUIPMENT SECTION A-A
SAN CARLOS DATE APPROVED	
BELMONT DATE APPROVED	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
	Drawn by: LLK LFI — Scale: 1/4"=1'-0"
MENLO PARK S.D. DATE	Des/Chkd by: DAB — Date: 8-77/9-79

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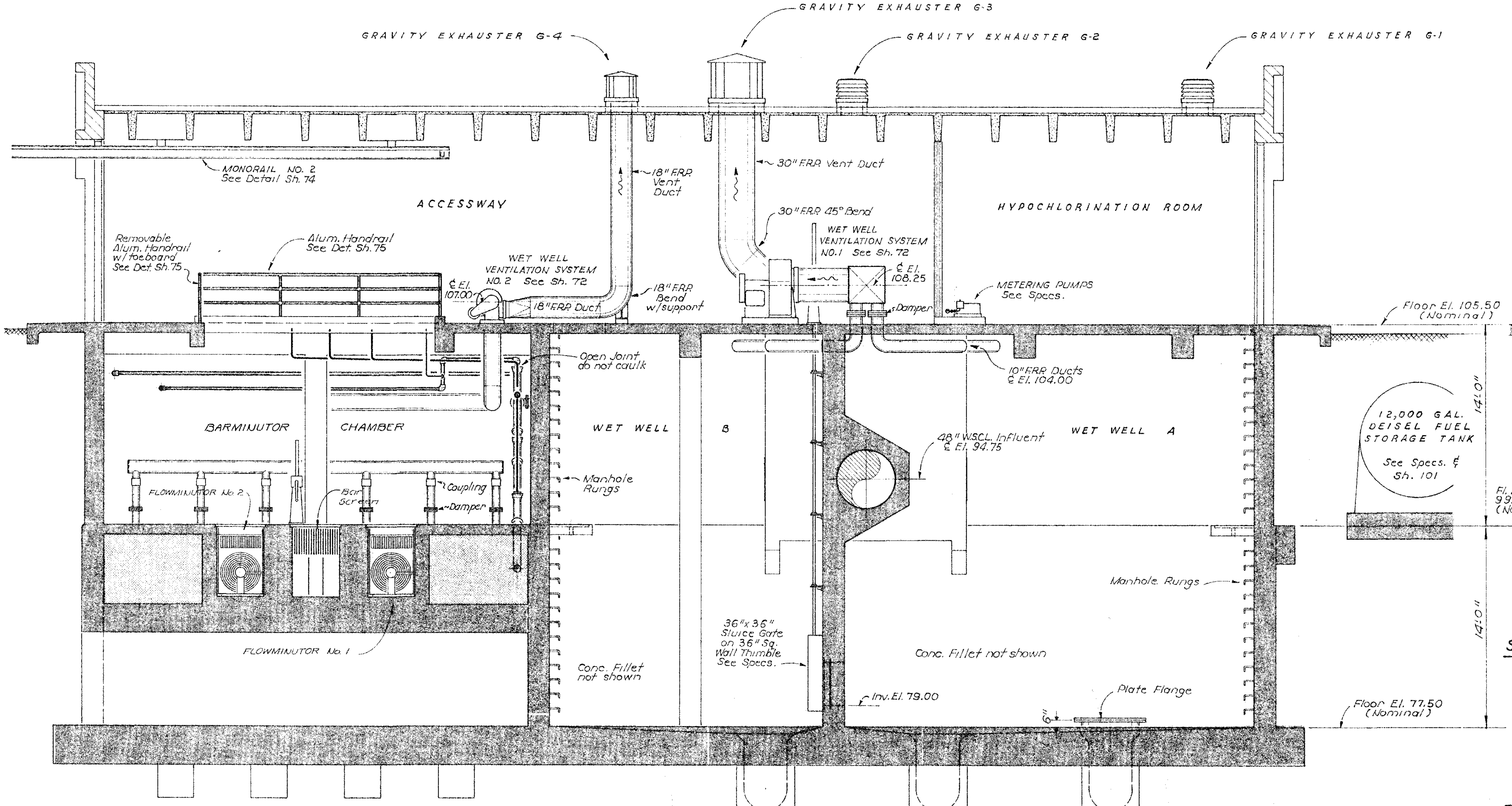
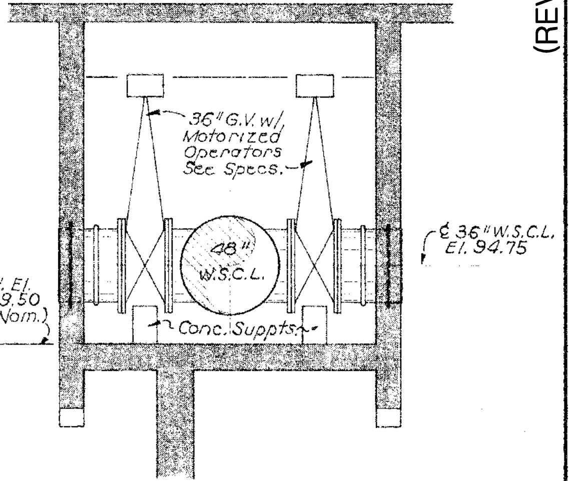
Record Drawing

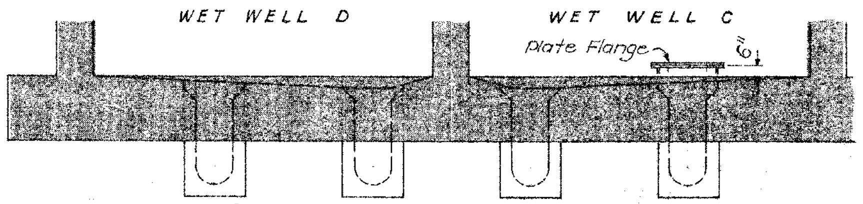
(REVISED SET JUNE 2006)



SECTION B – B



SECTION F – F



SECTION C – C

69 OF 141

RECORD DRAWING, JUNE 1982

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION PIPEWORK AND EQUIPMENT SECTION B-B AND C-C
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: LLK LFI — Scale: 1/4"=1'-0" Des/Chkd by: DAB — Date: 8-77/9-79

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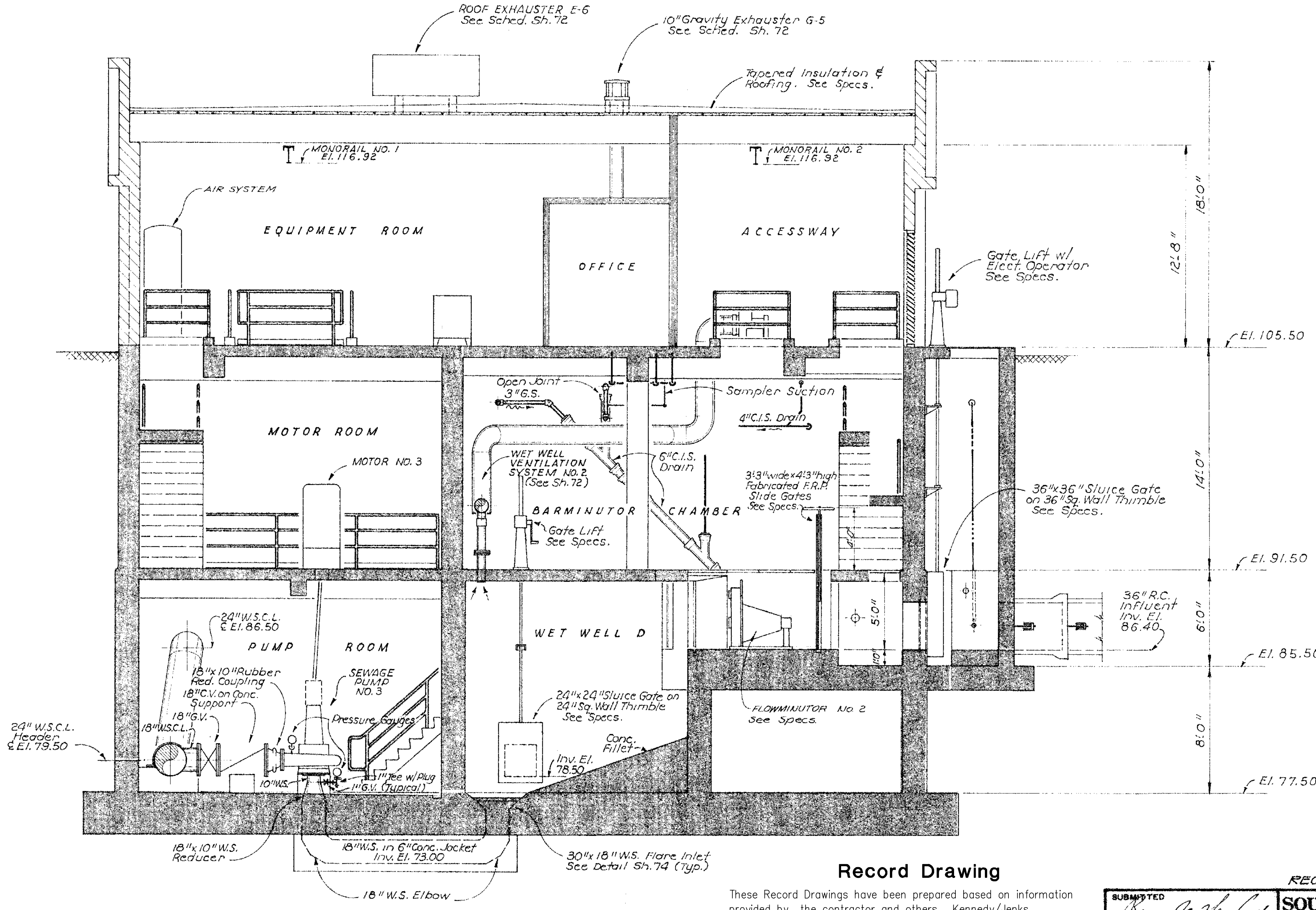

SECTION D-D

(REVISED SET JUNE 2006)

Record Drawing

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RECORD DRAWING, JUNE 1982

70 OF 141

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION PIPEWORK AND EQUIPMENT SECTION D-D
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: LLK LFI — Scale: 1/4"=1'-0" Des/Chkd by: DAB — Date: 8-77/9-79

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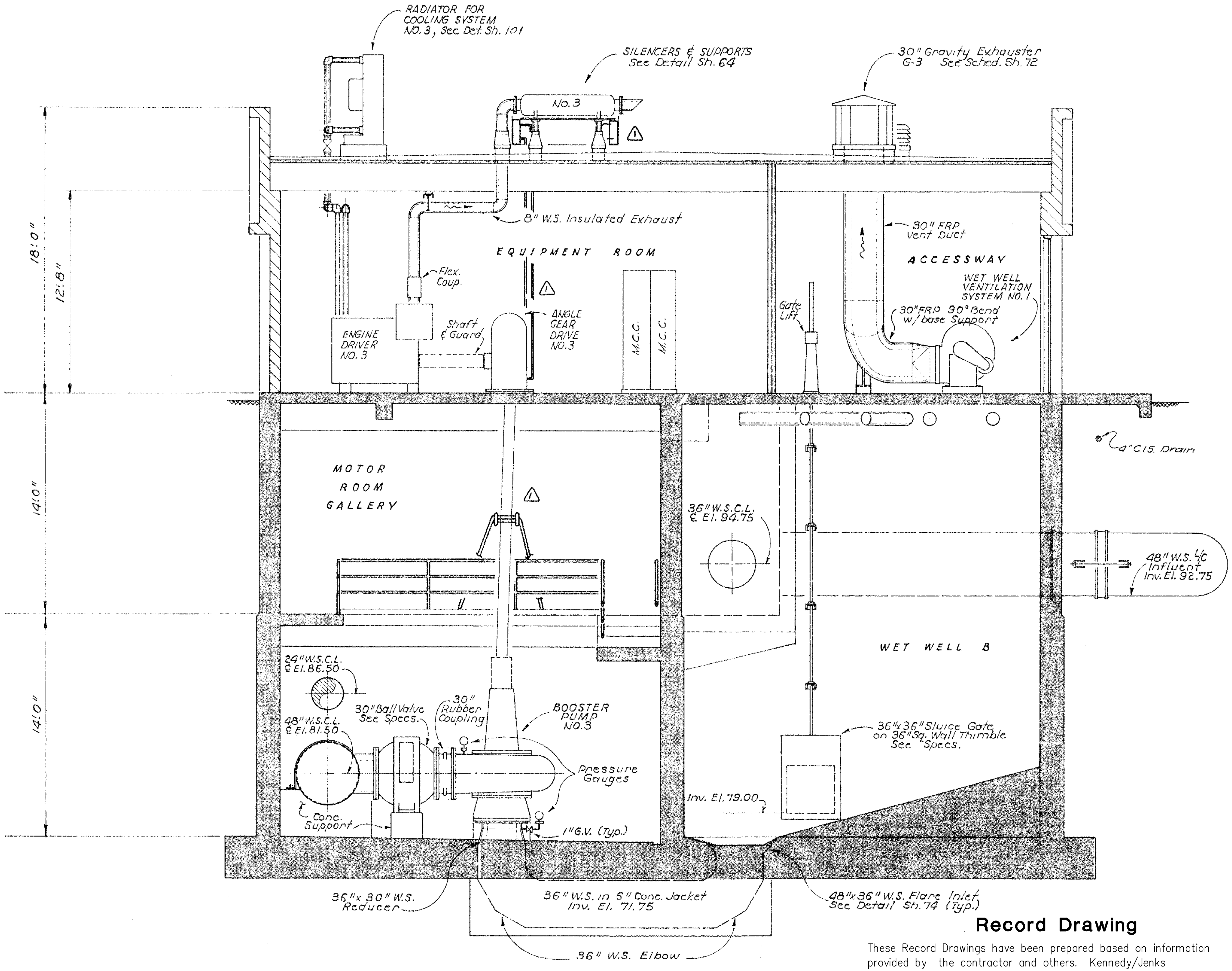

SECTION E-E

Record Drawing

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(REVISED SET JUNE 2006)

71 OF 141

⚠ RECORD DRAWING, JUNE 1982

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
PIPEWORK AND EQUIPMENT
SECTION E-E

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: LLK LFI
Scale: 1/4" = 1'-0"
Des/Chkd by: DAB
Date: 8-77 / 9-79

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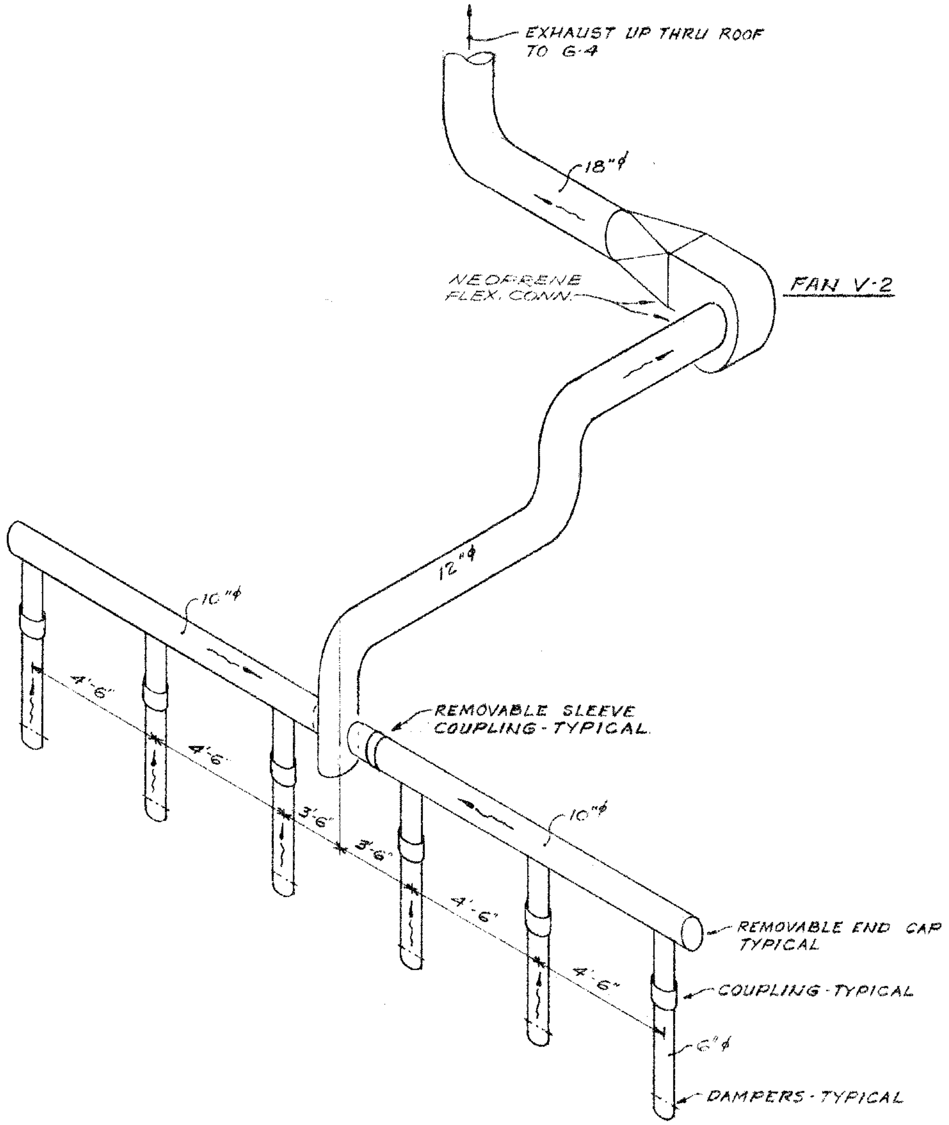
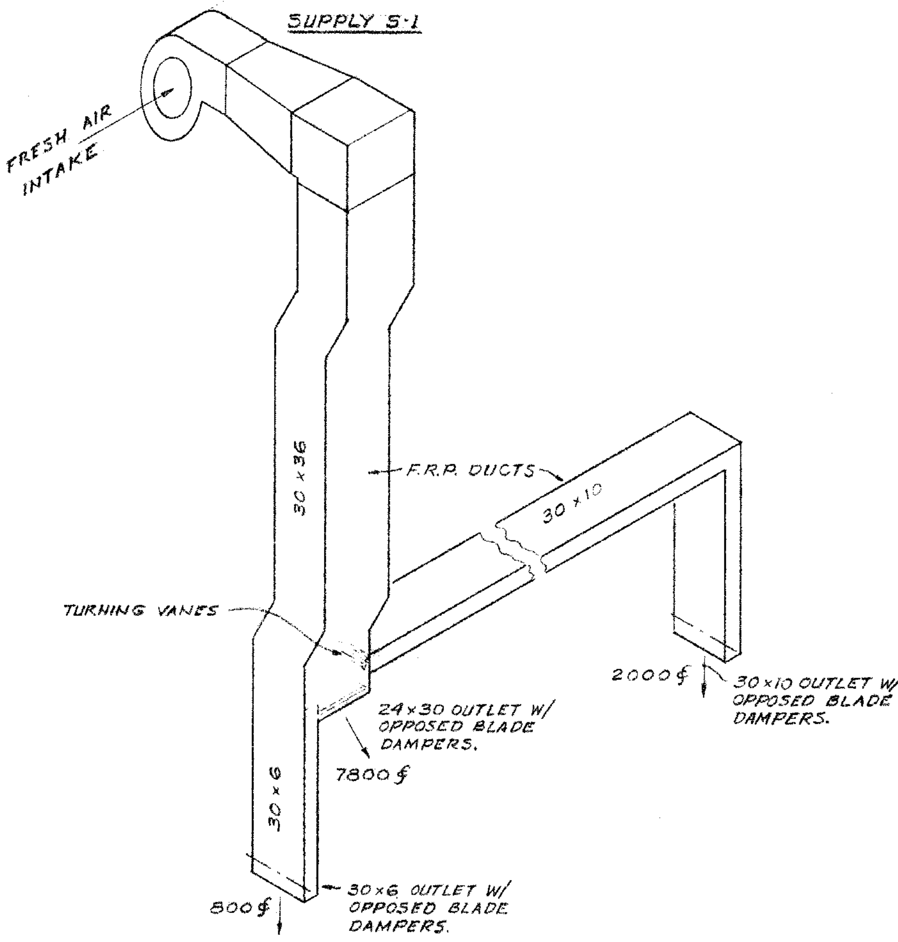


WET WELL VENTILATION DUCTWORK SYSTEM #2
NO SCALE

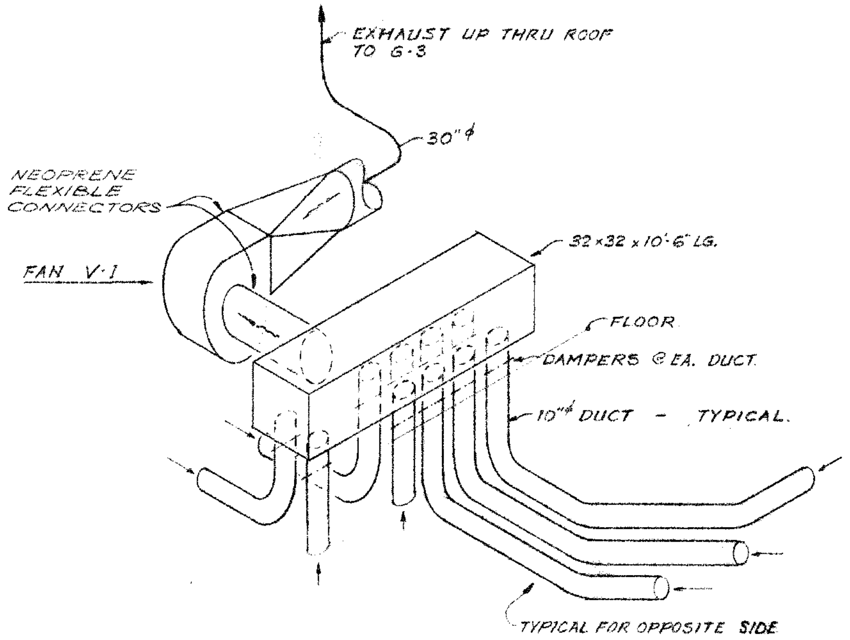


PUMP ROOM & MOTOR ROOM VENTILATION DUCTWORK
NO SCALE

NOTE
Gravity Exhausters G-3 thru G-6 shall be certified to perform as shown in cfm of wind induced ventilation assuming the following conditions: wind velocity 8 mph, Height of stack 19', temp. differential 10°.

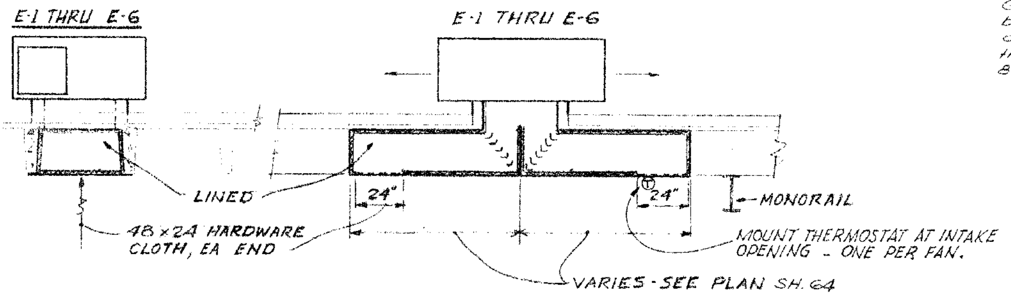
FAN SCHEDULE

MARK	SERVICE	TYPE	SIZE	S.P.	C FM	ELECT. DATA			REMARKS
						HP	ϕ	VOLT	
S-1	SUPPLY	PLR UTILITY	338	1"	10600	3	3	460	
V-1	EXHAUST WET WELL	NYB UTILITY	248	2½"	7400	7½	3	460	EXPLOSION PROOF MOTOR - SEE SPECS
V-2	"	"	128	1½"	1570	1	3	460	"
E-1	EXHAUST ENGINE RM.	ROOF	L03606	¼"	11,700	1½	3	460	THERMOSTAT CONTROLLED
E-2	"	↓	↓	↓	↓	↓	↓	↓	"
E-3	"								"
E-4	"								"
E-5	"								"
E-6	"								"
G-1	GRAVITY	ROOF	SG-18"	–	725	–	–	–	TRANSLUCENT TOP
G-2	"	↓	SG-18"	–	725	–	–	–	"
G-3	V-1 DISCH		F-30"	–	1923	–	–	–	–
G-4	V-2 DISCH.		F-18"	–	691	–	–	–	–
G-5	GRAVITY TOILET		F-10"	–	214	–	–	–	–
G-6	GRAVITY OFFICE.		F-10"	–	214	–	–	–	–

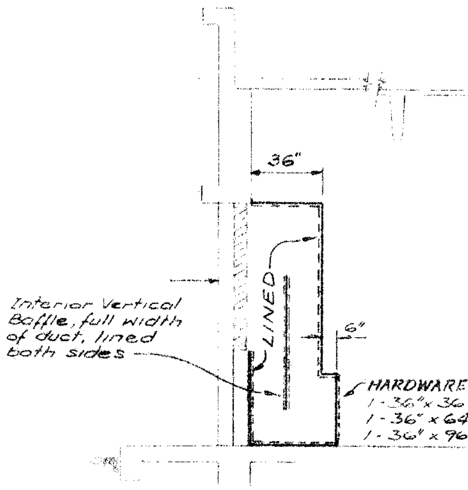


WET WELL VENTILATION DUCTWORK SYSTEM #1
NO SCALE

(REVISED SET JUNE 2006)



SECTIONS
SCALE: ¼"=1'-0"



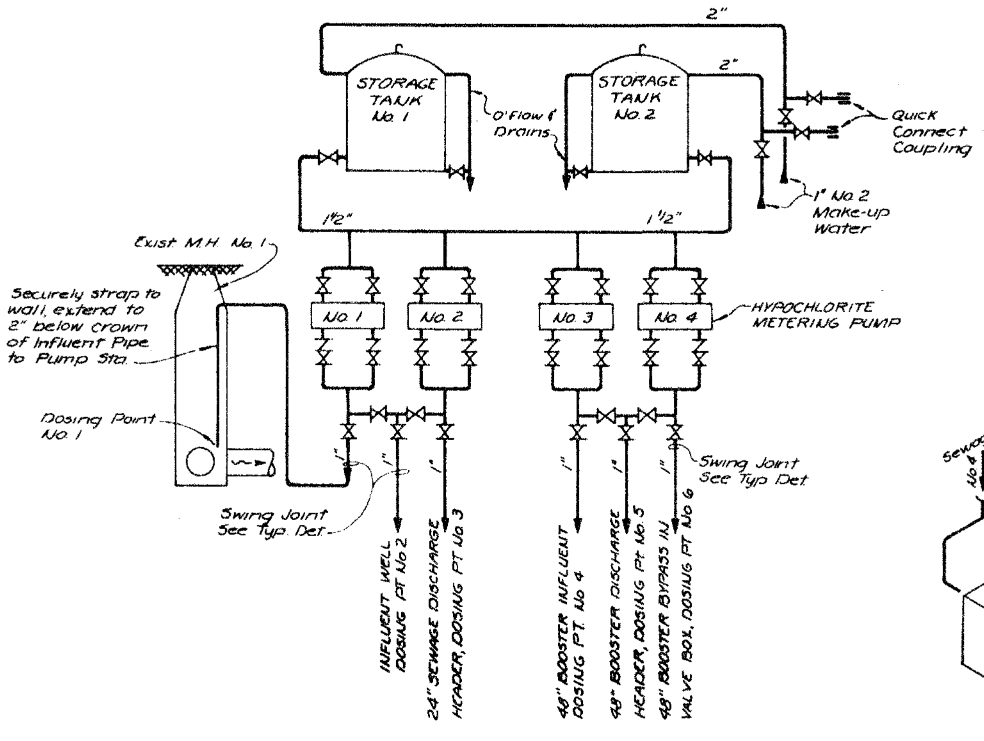
TYPICAL INLET DUCT SECTION
SCALE: ¼"=1'-0"

Record Drawing

RECORD DRAWING, JUNE 1982

SUBMITTED
Bruce M. Wagstaff
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

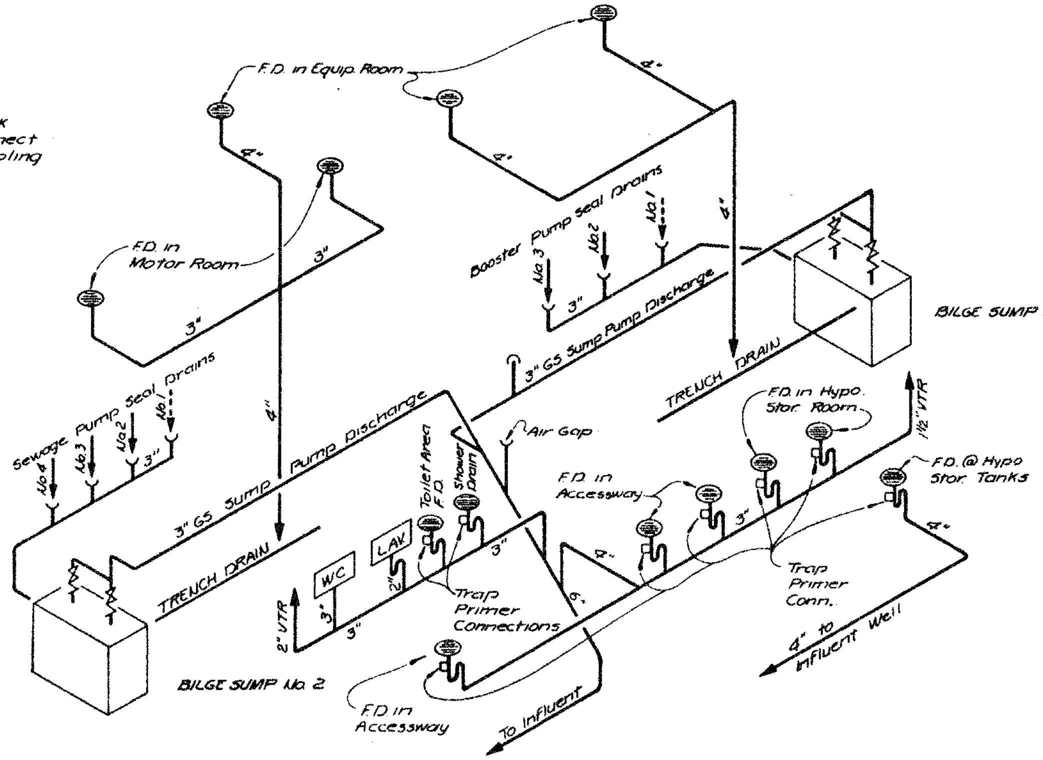
SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA
SUBREGIONAL WASTEWATER WORKS
SAN CARLOS PUMP STATION
PIPEWORK AND EQUIPMENT
VENTILATION DETAILS
JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS
Drawn by: KT
Des/Chkd by: HHA
Scale: AS NOTED
Date: 8-77 / 9-79



All piping to be PVC unless otherwise noted. All Valves to be PVC Ball Valves.

HYPOCHLORITE DOSING SYSTEM DIAGRAM

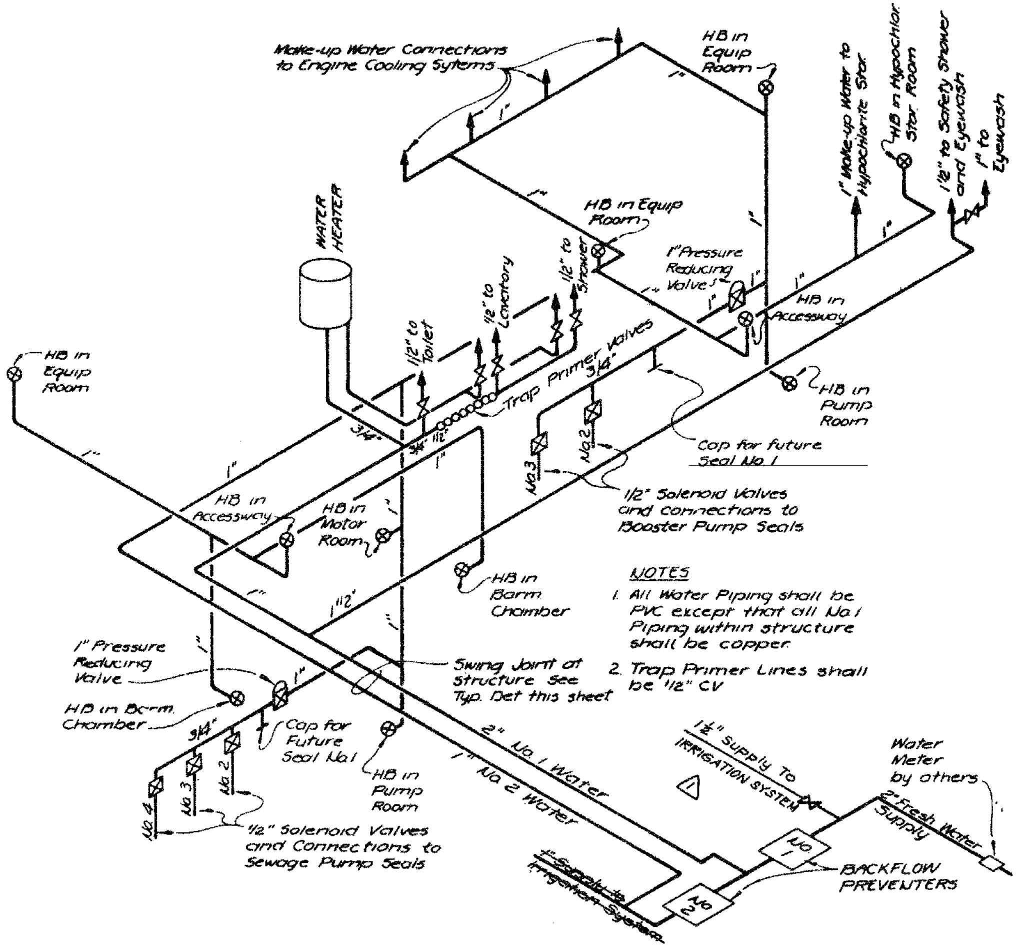
No Scale



All Drain Pipe to be Cast Iron Soil Pipe (except as noted)

DRAINS & PLUMBING DIAGRAM

No Scale

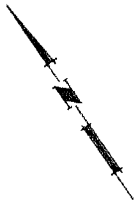


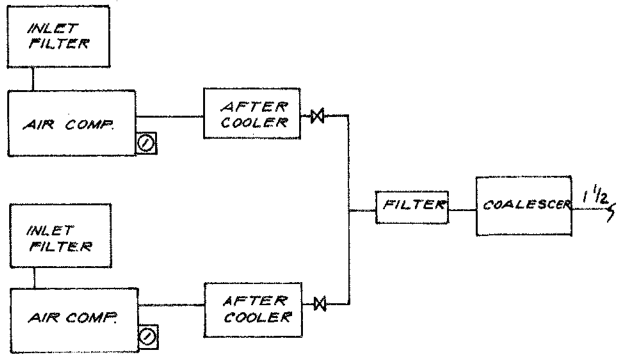
NOTES

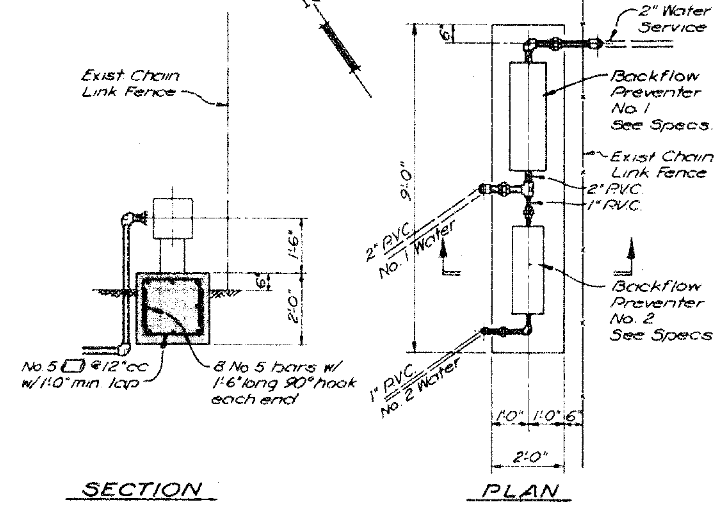
1. All Water Piping shall be PVC except that all No. 1 Piping within structure shall be copper.
2. Trap Primer Lines shall be ½" CV

WATER SUPPLY SYSTEM DIAGRAM

No Scale

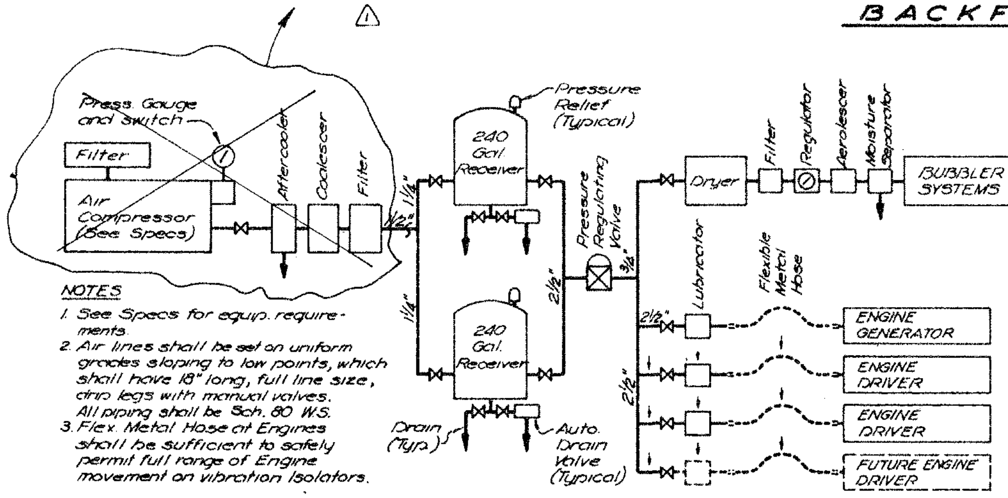






BACKFLOW PREVENTER

Scale ⅜"=1'-0"

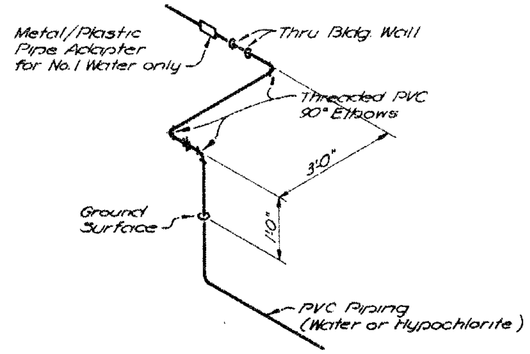


NOTES

1. See Specs for equip. requirements.
2. Air lines shall be set on uniform grades sloping to low points, which shall have 18" long, full line size, drip legs with manual valves. All piping shall be Sch. 80 W.S.
3. Flex. Metal Hose at Engines shall be sufficient to safely permit full range of Engine movement on vibration Isolators.

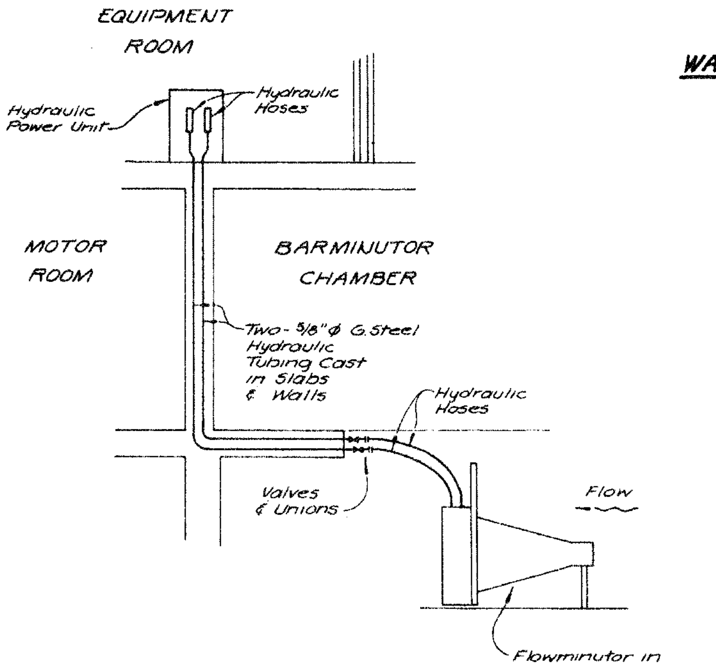
COMPRESSED AIR DIAGRAM

No Scale



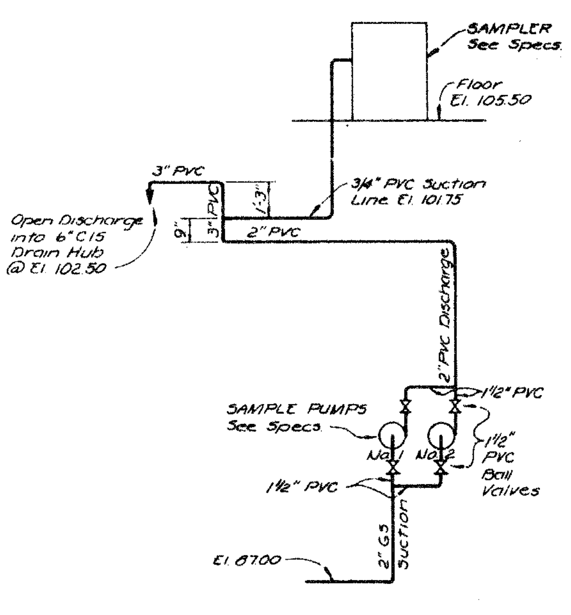
TYPICAL SWING JOINT DETAIL

No Scale



FLOWMINUTOR SYSTEM DIAGRAM

No Scale



SAMPLING SYSTEM DIAGRAM

No Scale

⚠ RECORD DRAWING, JUNE 1982

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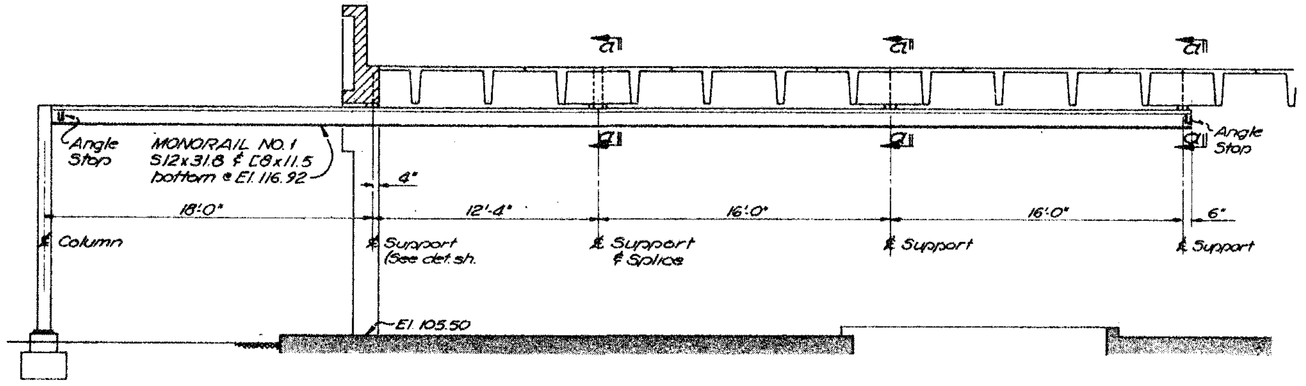
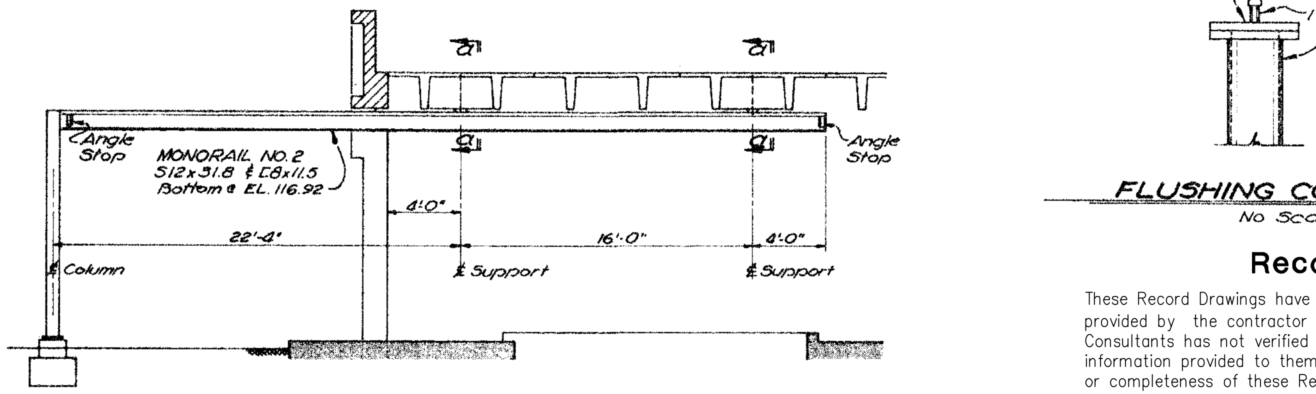
(REVISED SET JUNE 2006)

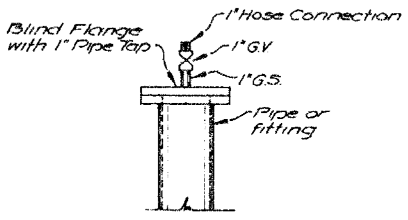
SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION PIPEWORK & EQUIPMENT SYSTEM SCHEMATICS
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: LLK EB — Scale: AS NOTED Des/Chkd by: DAB — Date: 8-77 / 9-79



ELEVATION OF MONORAIL NO. 1
Scale 3/16"=1'0"



ELEVATION OF MONORAIL NO. 2
Scale 3/16"=1'-0"



FLUSHING CONNECTION
No Scale

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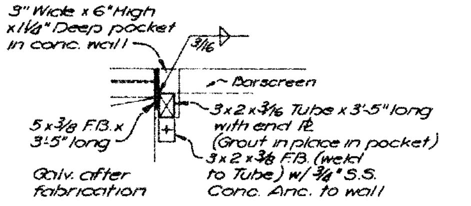
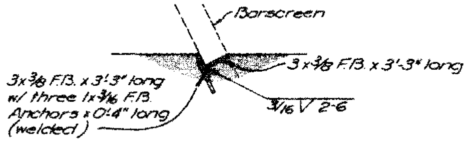
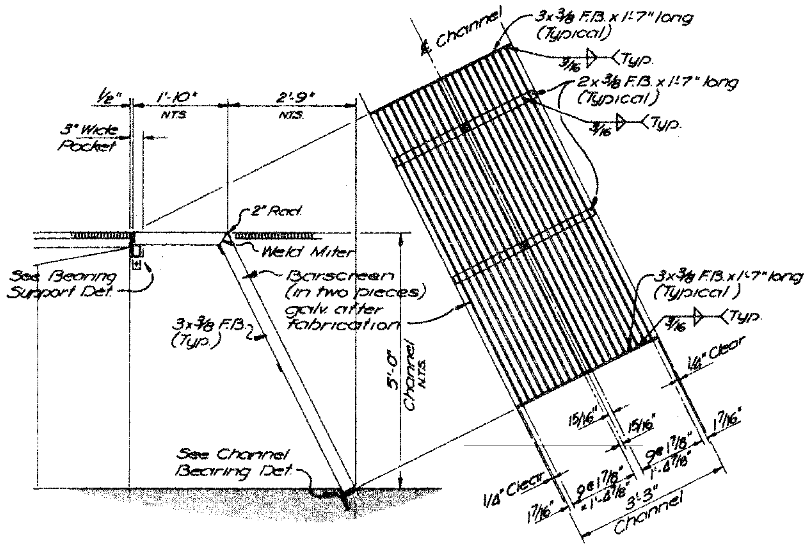


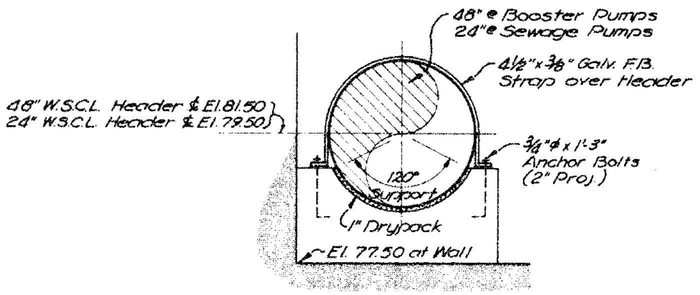
BEARING SUPPORT DETAIL
Scale 1"=1'-0"



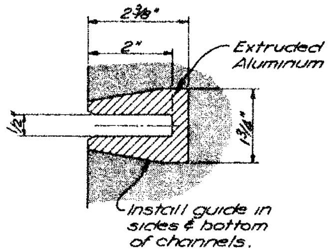
CHANNEL BEARING DETAIL
Scale 1"=1'-0"



BAR SCREEN DETAIL
Scale 1/2"=1'-0"



DISCHARGE HEADER SUPPORTS
No Scale



STOP PLANK GUIDE
No Scale

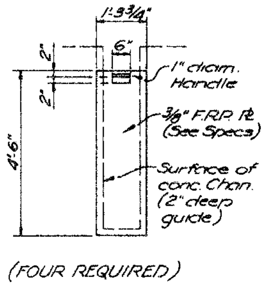
PIPE SUPPORT NOTE

All piping installed as part of this project shall be adequately supported. The elevated piping shall be supported on approved hangers, saddles, straps, brackets, frames and/or concrete piers which shall be securely connected to the reinforced concrete floor slabs, walls and/or roof slabs. The Support System shall be designed to adequately support the full weight of the pipe, pipe fittings and pipe contents as well as to provide lateral and longitudinal support for the complete elevated piping system. The pipe supports shall be located as shown and/or noted on these plans, and they shall also conform to the following maximum spacings and locations:

1. 30"φ to 14"φ pipes - - - -15'-0" max. spacing.
2. 12"φ to 8"φ pipes - - - -12'-0" " "
3. 6"φ C.I. or W.S. pipes - - - -10'-0" " "
4. 4"φ C.I. or W.S. pipes - - - -8'-0" " "
5. 3"φ to 2"φ metal pipes - - -6'-0" " "
6. 1½"φ to ½"φ metal pipes - - -4'-0" " "
7. 6"φ to 2½"φ P.V.C. pipes - -4'-0" " "
8. 2"φ to ½"φ P.V.C. pipes - -3'-0" " "
9. Locate a support at each end of each pipe.
10. Locate a support at each horizontal and each vertical angle point.

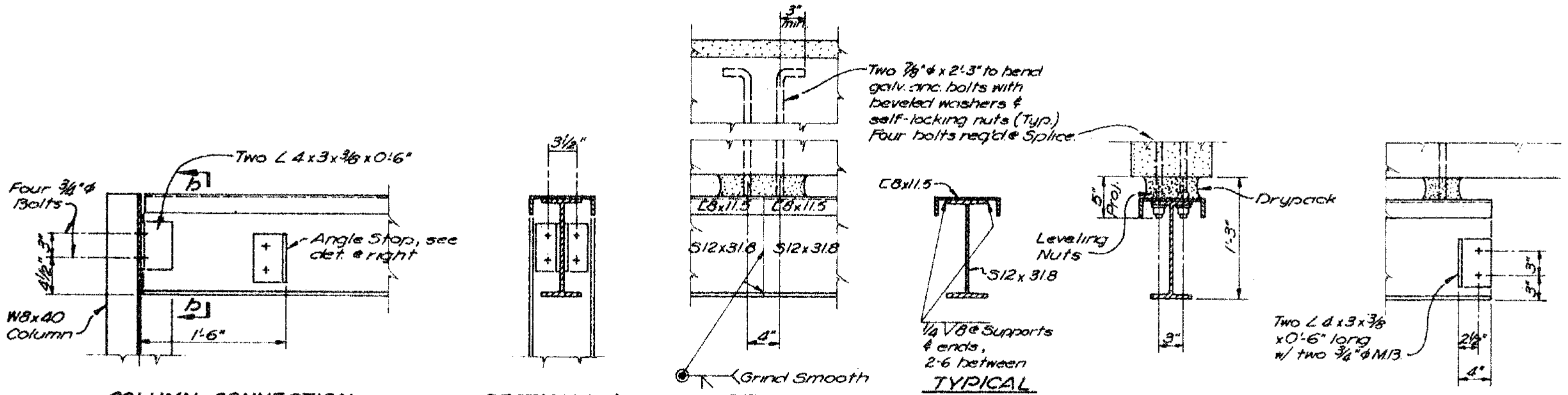
The proposed piping support system shall be submitted for approval prior to the pouring of the concrete structure.

Pipe support components shall be Grinnell, Elcen, Unistrut, Speedstrut or approved equal.



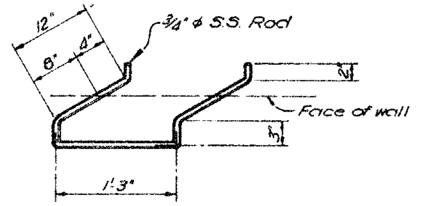
(FOUR REQUIRED)
STOP PLANK
No Scale

(REVISED SET JUNE 2006)



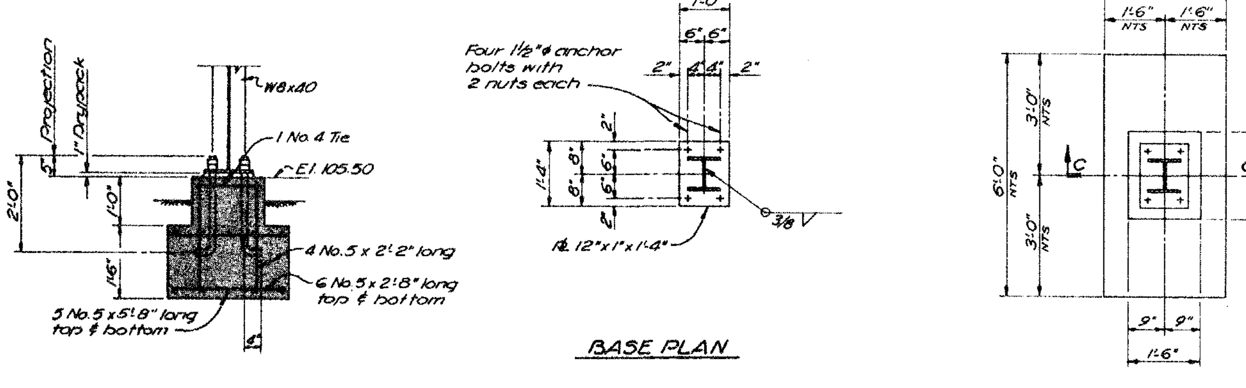
COLUMN CONNECTION
SECTION b-b
SPLICE
TYPICAL SECTION
SECTION a-a
ANGLE STOP

MONORAIL DETAILS
Scale 1"=1'-0"



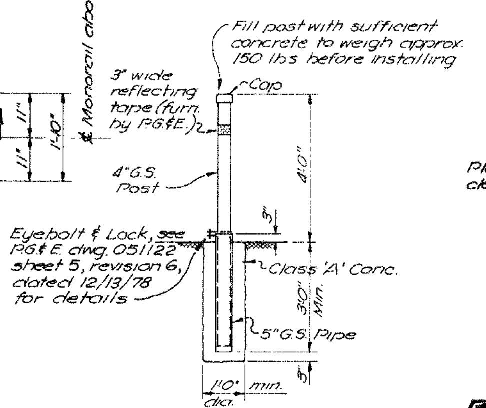
MANHOLE RUNG
Scale 1"=1'-0"

RECORD DRAWING, JUNE 1982

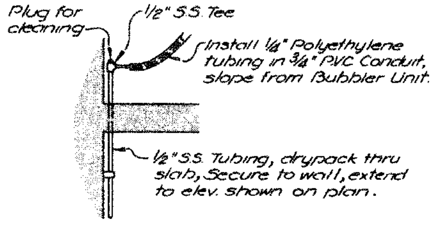


SECTION c-c
BASE PLAN
FOOTING PLAN

COLUMN FOOTING DETAILS
Scale 1/2"=1'-0"



TRANSFORMER PROTECTION POSTS
No Scale



BUBBLER TUBE DETAIL
No Scale

SUBMITTED Bruce M. [illegible] JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION PIPEWORK AND EQUIPMENT MONORAIL AND MISC. DETAILS
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: L.L.K — Scale: AS NOTED Des/Chkd by: DAB — Date: 8-77/9-79

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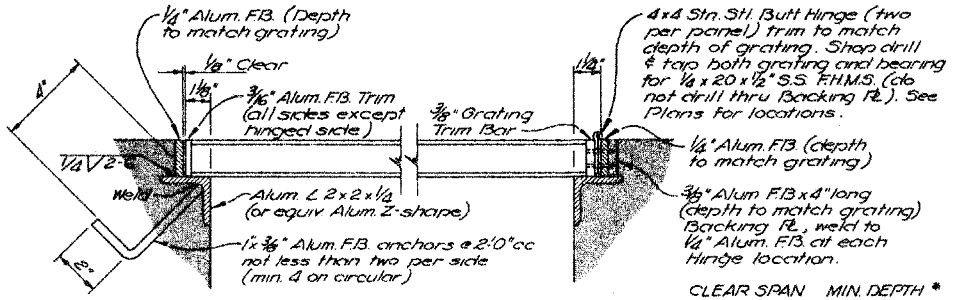


Grating shall be extruded aluminum with 19/32"×3" rectangular upset perforations (except where noted *without* perforations), heavy duty design. Grating without perforations shall have retractable handles.

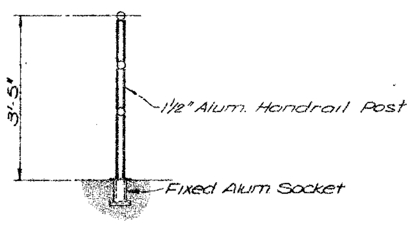
CLEAR SPAN	MIN. DEPTH *
0" to 2'-0"	1" deep
2'-1" to 3'-0"	1 1/4" deep
3'-1" to 4'-0"	1 1/2" deep
4'-1" to 5'-0"	1 3/4" deep
5'-1" to 6'-0"	2" deep

Over 6'-0" use intermediate supports.

*Unless otherwise noted on the plans.

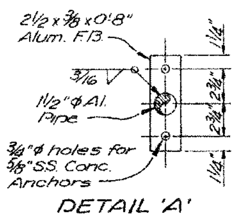
GRATING & BEARING DETAIL

Scale 3"=1'-0"



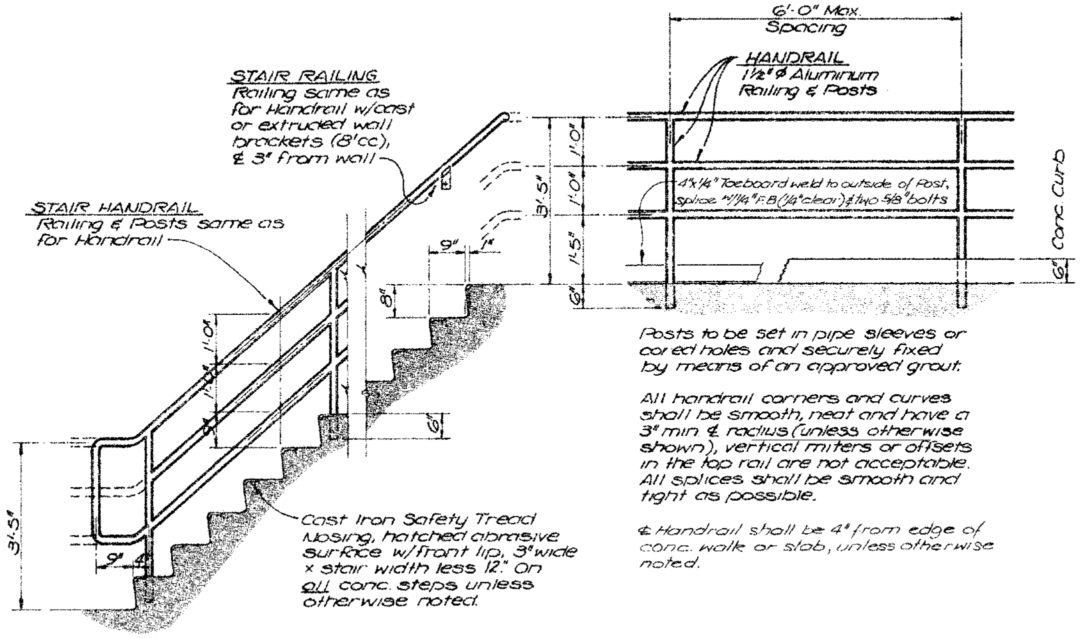
REMOVABLE POST DETAIL

Scale 1/2"=1'-0"



DETAIL 'A'

No Scale



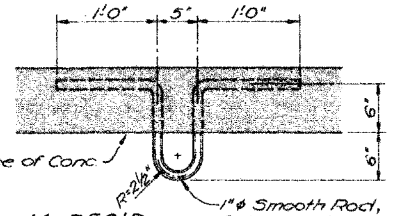
Posts to be set in pipe sleeves or cored holes and securely fixed by means of an approved grout.

All handrail corners and curves shall be smooth, neat and have a 3" min ℄ radius (unless otherwise shown), vertical miters or offsets in the top rail are not acceptable. All splices shall be smooth and tight as possible.

℄ Handrail shall be 4" from edge of conc. walk or slab, unless otherwise noted.

CONC. STAIR, HANDRAIL AND RAILING DETAILS

Scale 1/2"=1'-0"



14-REQ'D

LIFT HANGER

Scale 1"=1'-0"

Record Drawing

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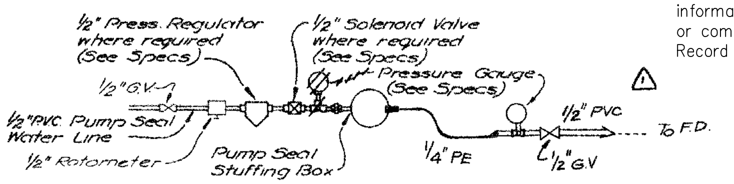
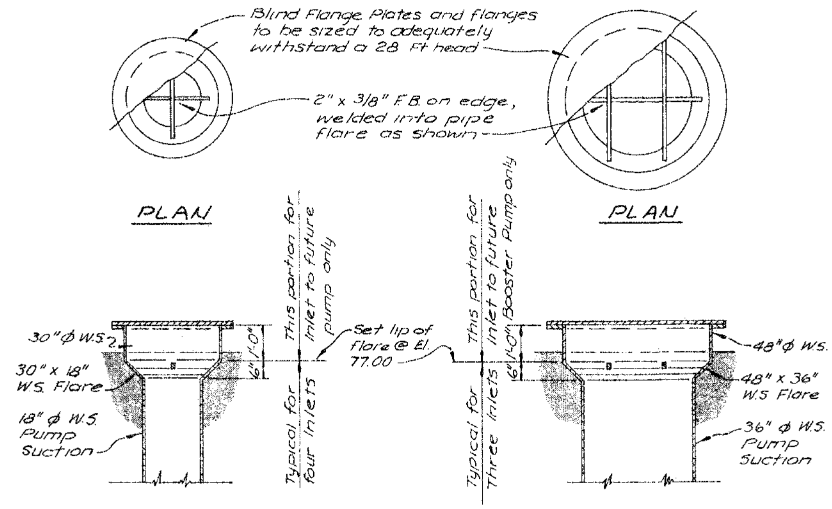


PUMP SEAL WATER ASSEMBLY

No Scale

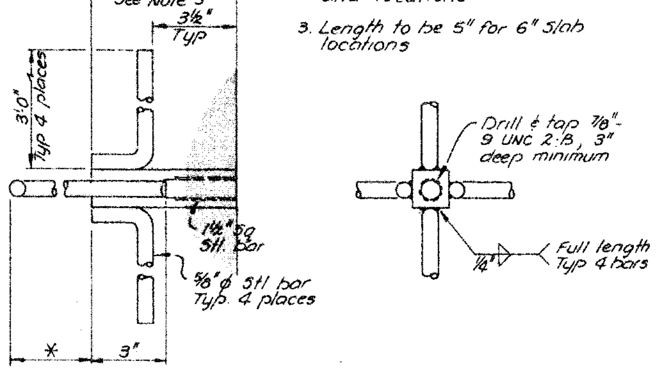


SUCTION BELL DETAILS

Scale 3/8"=1'-0"

NOTES

1. Material to be Stl. A-7 or equiv.
2. Refer to Plans for number and locations
3. Length to be 5" for 6" Slab locations



* Rear Bar lengths shall be as req'd for each wall and/or slab thickness to position 3'-0" hooks on inside of back principal reinforcing steel

50 REQ'D

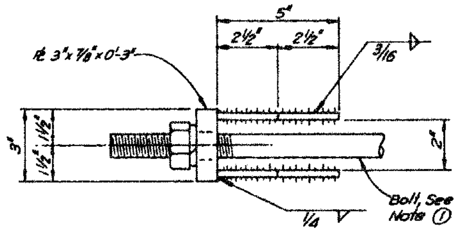
THREADED INSERT DETAIL

Scale 3"=1'-0"

TENSION ANCHOR NOTES

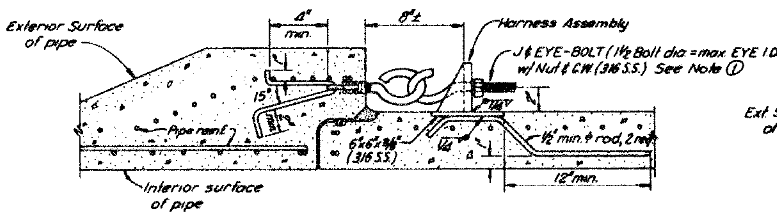
1. Tension anchors on pipe connections will be required at those locations indicated and/or noted on these plans. They will also be required in yard pipework on RC and Welded Steel pipe joints which are located within 8' of any bend greater than 15°. The Contractor shall provide and install two anchors at each required joint located at the springline of the pipe. All exposed tension anchor metal (including bolts) shall be 316 Stainless Steel. The sizes and dimensions shown on this detail are minimums and dimensions may require modification for specific locations. Minimum tension anchor bolt diameters shall be
   - 3/4" ø bolts for pipes smaller than 30" in diameter,
   - 7/8" ø bolts for 30" to 51" diameter pipes,
   - 1" ø bolts for pipes larger than 51" in diameter.

   The Contractor shall submit details for approval prior to fabrication.
2. Typical tension anchors located at the joints for RC and at the couplings for Welded Steel pipes have been detailed below. Portions of these typical details also apply to required tension anchors at other piping connections including RC to WS L/C connections, RC to structure connections and WS L/C to structure connections. Tension anchors at structure connections shall utilize anchor bolts cast in the concrete.



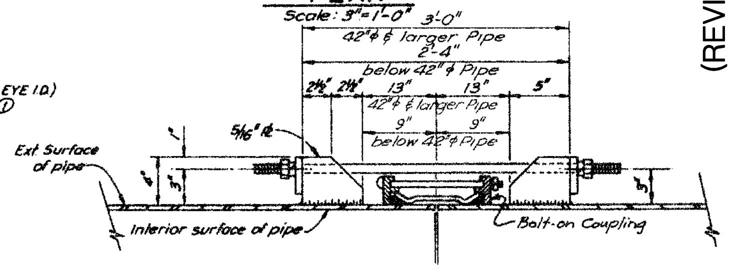
PLAN

Scale: 3"=1'-0"



REINFORCED CONCRETE PIPE

Scale 1 1/2"=1'-0"



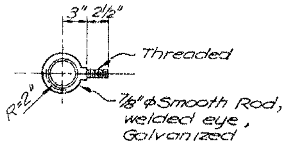
WELDED STEEL PIPE

(LININGS & COATINGS NOT SHOWN)

Scale 1 1/2"=1'-0"

TENSION ANCHOR DETAILS

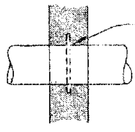
(REVISED SET JUNE 2006)



50 REQ'D

LIFT RING

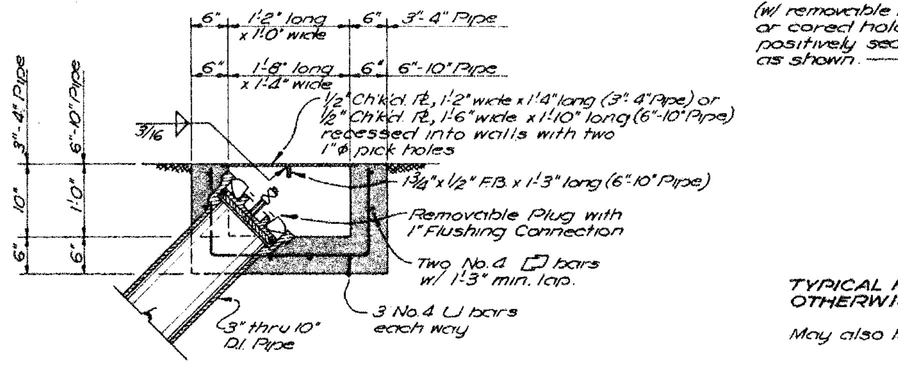
Scale 1"=1'-0"



1/4" ℞ Wall Ring, placed in center of wall, on all pipes subject to water pressure from within or without, continuous fillet weld all around, O.D. of Ring sized as follows:
3" to 5" Pipe, O.D. of pipe +3" min.
6" to 12" Pipe, " " " +4" "
over 12" Pipe, " " " +6" "

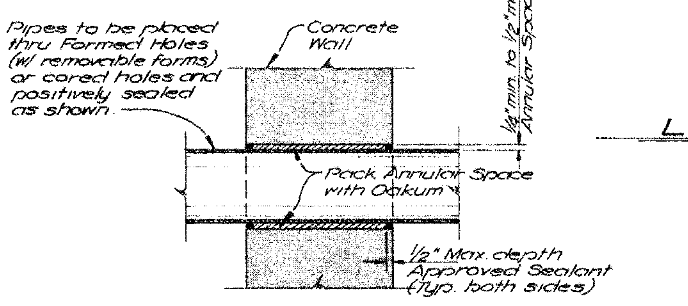
CUT-OFF RING DETAIL

No Scale



CLEANOUT

Scale 3/4"=1'-0"

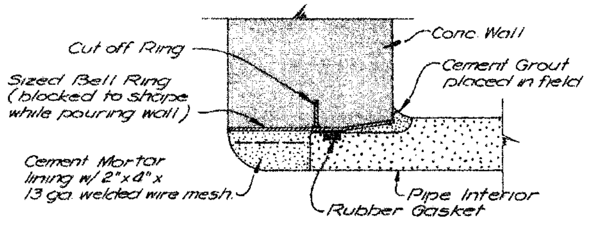


TYPICAL FOR ALL A.C., Cu., F.R.P. & P.V.C. PIPES UNLESS OTHERWISE DETAILED ON THE PLANS.

May also be used for *all* 2" ø and smaller piping.

TYPICAL PIPE WALL PENETRATION

NO SCALE



CONC. PIPE WALL CONNECTION

No Scale

1 RECORD DRAWING, JUNE 1982

SUBMITTED Bruce M. Wagenhoff JENKS & HARRISON — DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY — DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS — DATE	SAN CARLOS PUMP STATION PIPEWORK AND EQUIPMENT MISCELLANEOUS DETAILS
APPROVED BELMONT — DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. — DATE	Drawn by: LLK — Scale: AS NOTED Des/Chkd by: DAB — Date: 8-77/9-79

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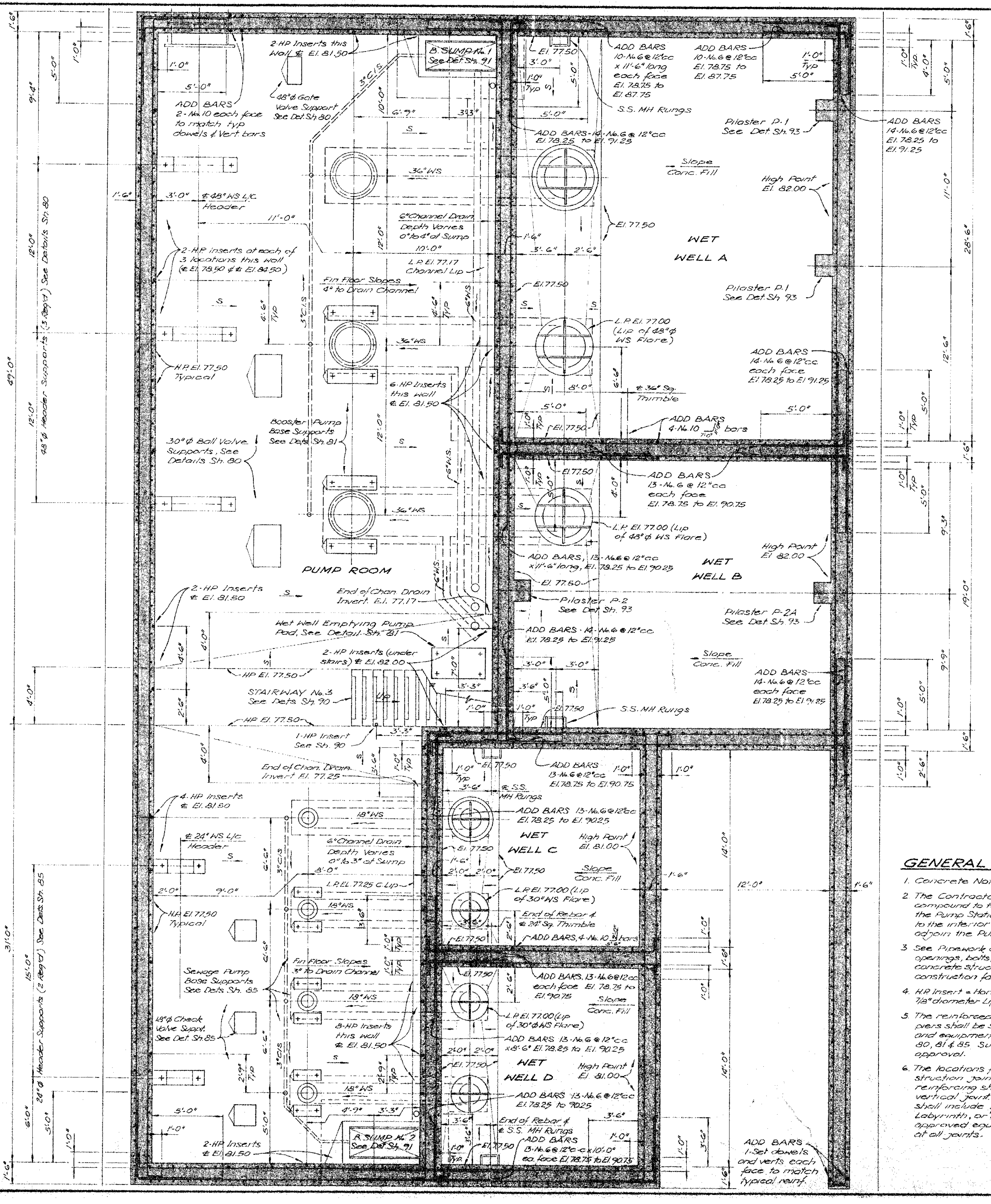

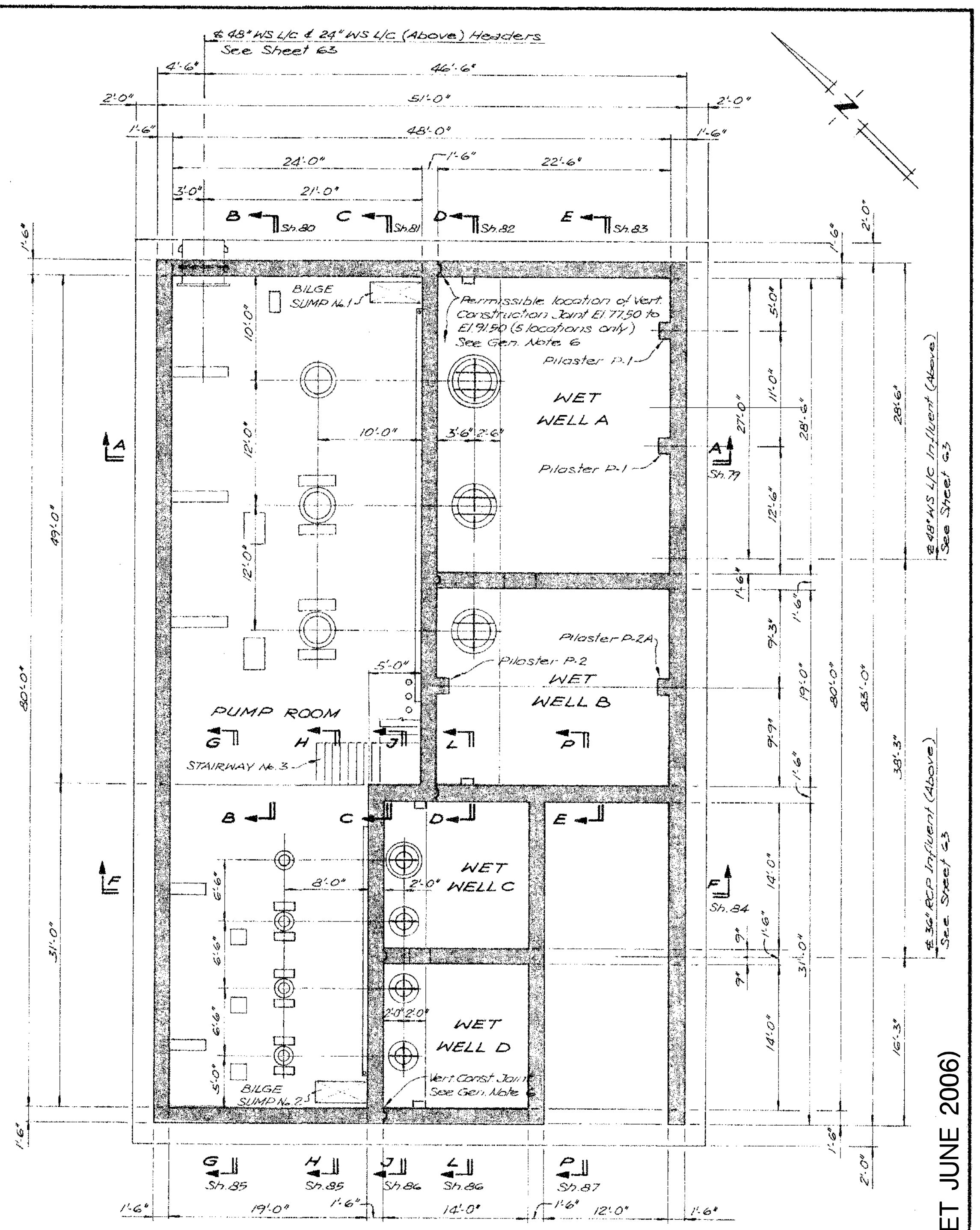

DIMENSIONAL PLAN

Scale 1/8" = 1'-0"

GENERAL NOTES

1. Concrete Notes for this Structure are on Sh. 15
2. The Contractor shall apply a waterproofing compound to the exterior face of all the walls of the Pump Station below the ground surface and to the interior surfaces of the Wet Well walls which adjoin the Pump Room; see Specs.
3. See Pipework and Equipment drawings for required openings, bolts, pipework and equipment in the concrete structure. See Section A-A, Sheet 79, for construction falsework requirements in the Pump Station
4. H.P. Insert = Horizontal Pull threaded steel Insert for 7/8" diameter Lift Ring - see Details, Sheet 75
5. The reinforced concrete pipe supports and pump piers shall be sized to conform to the pipework and equipment to be installed; see Details, Sheets 80, 81 & 85. Submit details to the Engineer for approval.
6. The locations for permissible vertical wall construction joints are shown on this Sheet. Wall reinforcing shall be continuous through each vertical joint. Vertical construction joints shall include a Type E-3 (3 ribs) "Harzo" Labyrinth, or "Waterseals" Inc. Waterstop, or approved equal; waterstops shall be welded at all joints.

Record Drawing

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(REVISED SET JUNE 2006)

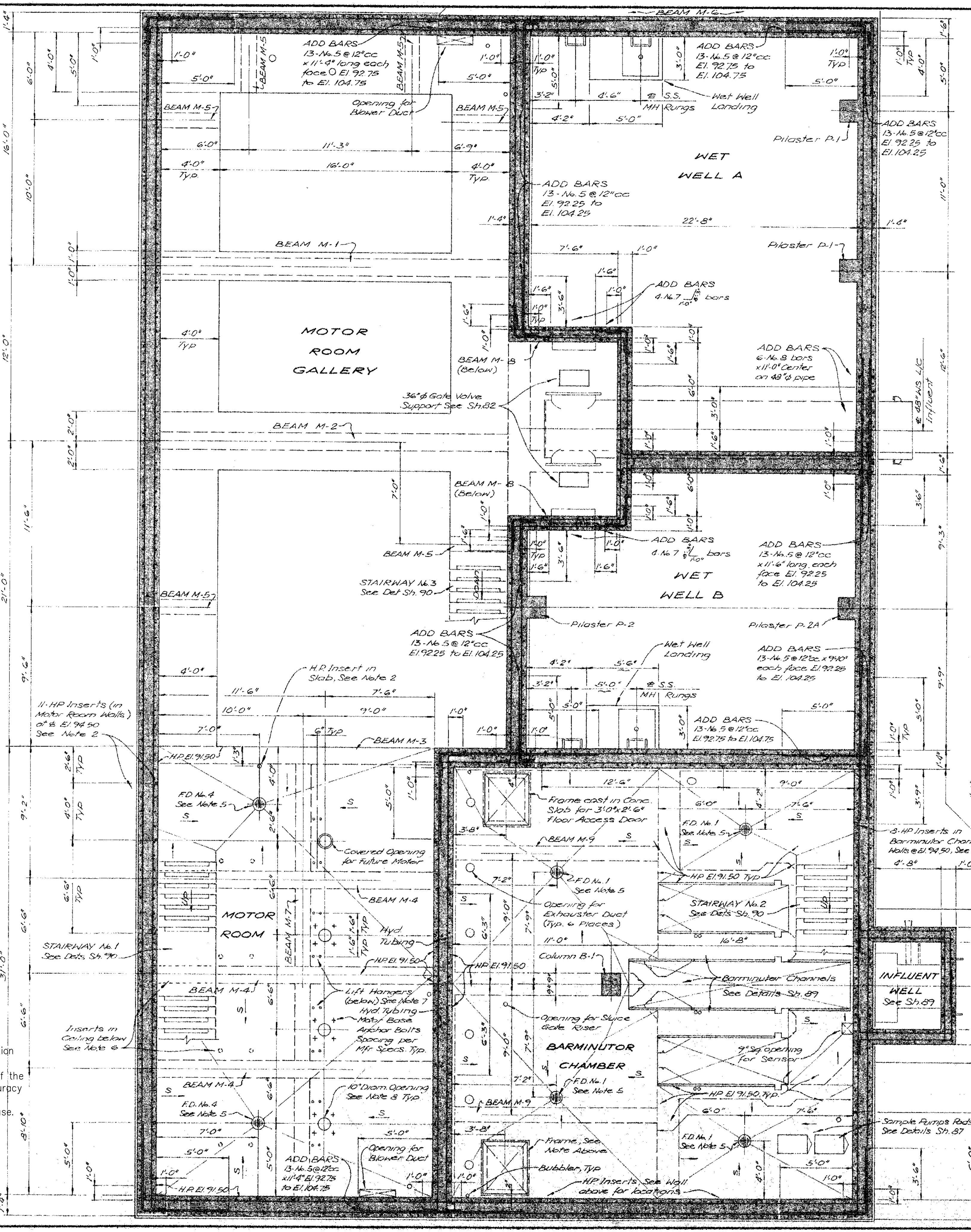
76 OF 141

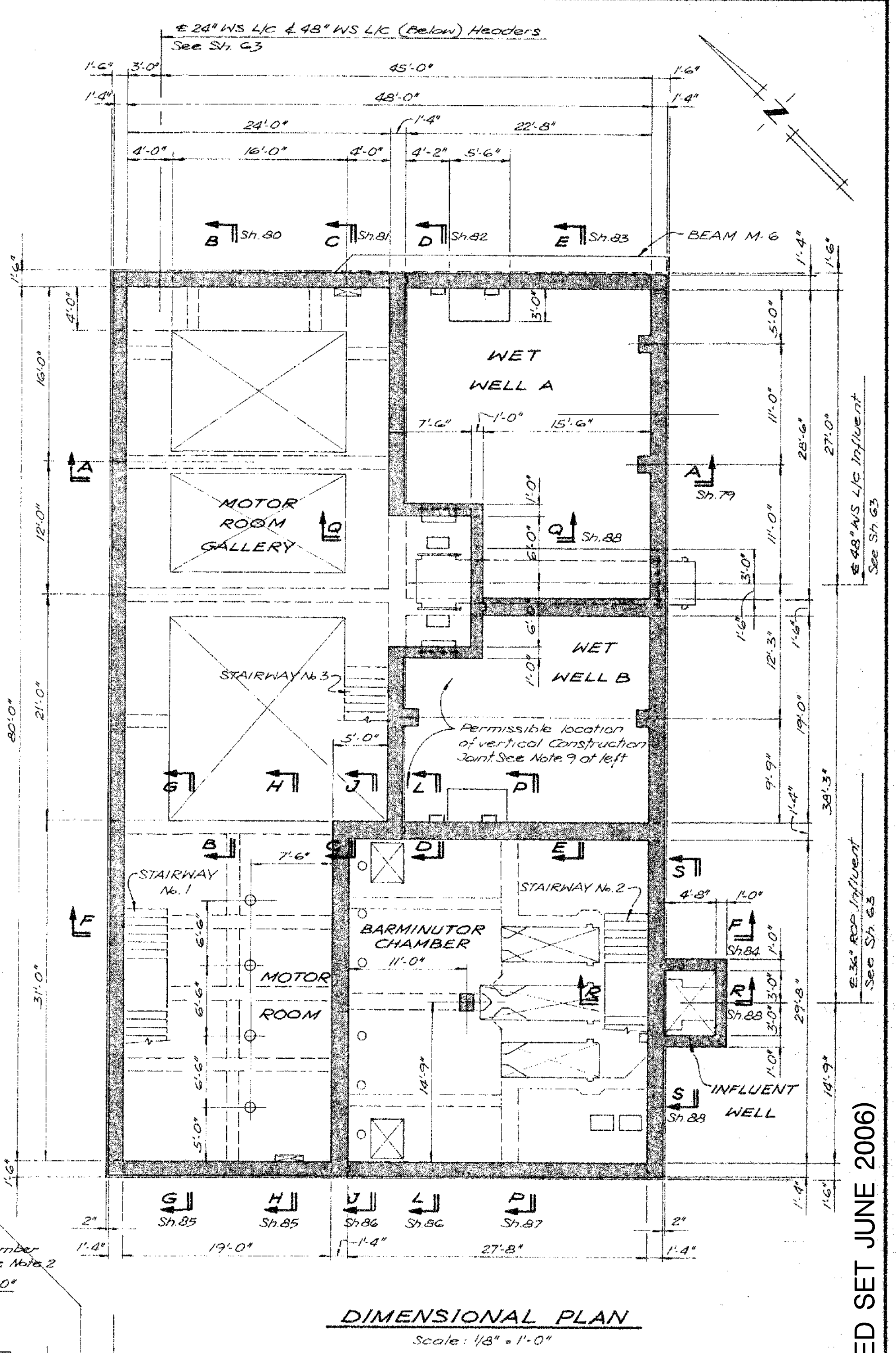
RECORD DRAWING, JUNE 1982

SUBMITTED Bruce M. [illegible] JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION STRUCTURAL PUMP ROOM & WET WELL PLANS
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: MR CGS — Scale: 1/4"=1'-0", EX. AS NOTED Des/Chkd by: DAB — Date: 8-77 / 9-79

NOTES

1. General Notes 1, 2 and 3 shown on Sheet 76 shall also apply to this Plan.
2. H.P. Insert = Horizontal Pull threaded steel insert for 7/8" diameter Lift Ring - See Details Sheet 75. Note that one H.P. Insert is to be located in the Motor Room Slab, modify the details of this insert to provide a 1 1/2" square bar with a threaded hole both of which extend completely through the conc. slab.
3. The reinforced concrete pipe supports and pump piers shall be sized to conform to the pipework and equipment to be installed, See Details Sheets 82 and 87. Submit details to the Engineer for approval.
4. The Motor Room Beams, Wet Pit Beams and Barminutor Chamber Beams are detailed on Sheet 92 and the Barminutor Chamber Column is detailed on Sheet 93.
5. The top of the concrete floor slabs in the Motor Room and the Barminutor Chamber shall slope 0.10' from the typical high points at Elev. 91.50 to the Floor Drains and/or low points at Elev. 91.40. The top of the concrete shall be ramped at the stairs as noted and shall also be ramped as shown at the concrete pads and piers to provide drainage. Ramp the top of concrete slab at the openings in the Motor Room floor slab to provide drainage around and/or away from the openings.
6. Cast threaded steel Inserts for 7/8" diameter Lift Rings in the bottom of the Motor Room slab (Pump Room ceiling) centered above each Sewage Pump Suction Gate Valve and each Suction Check Valve (including future units); 8-required. See Detail, Sheet 75.
7. Cast two Lift Hangers in the bottom of the Motor Room slab (Pump Room ceiling) above each Sewage Pump (including future units), 8-required. See Detail Sheet 75.
8. Add reinforcing bars to the Motor Room floor slab at each 10" Diameter Motor shaft slab opening as follows 4-No.6 x 6'-0" long diagonal bars at the top of the slab and 4-No.6 x 6'-0" long diagonal bars at the bottom of the slab.
9. The permissible locations of vertical wall construction joints from El. 91.50 to El. 105.50 (4 locations only) are shown on this Sheet. Wall Reinforcing shall be continuous through each vertical joint. Vertical construction joints shall include a Type E-3 (3-ribs) "Harzo" Labyrinth, or Waterseals Inc., Waterstop, or approved equal. Waterstops shall be welded at all joints.





DIMENSIONAL PLAN

Scale: 1/8" = 1'-0"

(REVISED SET JUNE 2006)

77 OF 141

RECORD DRAWING, JUNE 1982

Record Drawing

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION STRUCTURAL INTERMEDIATE FLOOR PLANS
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: MR CGS — Scale: 1/4" = 1'-0", EX. AS NOTED Des/Chkd by: DAB — Date: 8-77 / 9-79

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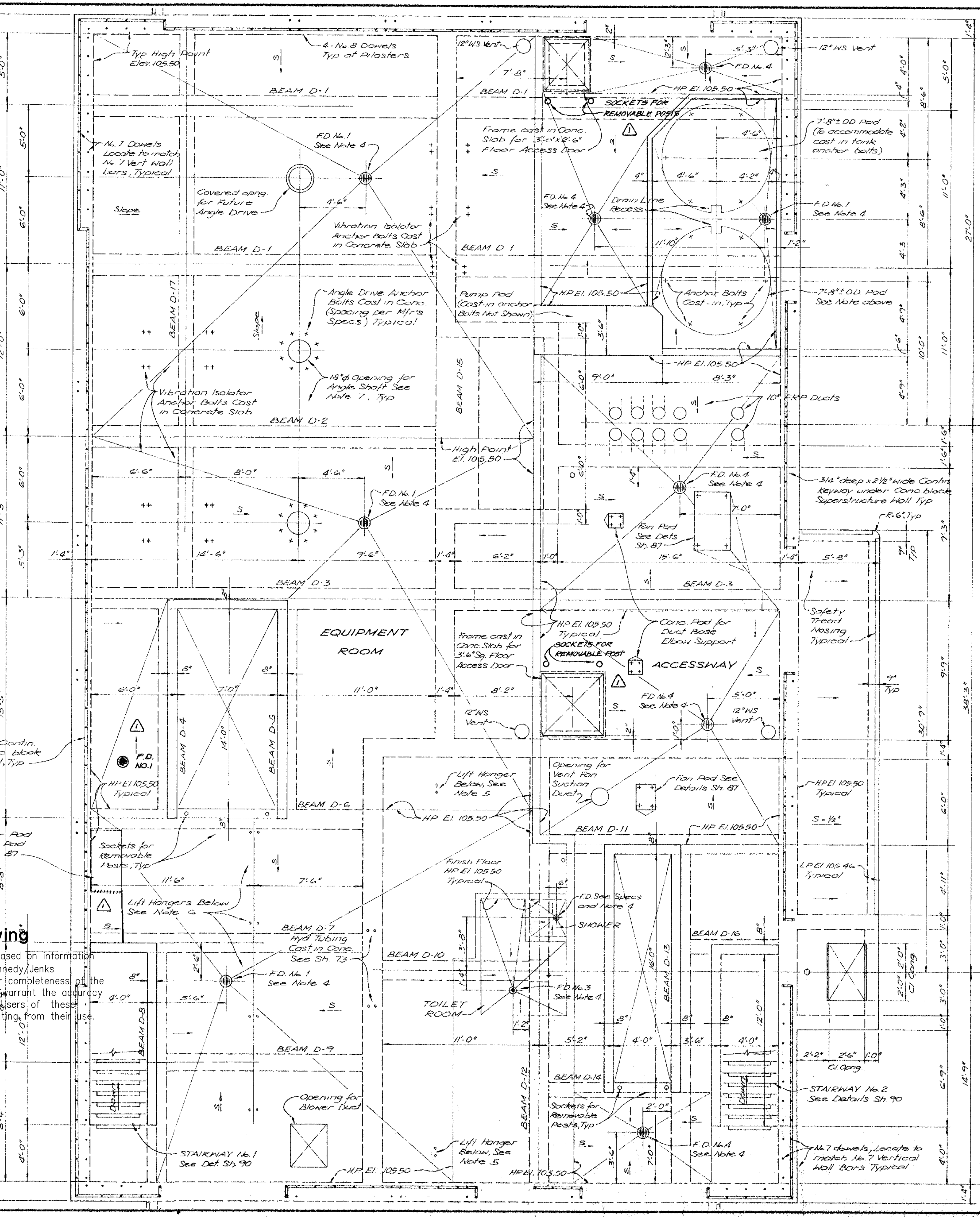
NOTES

1. The Pump Sta. Superstructure is detailed on Sheets 96 thru 100
2. General Notes 1,2 and 3 shown on Sheet 76 shall also apply to this Plan.
3. The Ground Floor Beams are detailed on Sheets 93 and 94
4. The top of the concrete floor slabs in the Equipment Room and Accessway shall slope 1/2" from the typical high points at Elev. 105.50 to the Floor Drains at Elev. 105.46, except Shower & Toilet Room where the slope shall be 1/4" to the Floor Drain at Elev. 105.48 The top of the concrete shall be ramped as shown at the concrete pads to provide drainage. Ramp the top of concrete slabs at the openings for ventilation ducts to provide drainage around and/or away from the openings. Floor Drains are noted on Sheet 65
5. Cast one Lift Hanger in the bottom of the Ground Floor Slab (Barminutor Chamber Ceiling) centered on the Floor Openings to the Wet Wells C & D below, 2 required. See Detail, Sheet 75.
6. Cast one Lift Hanger in the bottom of the Ground Floor Slab (Motor Room Ceiling) above each Motor (including future units) 4 required. See Detail, Sheet 75.
7. Add reinforcing bars to the Equipment Room floor slab at each 18" Diameter Angle Drive shaft slab opening as follows: 4-No. 6 x 6'-0" long diagonal bars at the top of the slab and 4-No. 6 x 6'-0" long diagonal bars at the bottom of the slab.



Record Drawing

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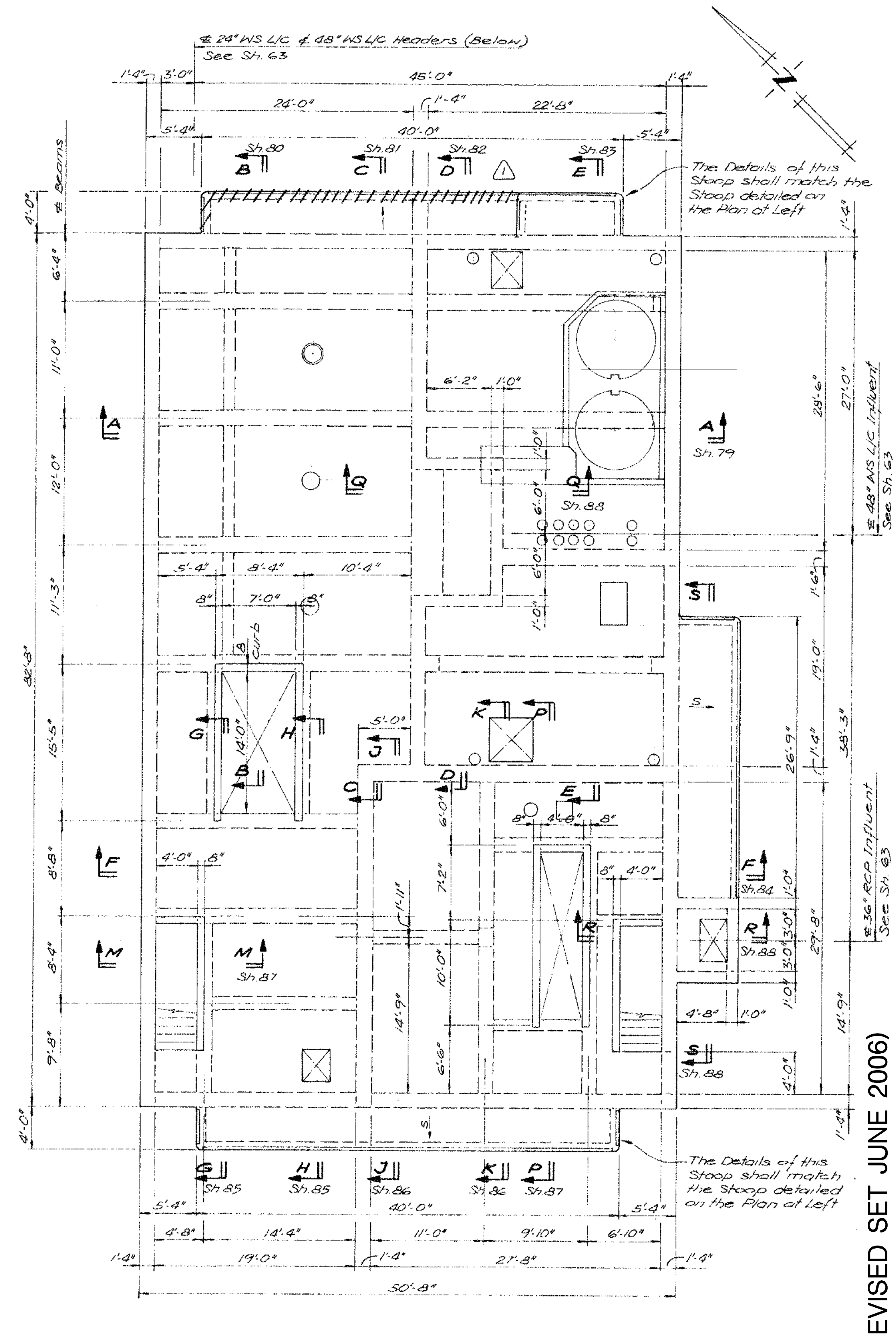

DIMENSIONAL PLAN

Scale: 1/8" = 1'-0"

(REVISED SET JUNE 2006)

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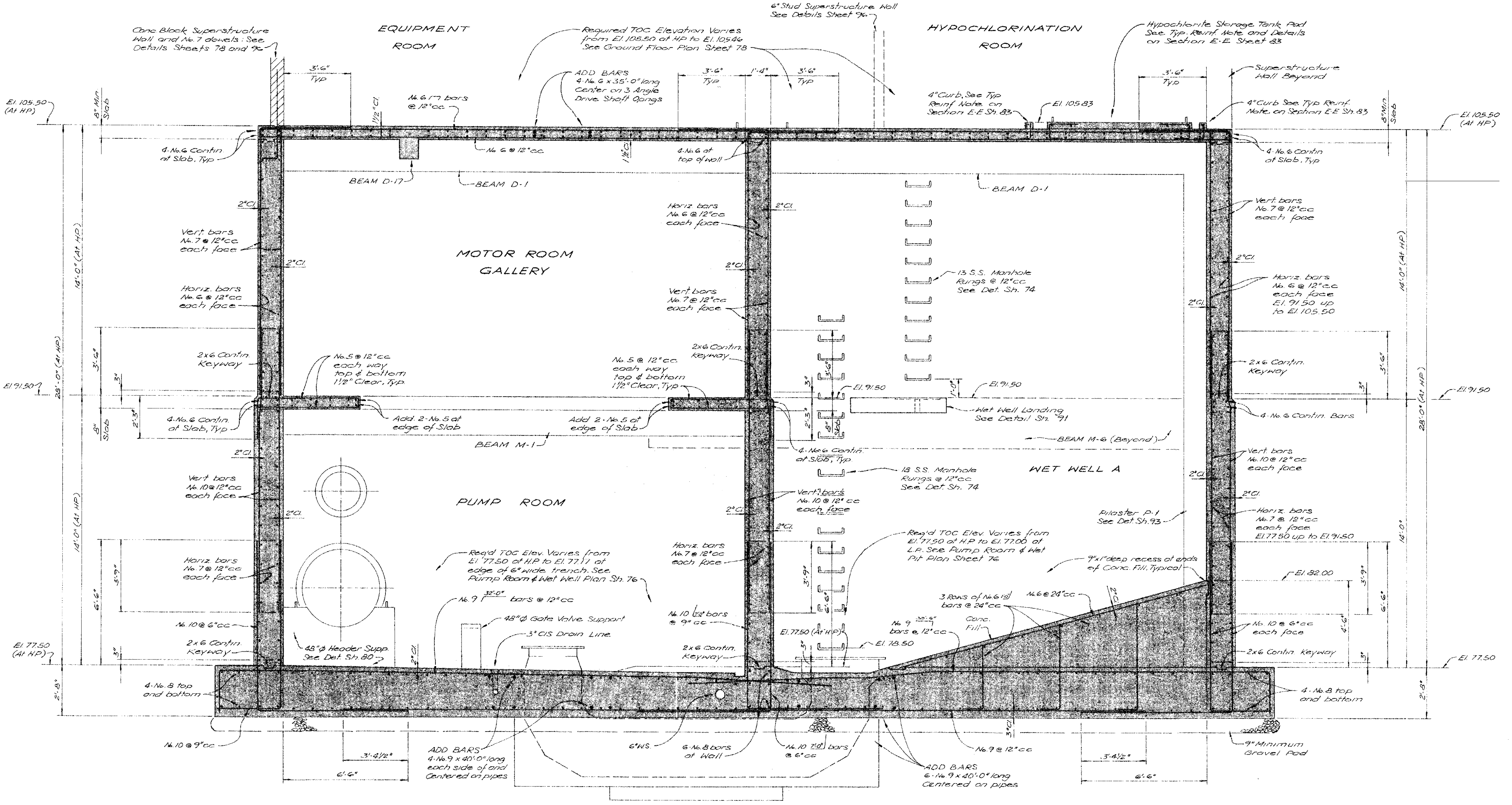
⚠ RECORD DRAWING, JUNE 1982

SUBMITTED Bruce M. Wambach JENKS & HARRISON — DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY — DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS — DATE	SAN CARLOS PUMP STATION STRUCTURAL GROUND FLOOR PLAN
APPROVED BELMONT — DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. — DATE	Drawn by: MR CGS — Scale: 1/4"=1'-0", EX. AS NOTED Des/Chkd by: DAB — Date: 8-77 / 9-79



SECTION A-A

79 OF 141

(REVISED SET JUNE 2006)

Record Drawing

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FALSEWORK NOTE

Falsework for the slab and beams at Elevation 91.50 shall be adequate to support (in addition to the weight of the slab & beams and the loads applied by the construction operations) the weight of the following: the interior walls above Elevation 91.50, the slab & beams at Elevation 105.50 and the interior stud walls above Elevation 105.50. This falsework shall not be removed or released in less than 21 days after placing the upper slab & beams. The falsework for the slabs & beams shall be released simultaneously, proceeding uniformly and gradually and working from midspan toward the supports. This procedure shall be applied to each floor commencing with the upper floor.

RECORD DRAWING, JUNE 1982

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

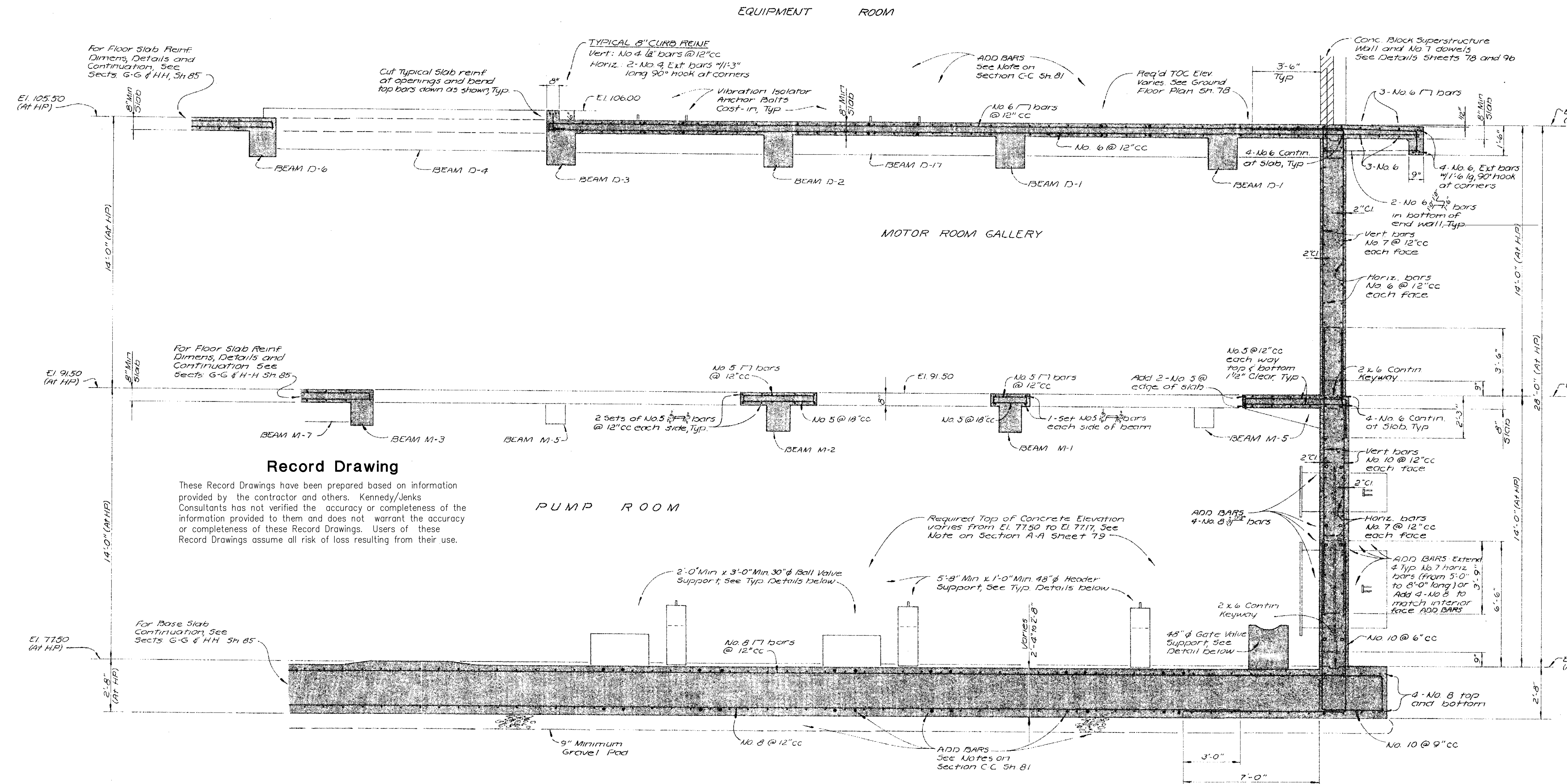
SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
STRUCTURAL
SECTION A-A

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: MR CGS
Scale: 3/8"=1'-0"
Des/Chkd by: DAB
Date: 8-77 / 9-79



Record Drawing

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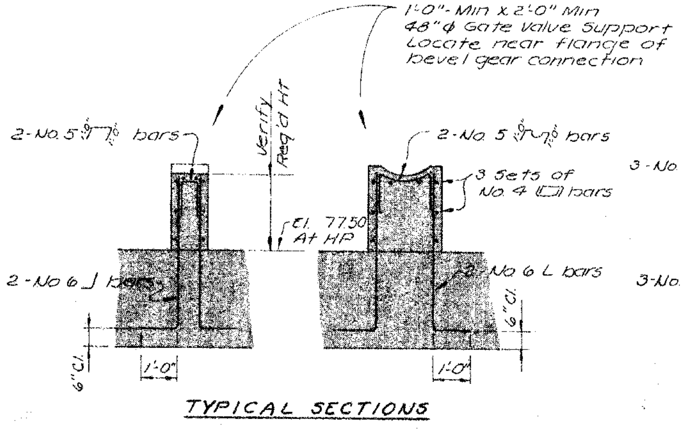
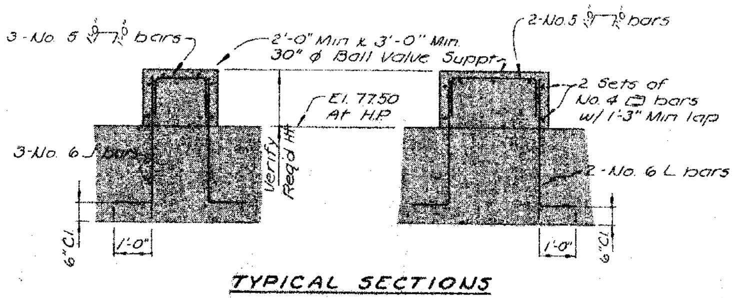
SECTION B-B



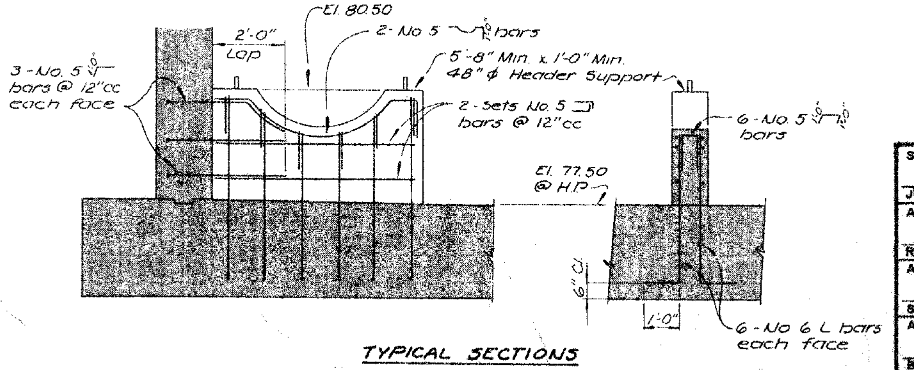
TYPICAL SECTIONS

48" ø GATE VALVE SUPPORT DETAILS



TYPICAL SECTIONS

30" ø BALL VALVE SUPPORT DETAILS



TYPICAL SECTIONS

48" ø HEADER SUPPORT DETAILS

(REVISED SET JUNE 2006)

80 OF 141

RECORD DRAWING , JUNE 1982

SUBMITTED
Bruce M. Vleyhoff
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

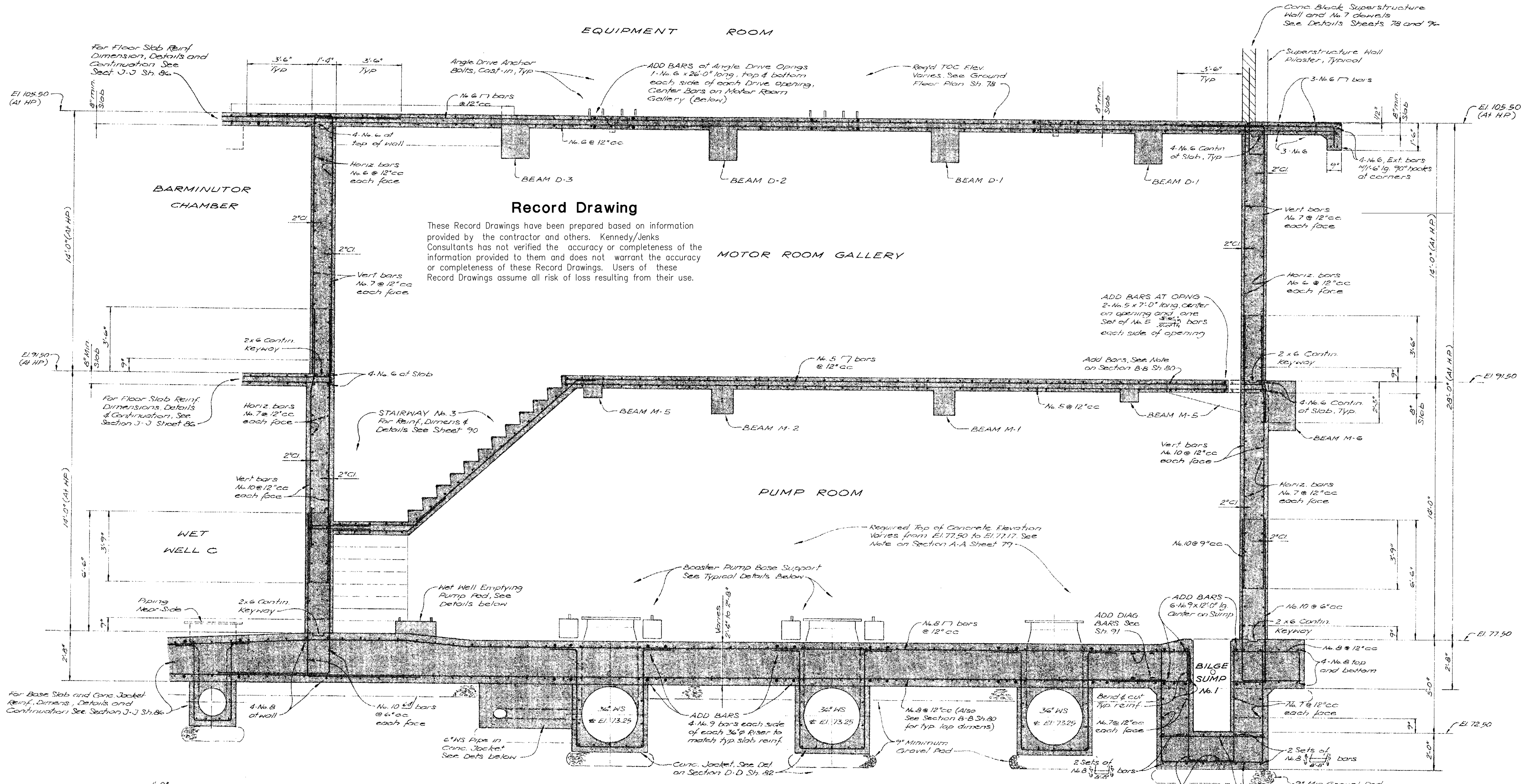
SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
STRUCTURAL
SECTION B-B

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: MR EB
Scale: 3/8"=1'-0"
Des/Chkd by: DAB
Date: 8-77/9-79



Record Drawing

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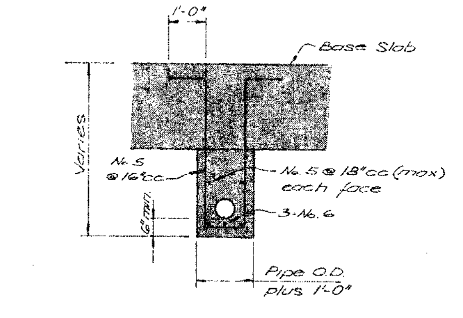
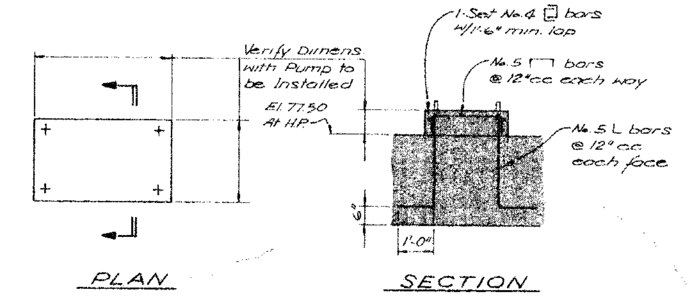
SECTION C-C



0" TO 6" LINE

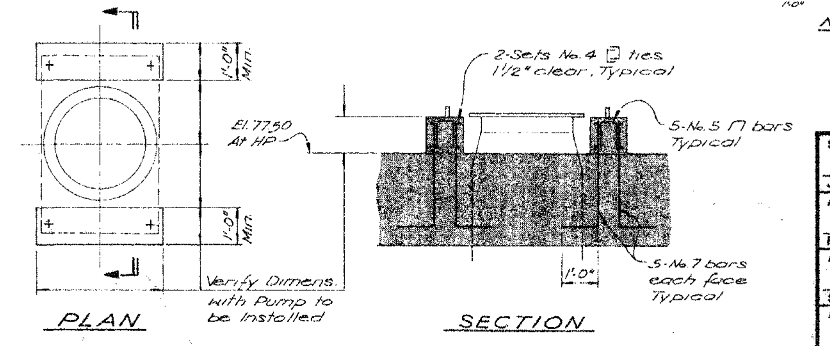
CONC. JACKET DETAIL



PLAN

SECTION

WET WELL EMPTYING PUMP PAD DETAILS



PLAN

SECTION

BOOSTER PUMP BASE SUPPORT DETAILS

NOTE - This Section does not show the Added horiz. wall bars nor the horiz. wall bars which extend from the interior walls into these walls. These bars are shown on the Sect. Plans on Shs. 76 and 77. This Section also does not show the vert. wall bars which extend into the slab at El. 105.50. These bars are shown on Sect. A-A Sh. 79.

RECORD DRAWING, JUNE 1982

81 OF 141

(REVISED SET JUNE 2006)

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION STRUCTURAL SECTION C-C
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: MR CGS — Scale: 3/8" = 1'-0" Des/Chkd by: DAB — Date: 8-77 / 9-79

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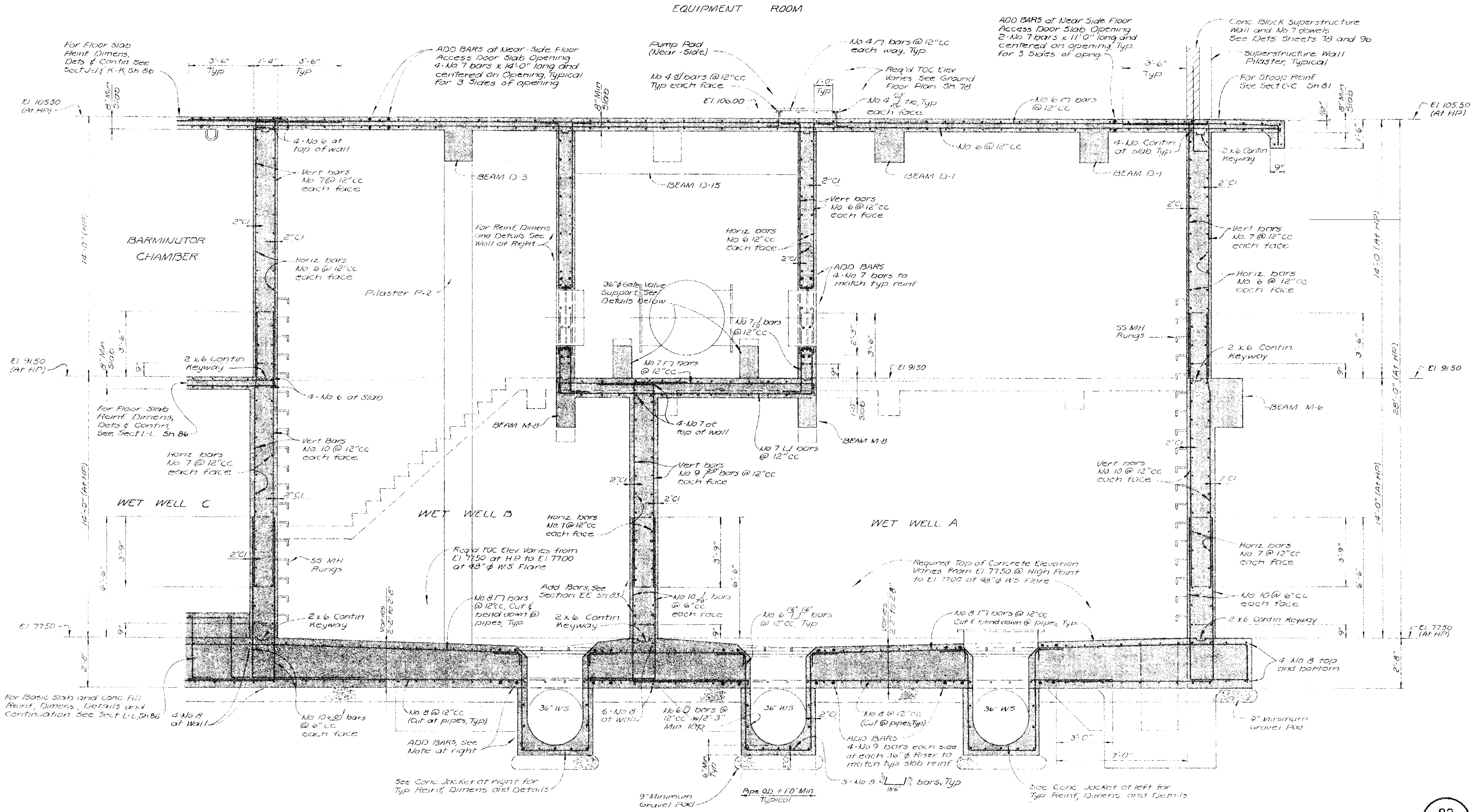
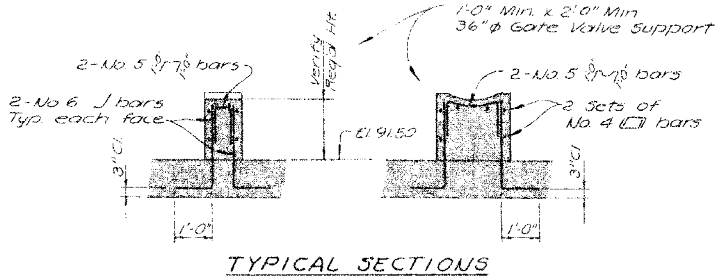


SECTION D-D

Record Drawing

These Record Drawings have been prepared based on information provided by the contractor and others. Kennedy/Jenks Consultants has not verified the accuracy or completeness of the information provided to them and does not warrant the accuracy or completeness of these Record Drawings. Users of these Record Drawings assume all risk of loss resulting from their use.



TYPICAL SECTIONS

36" ϕ GATE VALVE SUPPORT DETAILS

NOTE
This Section does not show the Added horiz. wall bars nor the horiz. wall bars which extend from the interior walls into these walls. These bars are shown on the Sect. Plans on Sheets 76 and 77. This Section also does not show the vertical wall bars which extend into the slab at El. 105.50. These bars are shown on Section A-A Sh. 79

RECORD DRAWING, JUNE 1982

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION STRUCTURAL SECTION D-D
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: MR EB Scale: 3/8"=1'-0" Des/Chkd by: DAB Date: 8-77/9-79

(REVISED SET JUNE 2006)

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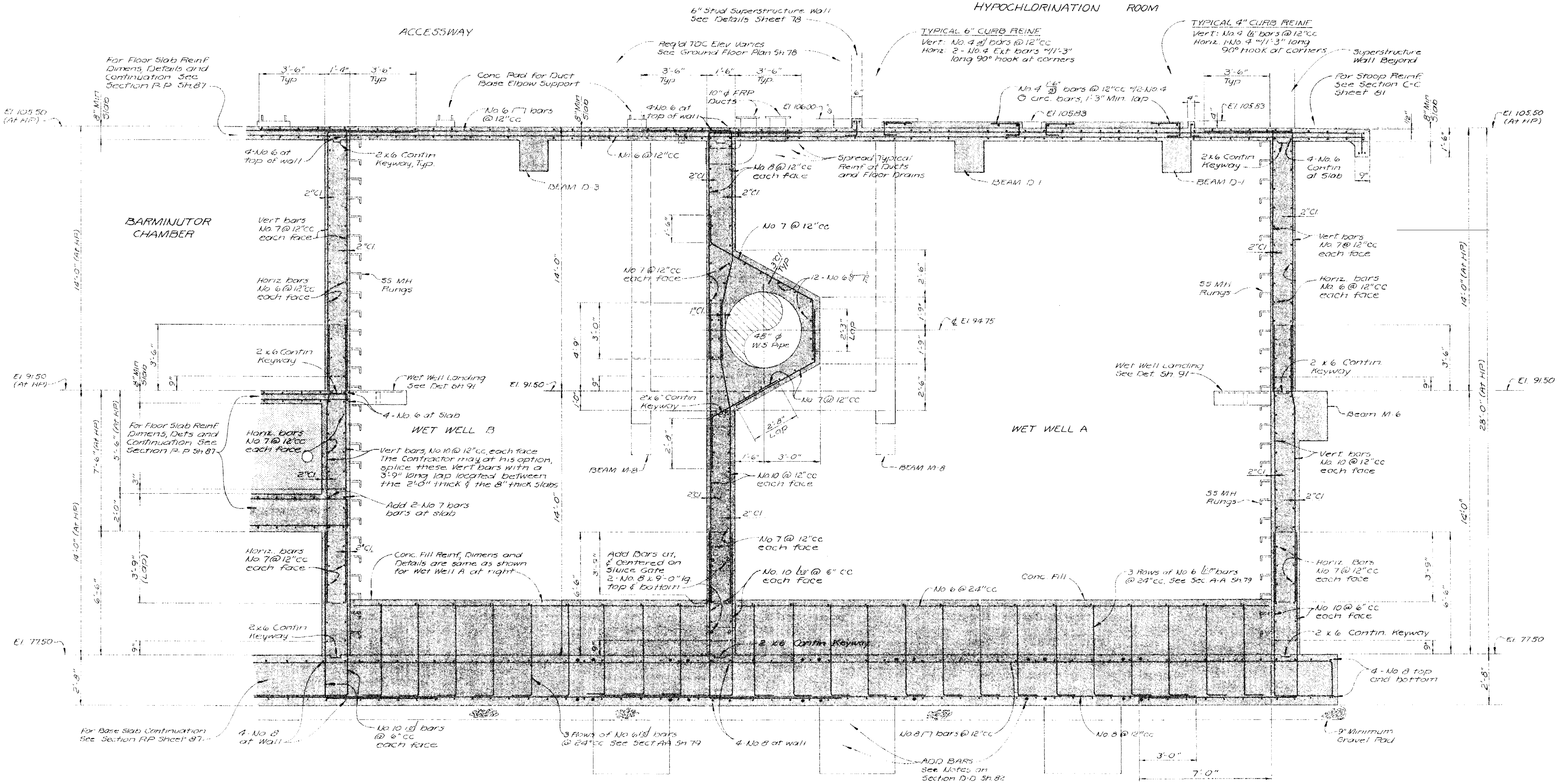

SECTION E-E

83
OF
141

(REVISED SET JUNE 2006)

Record Drawing

These Record Drawings have been prepared based on information provided by the contractor and others. Kennedy/Jenks Consultants has not verified the accuracy or completeness of the information provided to them and does not warrant the accuracy or completeness of these Record Drawings. Users of these Record Drawings assume all risk of loss resulting from their use.

RECORD DRAWING, JUNE 1982

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
STRUCTURAL
SECTION E-E

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by:	MR EB	Scale:	3/8" = 1'-0"
Des/Chkd by:	DAB	Date:	8-77/ 9-79

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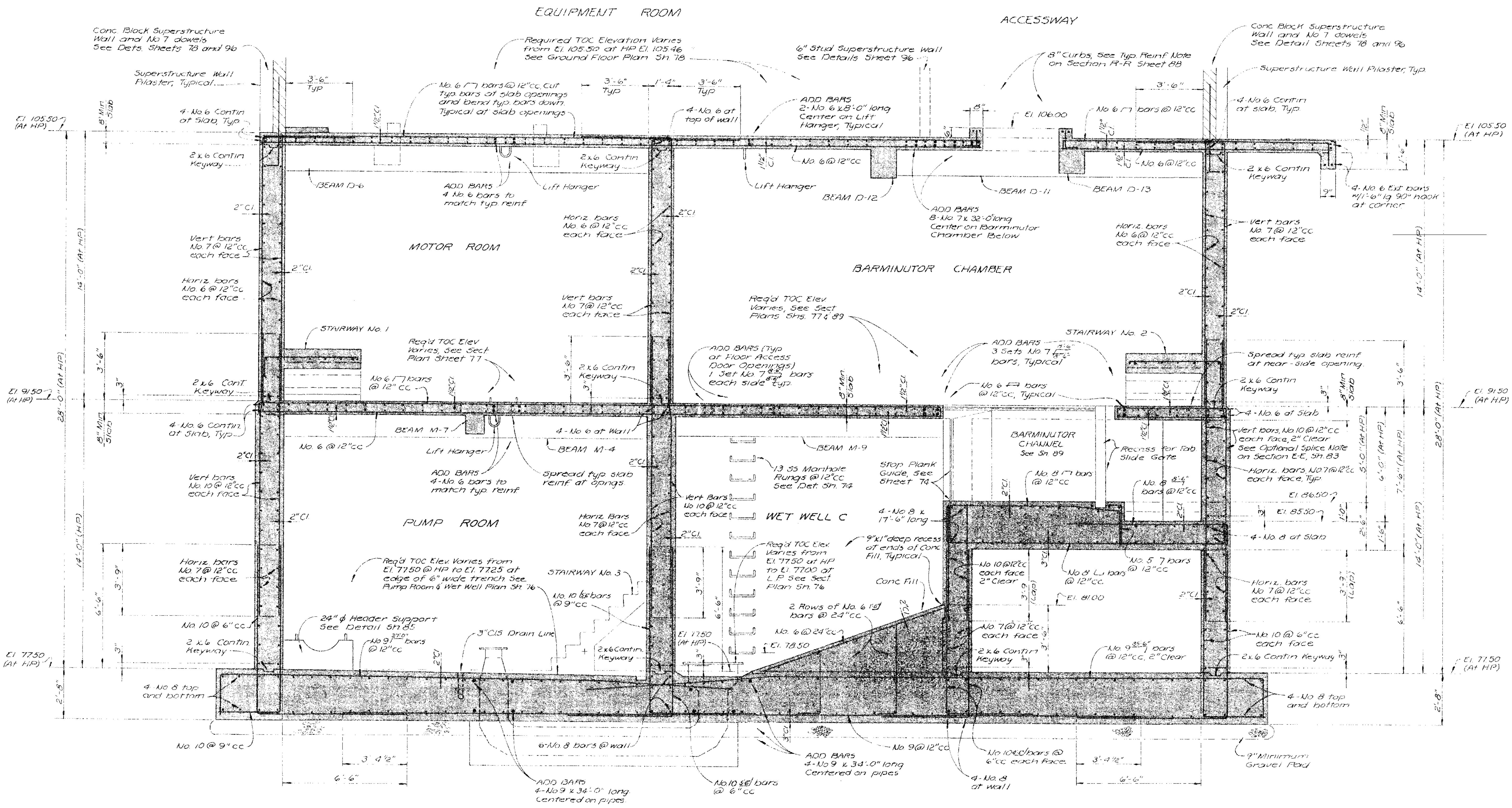


SECTION F-F

84 OF 141

Record Drawing

These Record Drawings have been prepared based on information provided by the contractor and others. Kennedy/Jenks Consultants has not verified the accuracy or completeness of the information provided to them and does not warrant the accuracy or completeness of these Record Drawings. Users of these Record Drawings assume all risk of loss resulting from their use.

RECORD DRAWING, JUNE 1982

SUBMITTED	
JENKS & HARRISON	DATE
APPROVED	
REDWOOD CITY	DATE
APPROVED	
SAN CARLOS	DATE
APPROVED	
BELMONT	DATE
APPROVED	
MENLO PARK S.D.	DATE

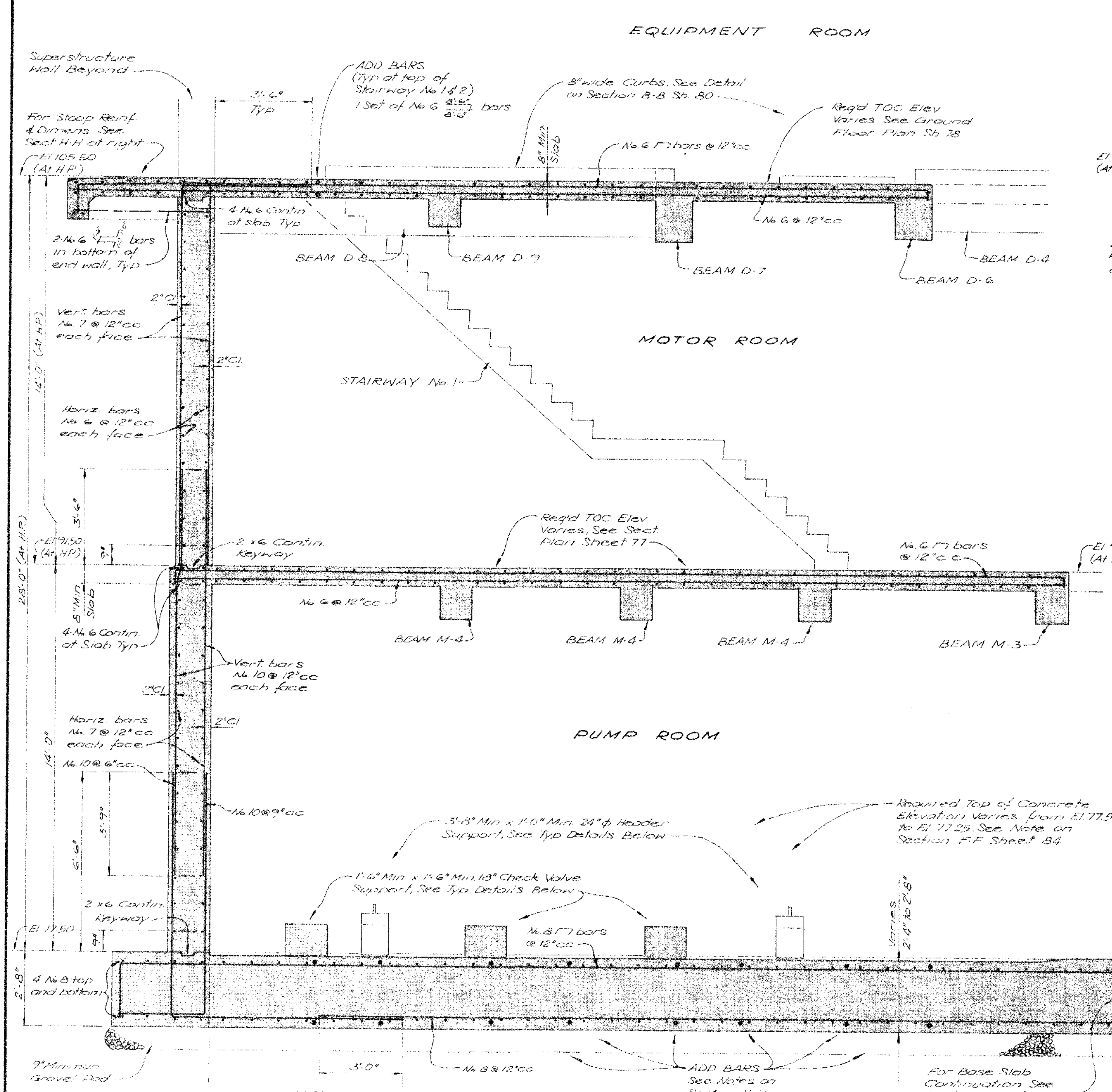
SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
STRUCTURAL
SECTION F-F

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: MR EB	Scale: 3/8"=1'-0"
Des./Chkd by: DAB	Date: 8-77/9-79



Record Drawing

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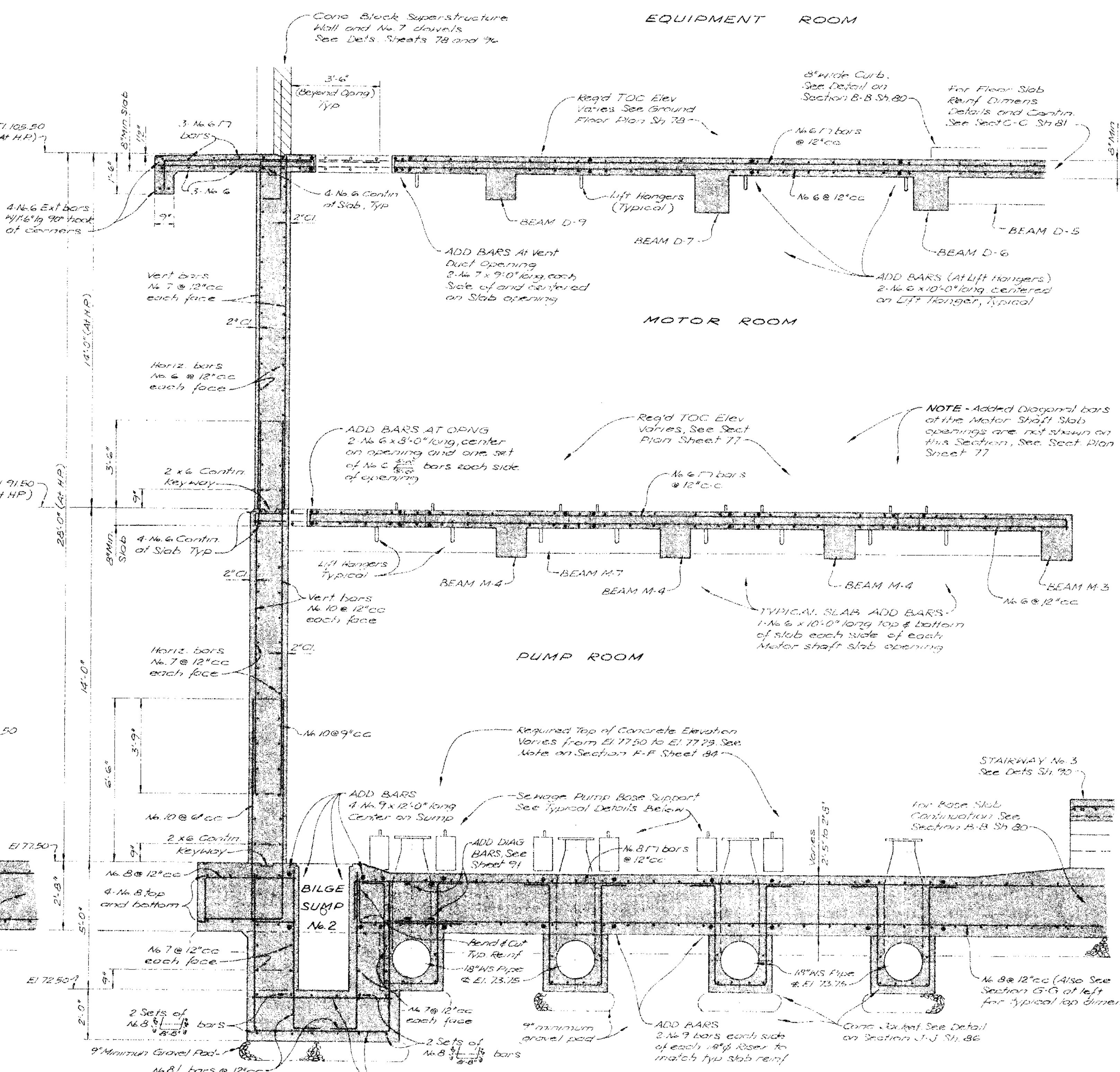
SECTION G-G

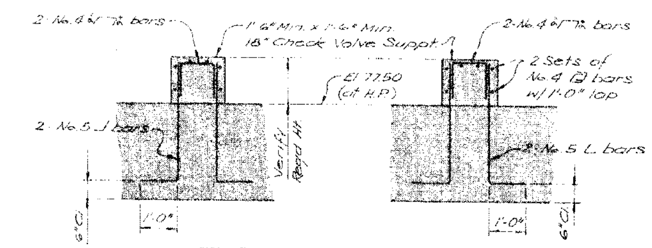


SECTION H-H

(REVISED SET JUNE 2006)

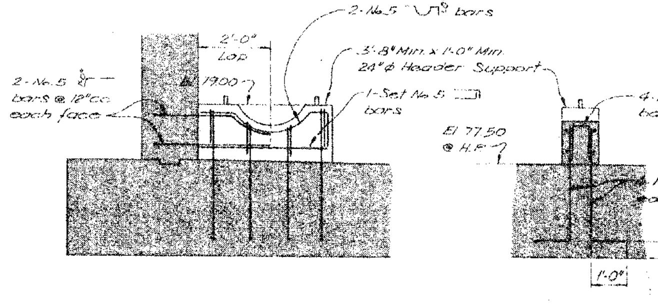
NOTE-This Section does not show the Added horiz wall bars which extend into these walls. These bars are shown on the Sect Plans on Sheets 76 and 77. This Section also does not show the vertical wall bars which extend into the slab at El. 105.50. These bars are shown on Section F-F Sheet 84.

85 OF 141



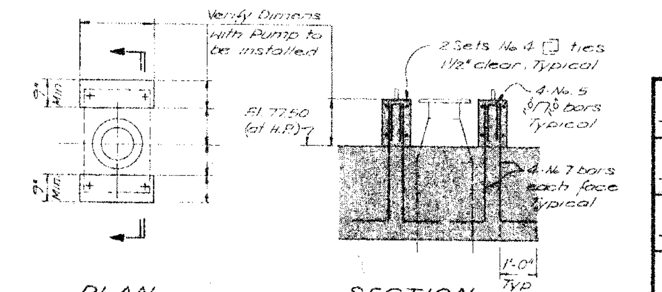
TYPICAL SECTIONS

18" CHECK VALVE SUPPORT DETAILS



TYPICAL SECTIONS

24" φ HEADER SUPPORT DETAILS



PLAN

SECTION

SEWAGE PUMP BASE SUPPORT DETAILS

RECORD DRAWING, JUNE 1982.

SUBMITTED
Dean M. Wagshoff
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

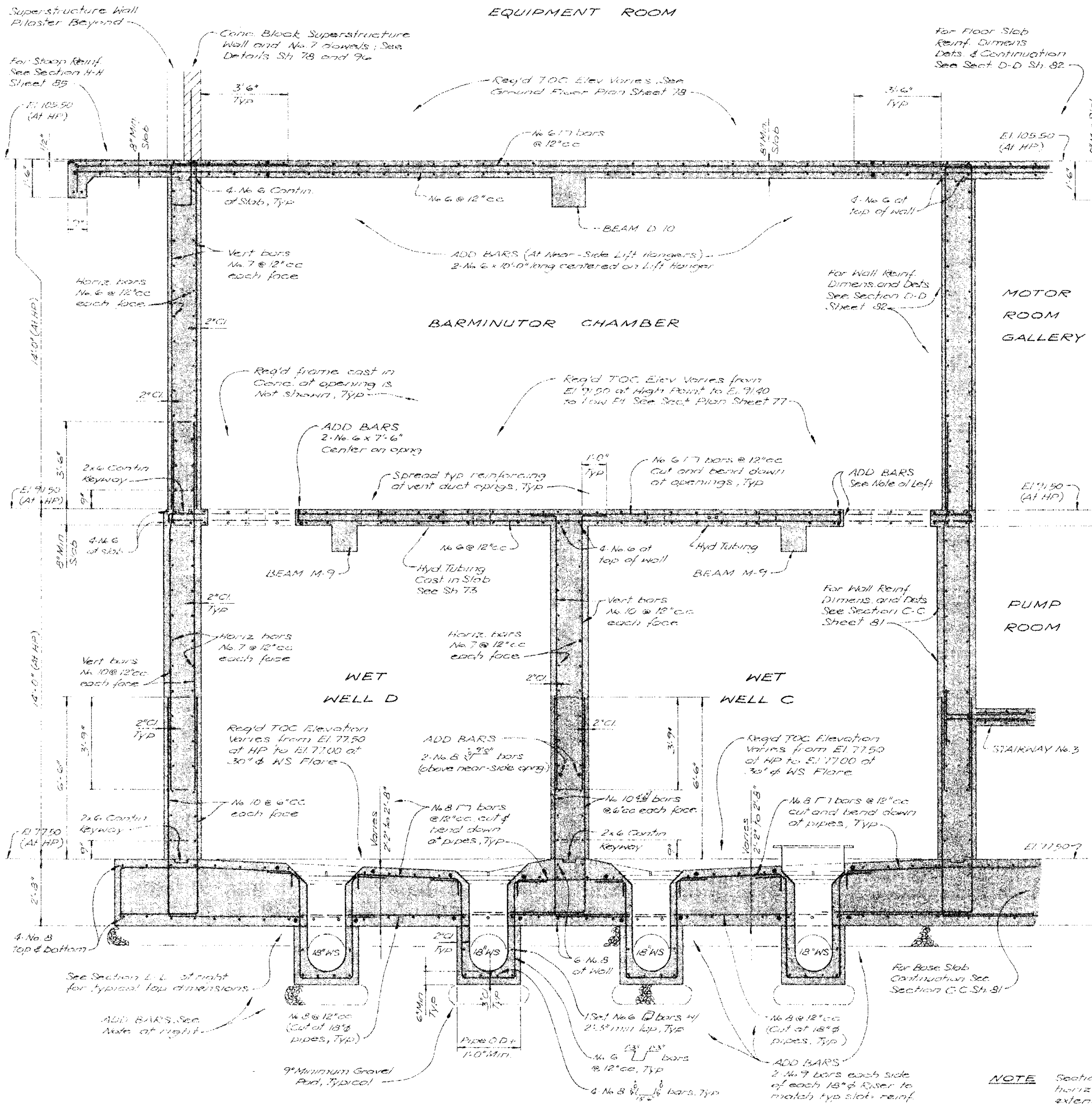
SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

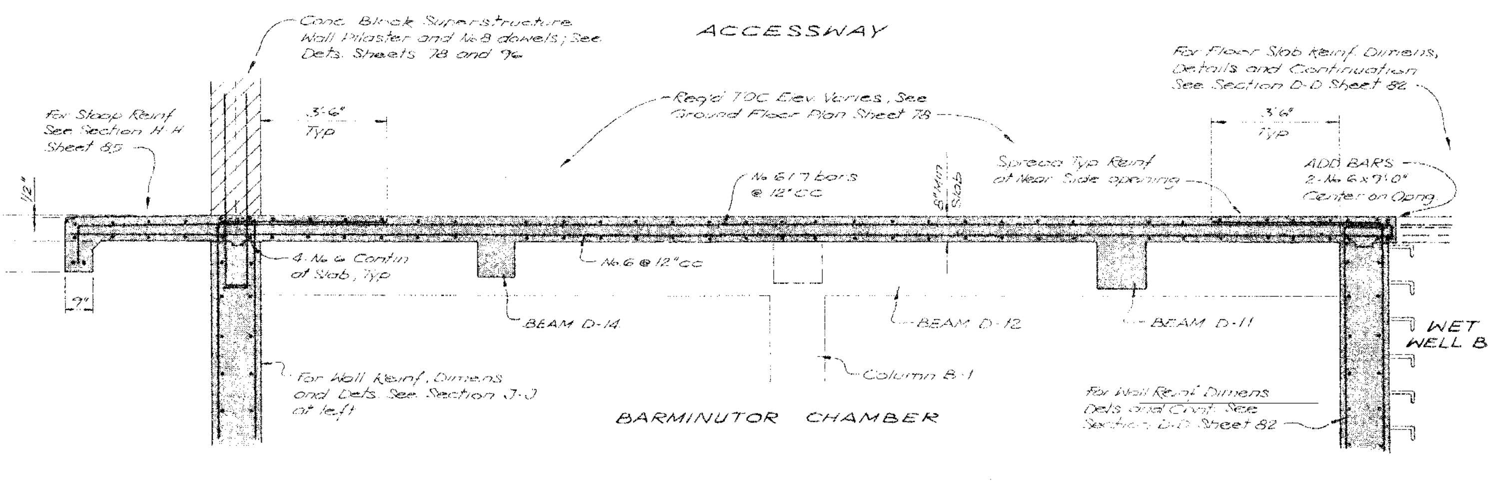
SAN CARLOS PUMP STATION
STRUCTURAL
SECTION G-G AND H-H

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

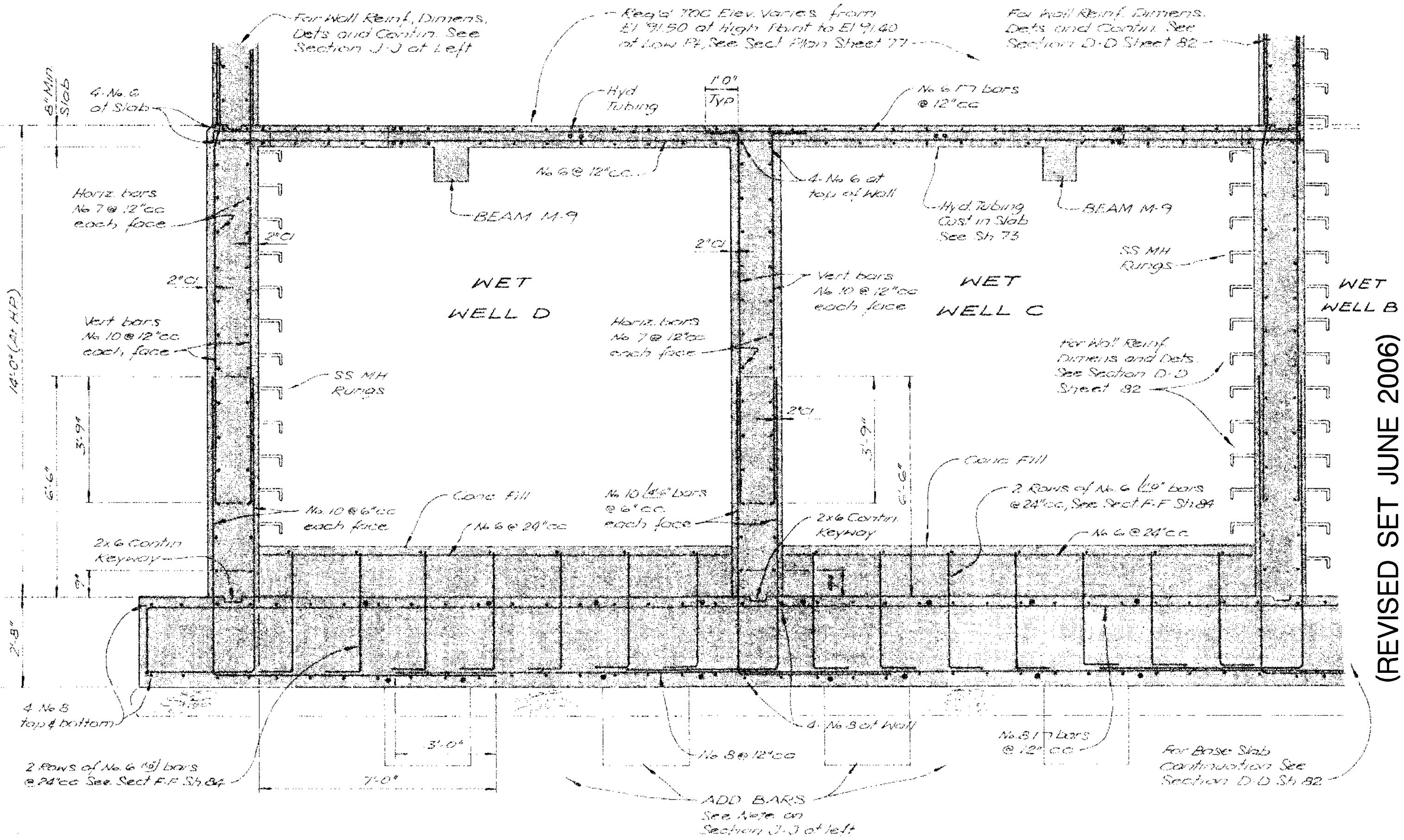
Drawn by:	MR CGS	Scale:	3/8" = 1'-0"
Des/Chkd by:	DAB	Date:	8-77/9-79



SECTION J-J



SECTION K-K



SECTION L-L

NOTE Sections J-J and L-L do not shown the Added horiz. wall bars nor the horiz. wall bars which extend from the interior walls into these walls. These bars are shown on the Sectional Plans on Sheets 76 and 77, Section J-J also does not show the vertical wall bars which extend into the slab of El 105.50 These bars are shown on Section F-F sheet 84.

(REVISED SET JUNE 2006)

86 OF 141

Record Drawing

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RECORD DRAWING , JUNE 1982

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION STRUCTURAL SECTION J-J, K-K AND L-L
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: MR CGS — Scale: 3/8" = 1'-0" Des/Chkd by: DAB — Date: 8-77 / 9-79

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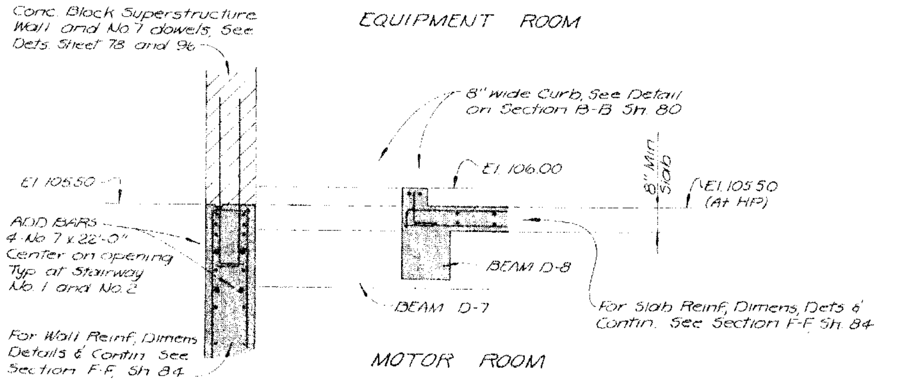
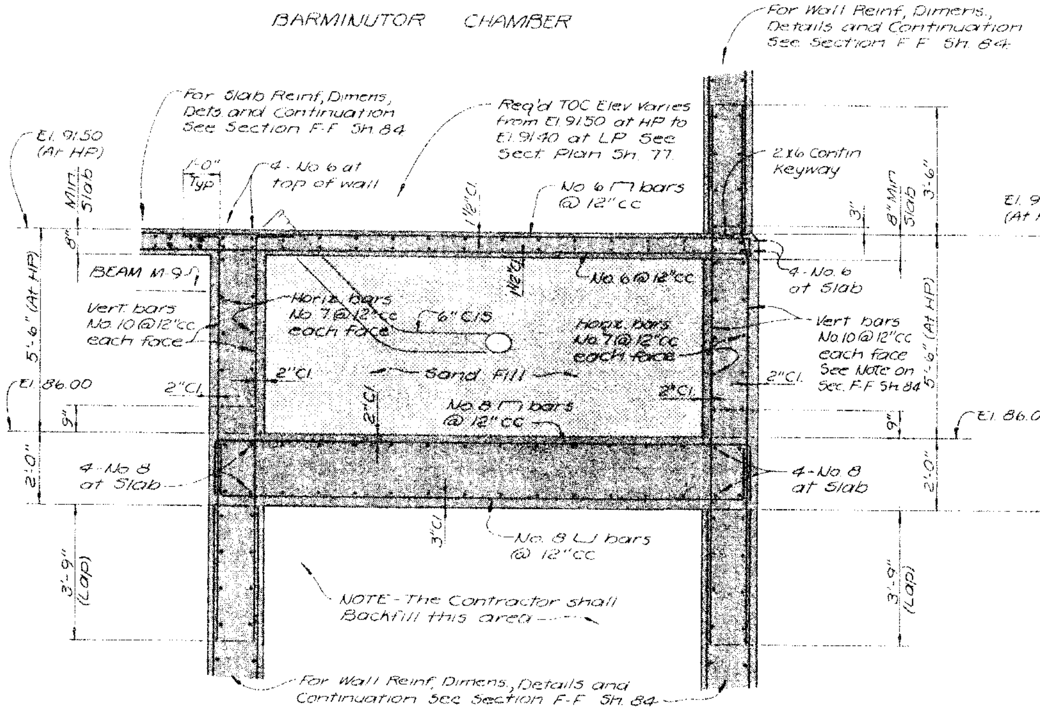
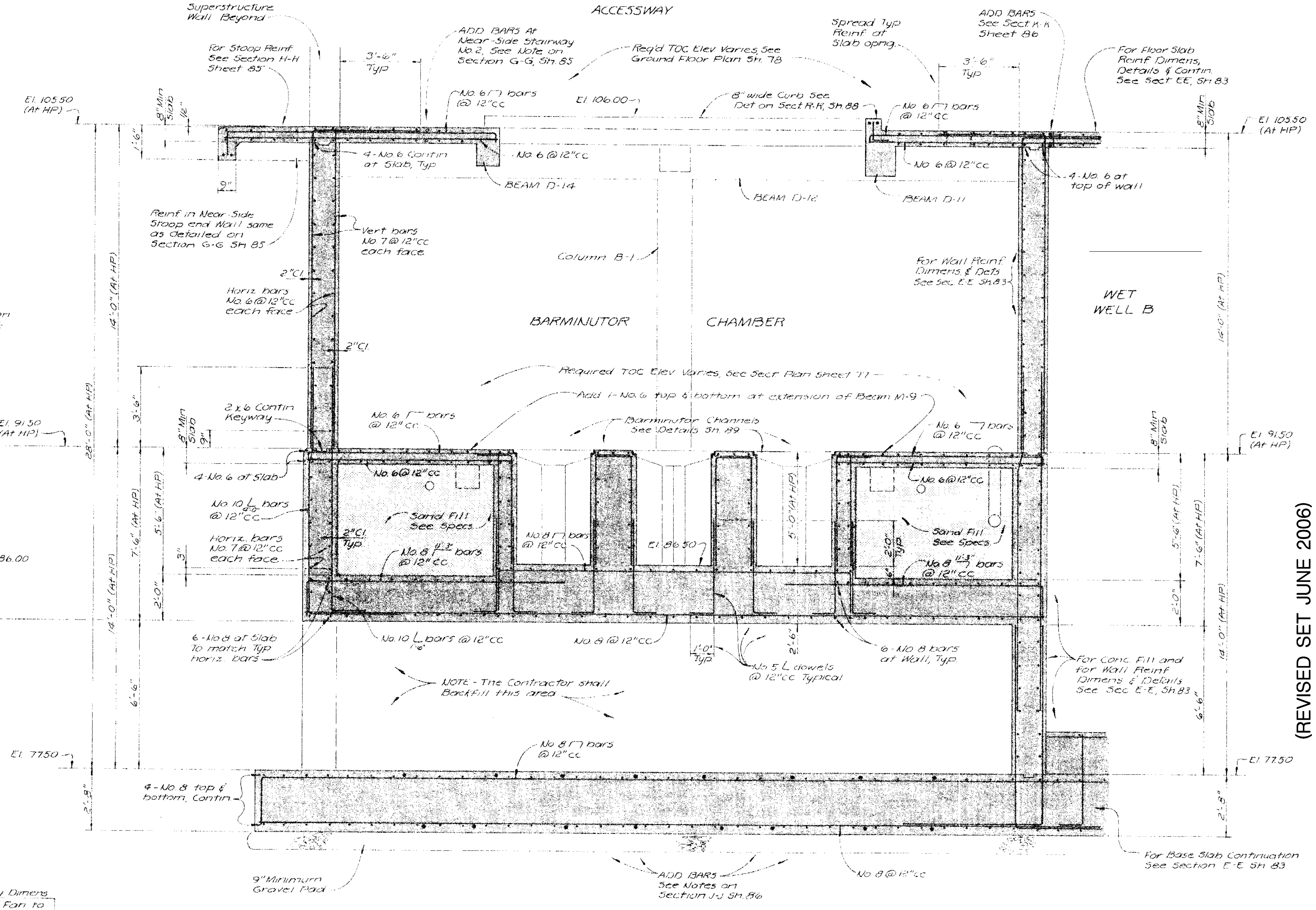


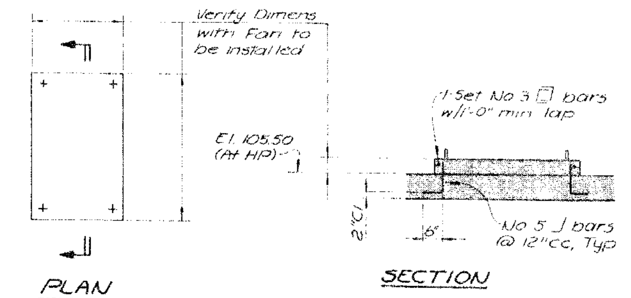
SECTION M-M



SECTION N-N



SECTION P-P

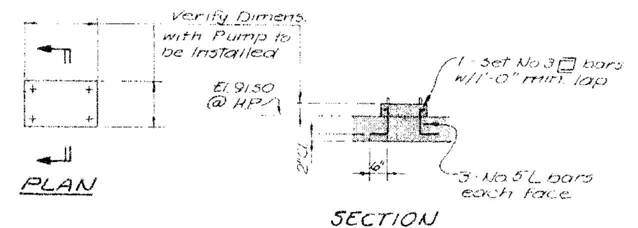


PLAN

SECTION

WET WELL VENTILATION SYSTEMS No.1 & No.2

FAN PAD DETAILS



PLAN

SECTION

SAMPLE PUMP PAD DETAILS

(REVISED SET JUNE 2006)

87 of 141

Record Drawing

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RECORD DRAWING, JUNE 1982

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION STRUCTURAL SECTION M-M, N-N AND P-P
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: MR EB Scale: 3/8"=1'-0" Des/Chkd by. DAB Date: 8-77 / 9-79

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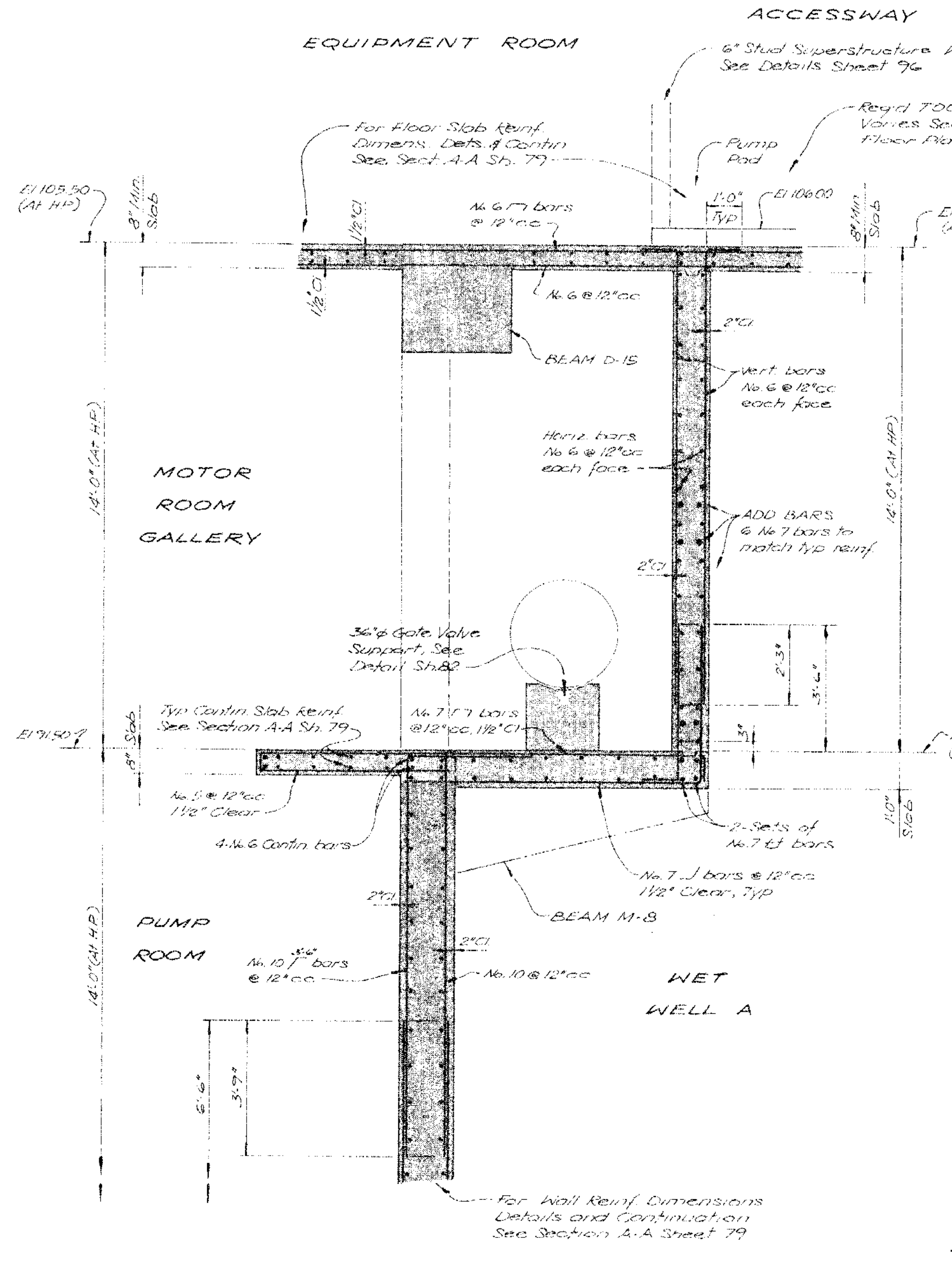
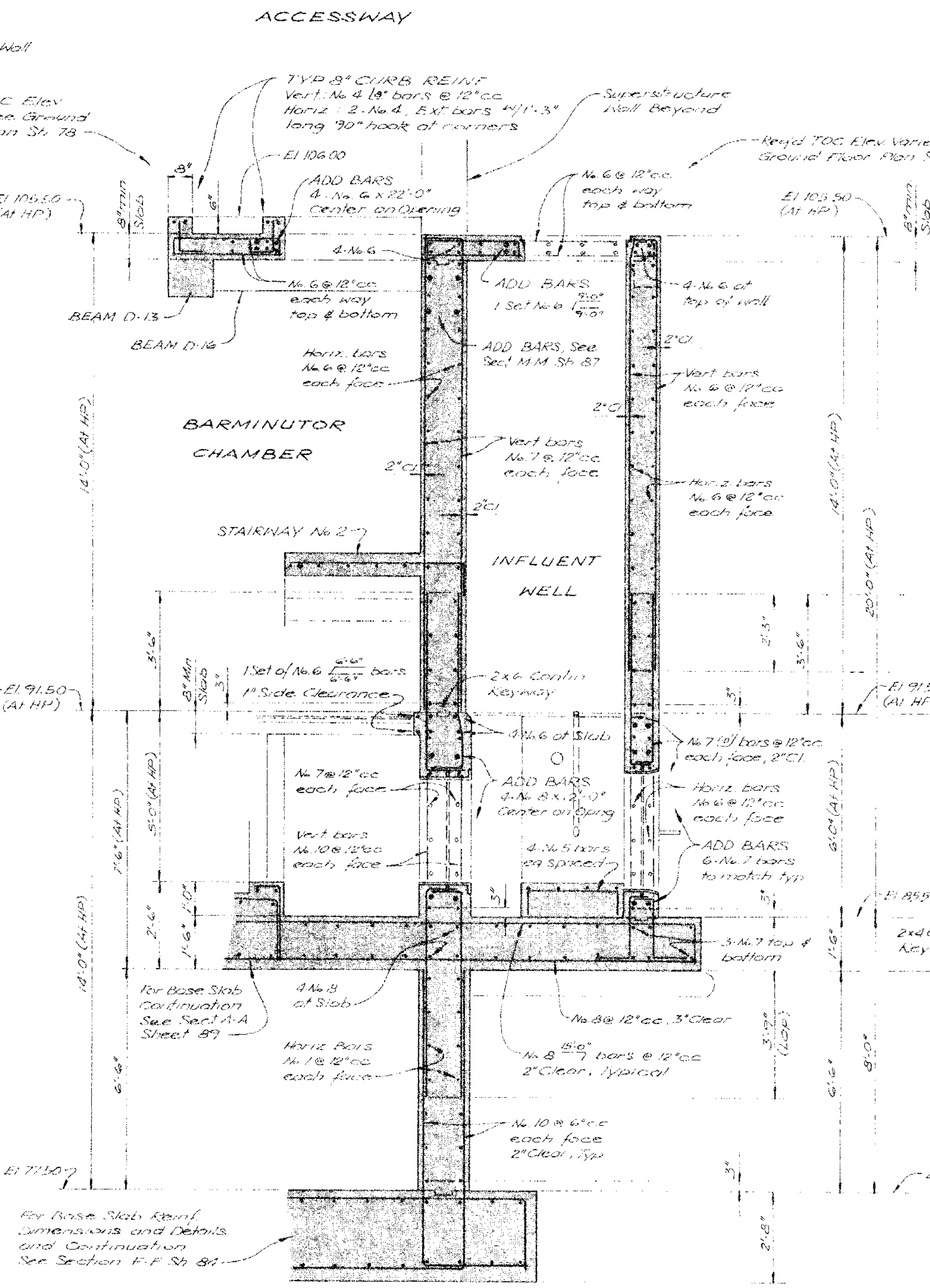
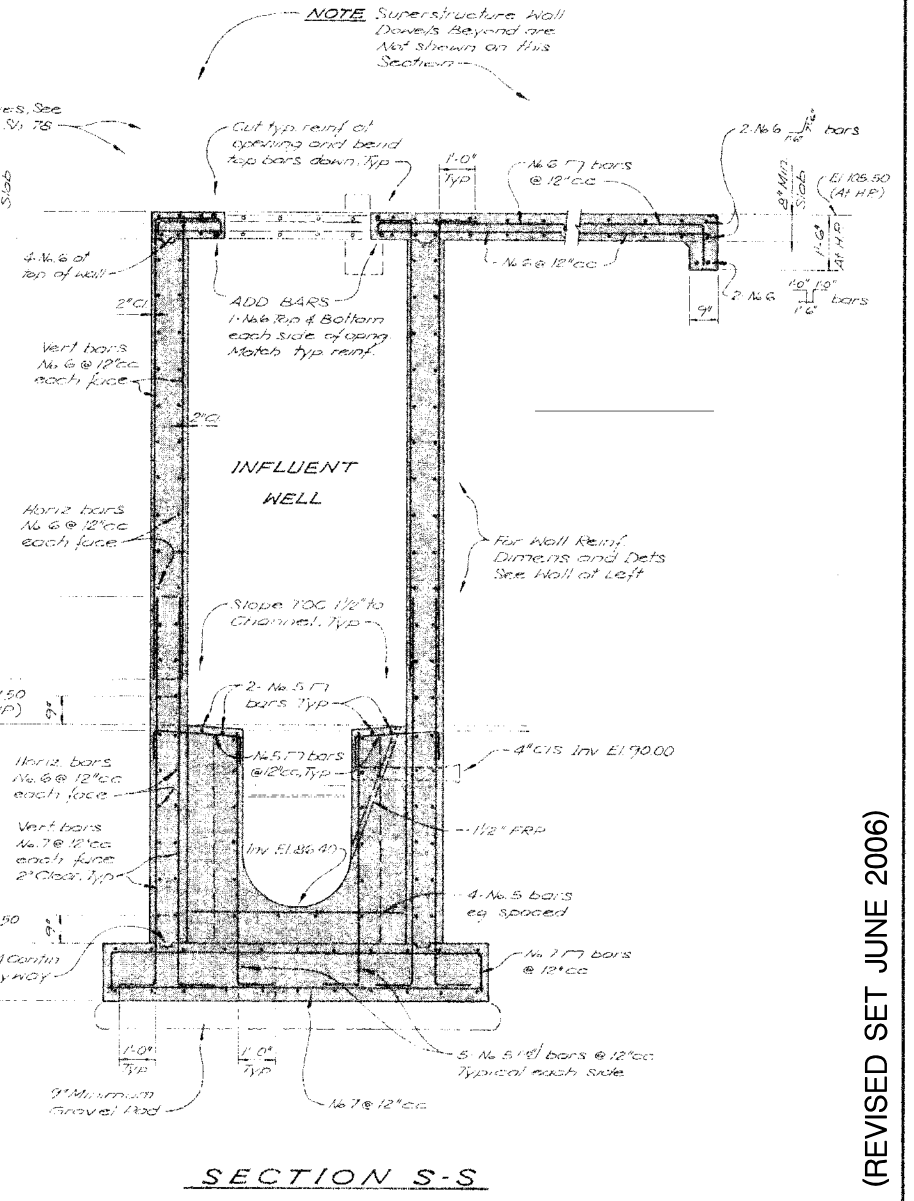


SECTION Q-Q



SECTION R-R



SECTION S-S

(REVISED SET JUNE 2006)

88 OF 141

Record Drawing

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RECORD DRAWING, JUNE 1982

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION STRUCTURAL SECTION Q-Q, R-R AND S-S
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: MR CGS — Scale: 3/8" = 1'-0" Des/Chkd by: DAB — Date: 8-77 / 9-79

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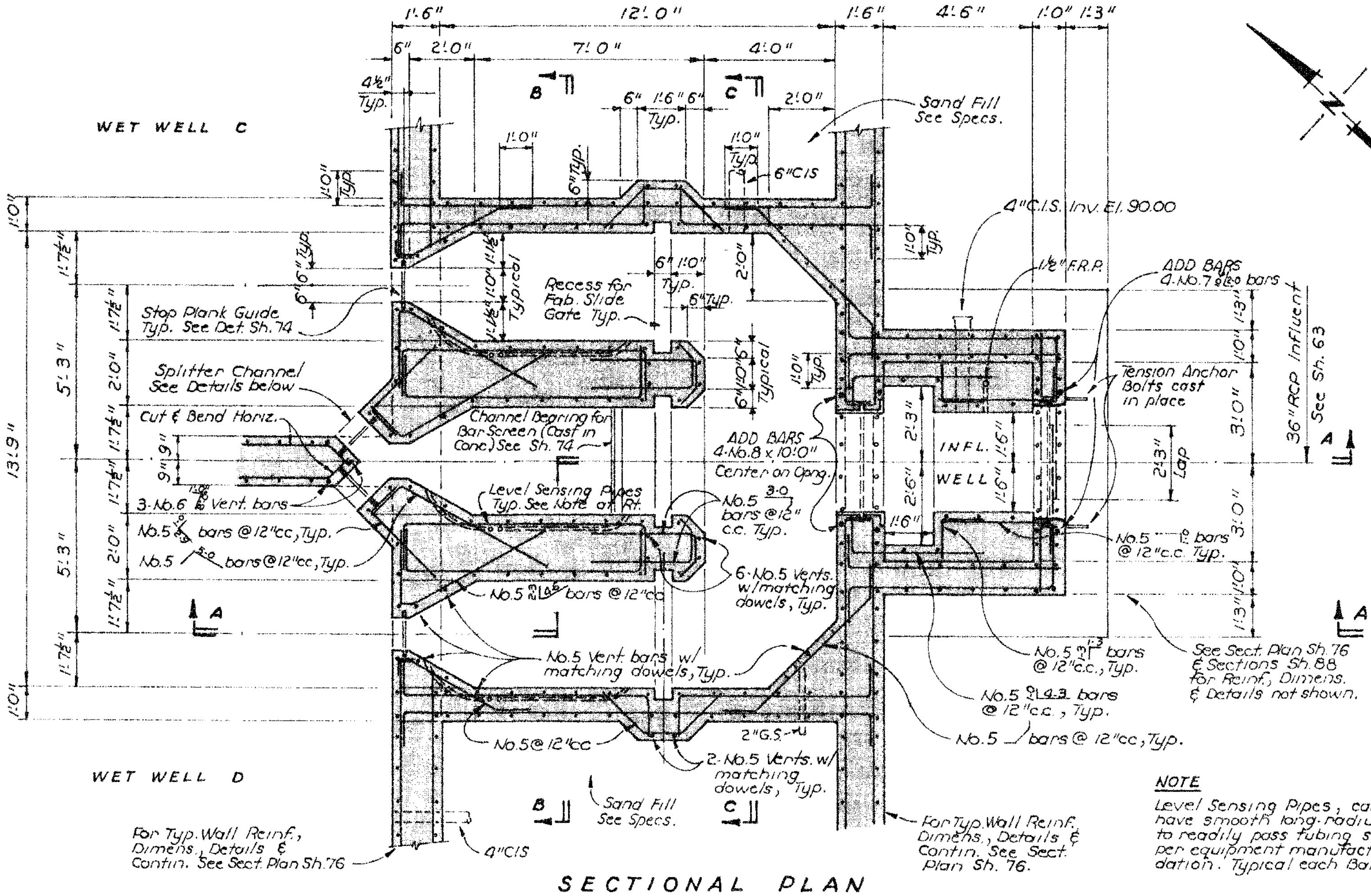
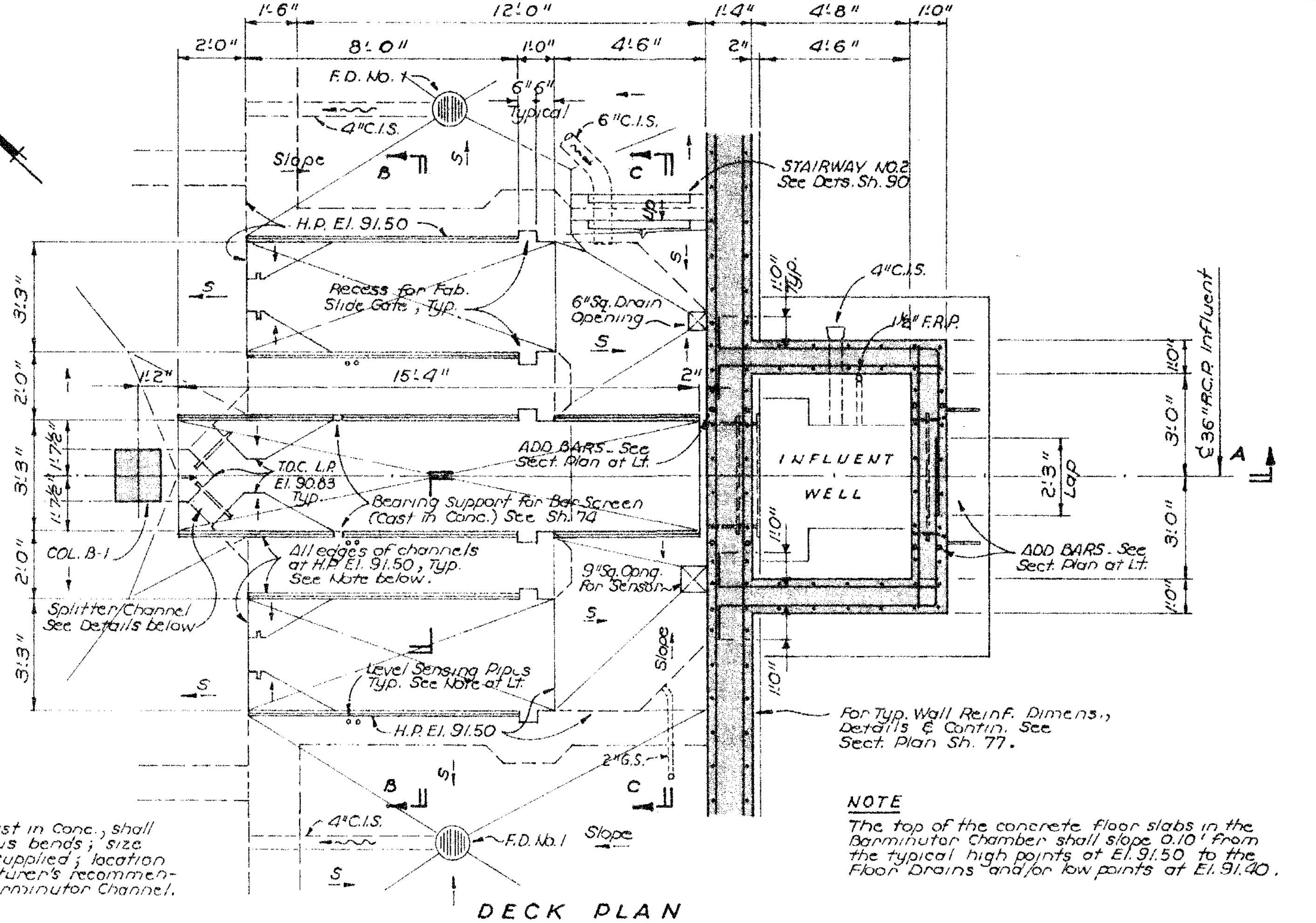


NOTE
Level Sensing Pipes, cast in Conc., shall have smooth long-radius bends; size to readily pass tubing supplied; location per equipment manufacturer's recommendation. Typical each Barminutor Channel.

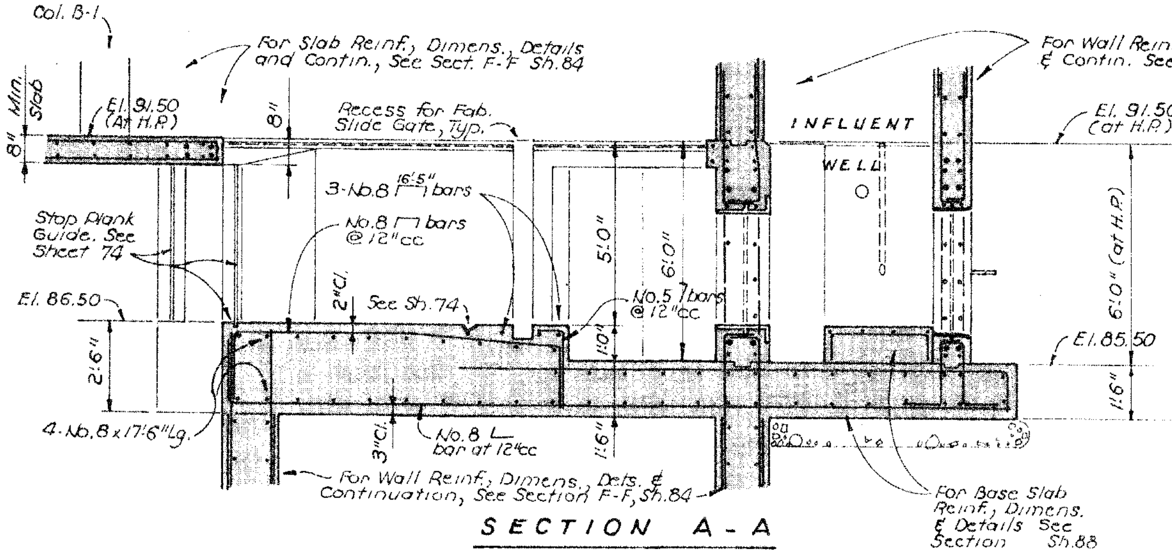
SECTIONAL PLAN



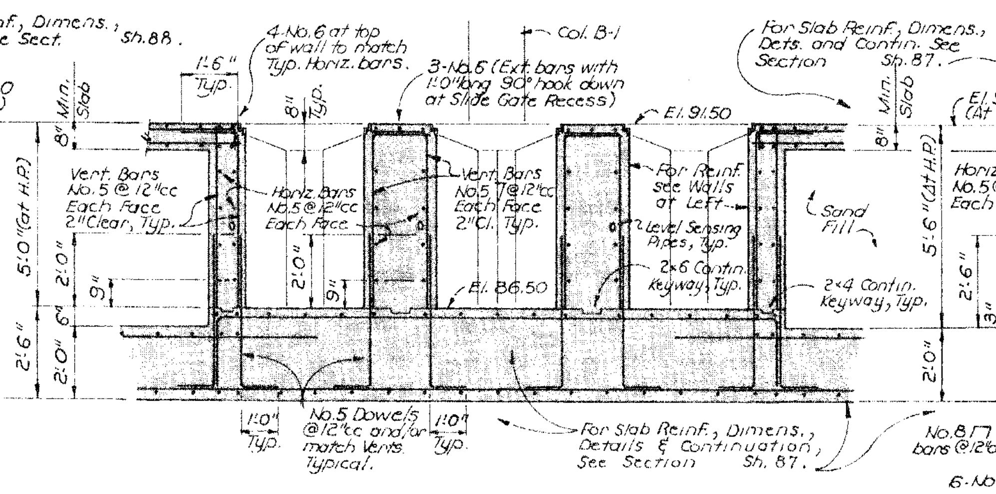
NOTE
The top of the concrete floor slabs in the Barminutor Chamber shall slope 0.10' from the typical high points at El. 91.50 to the Floor Drains and/or low points at El. 91.40.

DECK PLAN

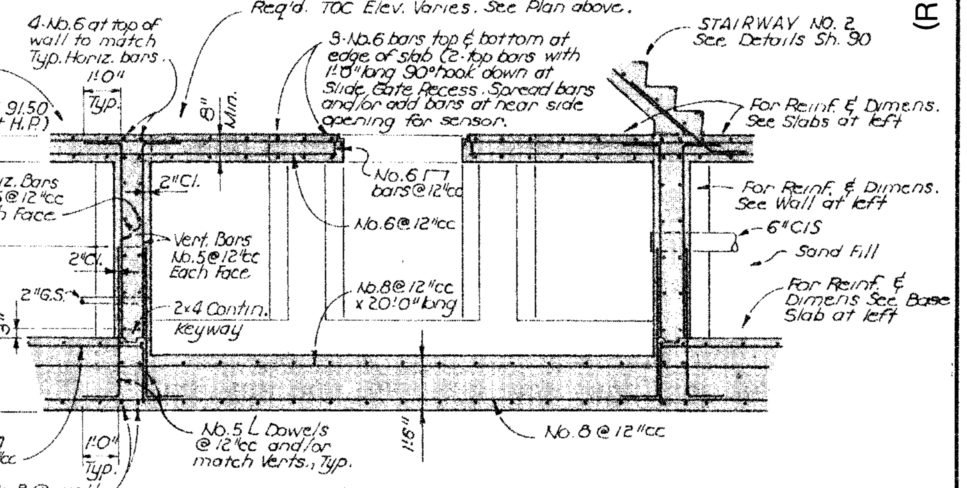
(REVISED SET JUNE 2006)



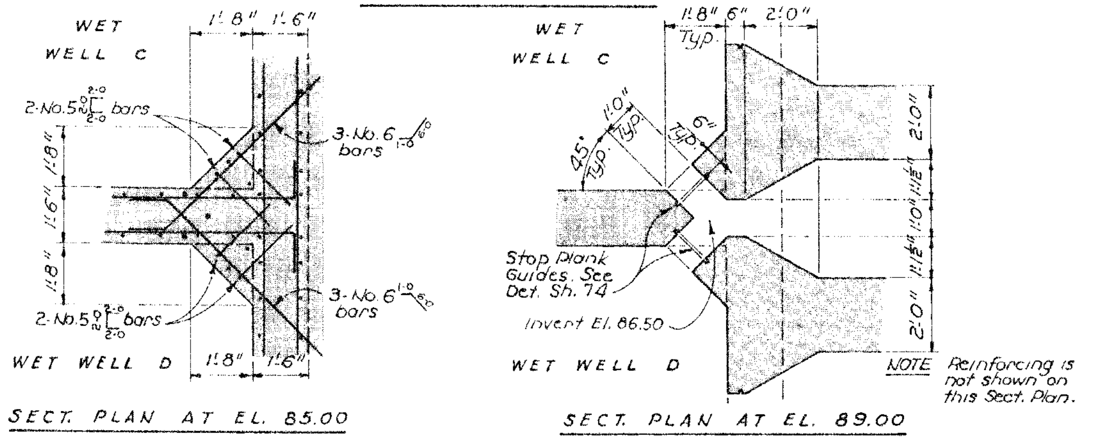
SECTION A - A



SECTION B - B



SECTION C - C



NOTE Reinforcing is not shown on this Sect. Plan.

SPLITTER CHANNEL DETAILS

Record Drawing

89 OF 141

RECORD DRAWING, JUNE 1982

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION STRUCTURAL BARMINUTOR CHANNEL DETAILS
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: LFI — Scale: 3/8"=1'-0" Des./Chkd by: DAB — Date: 8-77/9-79

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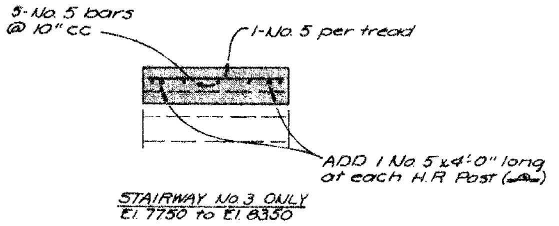
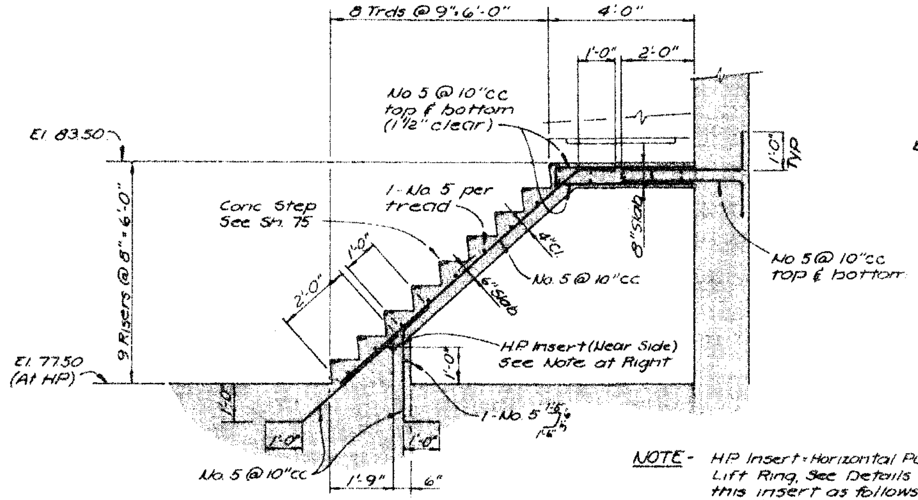


SECTION A-A

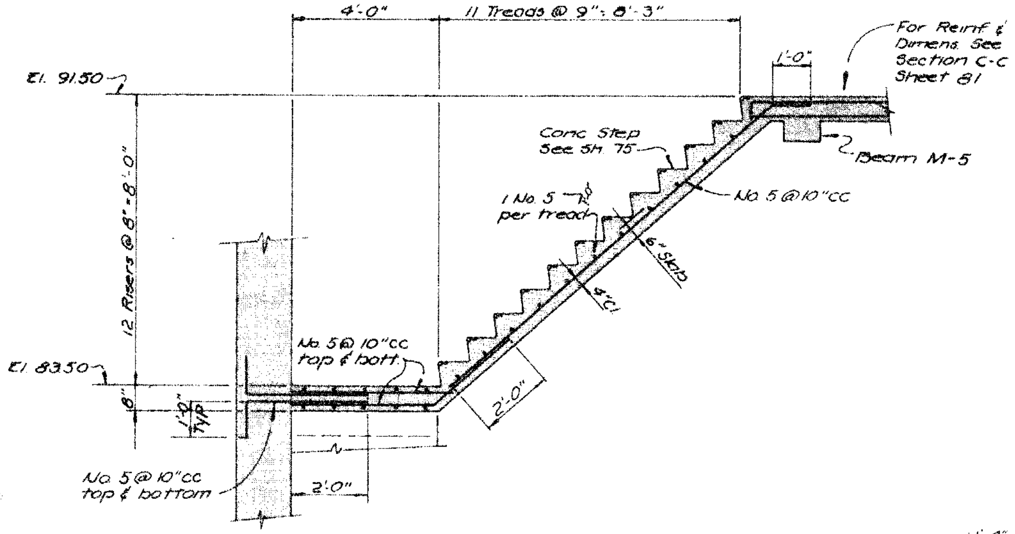
Scale 3/8" = 1'-0"



SECTION C-C

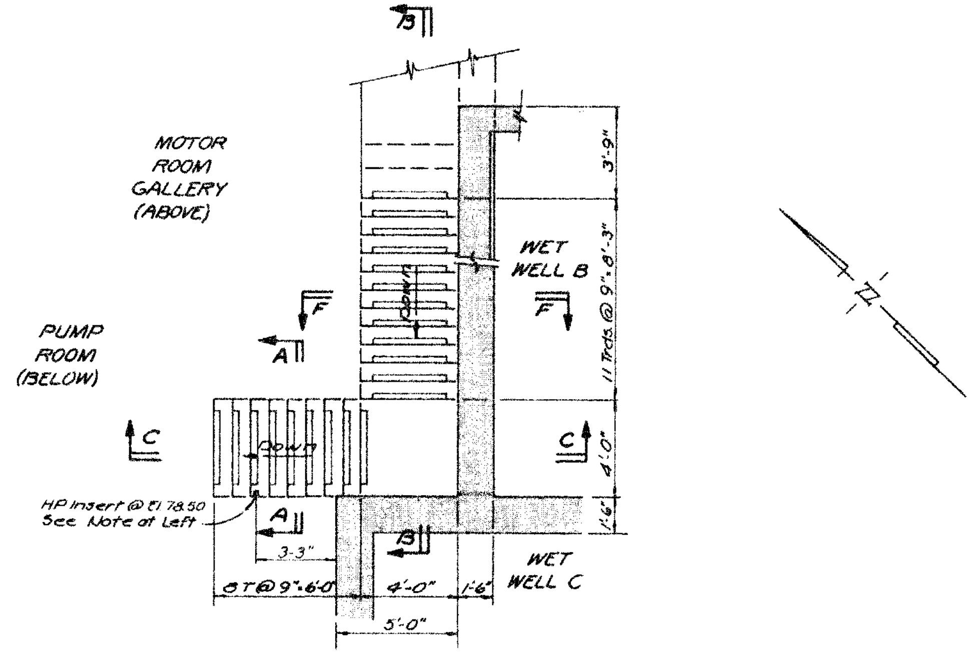
Scale 3/8" = 1'-0"

NOTE - HP Insert = Horizontal Pull threaded steel insert for 7/8" diameter Lift Ring, See Details on Sheet 75. Modify the typical details for this insert as follows: Near-Side rebar 90° anchor hooks shall be 2'-0" long located in the plane of the Stairway Slab 3½" clear from the side face of concrete; Far-side rebar anchor hooks shall be similar to the near-side units except that they shall be 1'-0" long and 3½" clear from the far-side face of concrete.



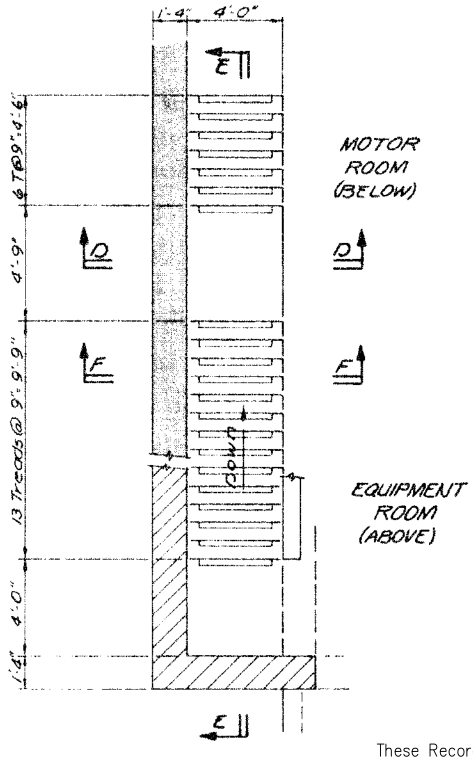
SECTION B-B

Scale 3/8" = 1'-0"



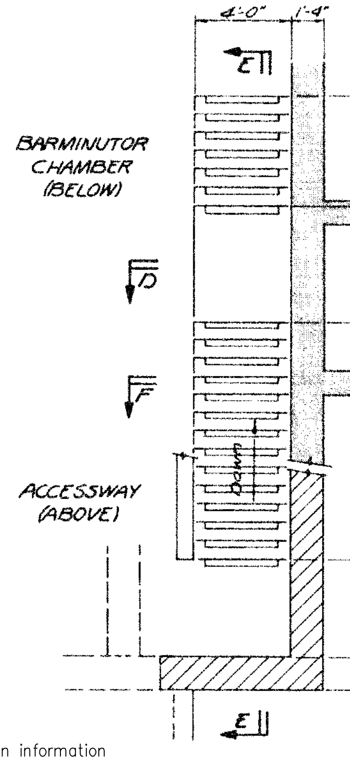
STAIRWAY NO 3
PLAN

Scale 1/4" = 1'-0"



STAIRWAY NO. 1
PLAN

Scale 1/4" = 1'-0"



STAIRWAY NO. 2
PLAN

Scale 1/4" = 1'-0"

Record Drawing

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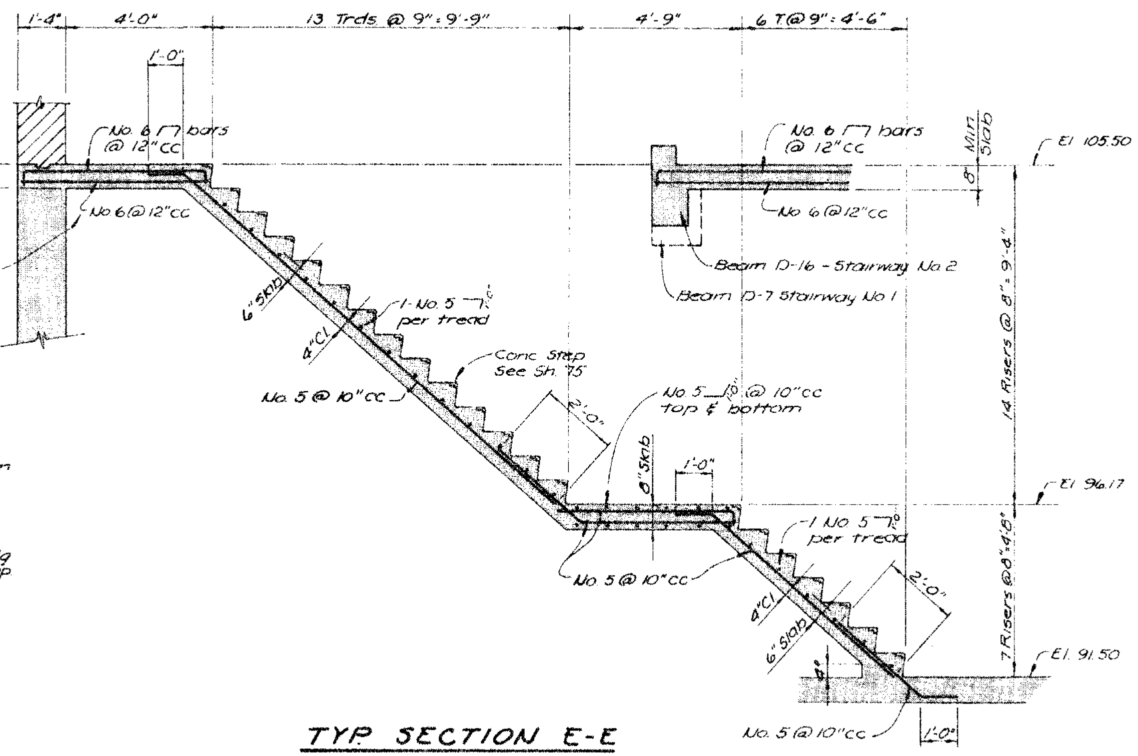

TYP SECTION E-E

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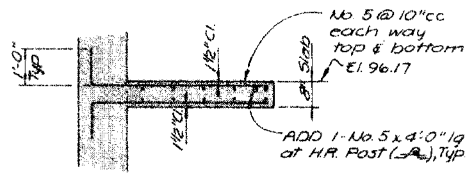

SECTION D-D

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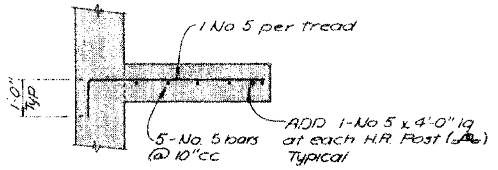

TYP STAIR SECTION F-F

Scale 3/8" = 1'-0"

RECORD DRAWING, JUNE 1982

90 OF 141

SUBMITTED	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
JENKS & HARRISON DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED REDWOOD CITY DATE	SAN CARLOS PUMP STATION
APPROVED SAN CARLOS DATE	STRUCTURAL STAIRWAY DETAILS
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: EB Scale: AS NOTED Des./Chkd by: DAB Date: 8-77 / 9-79

(REVISED SET JUNE 2006)

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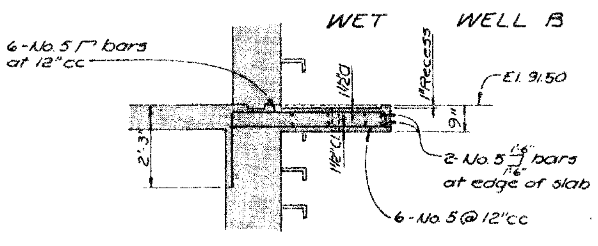

SECTION B B
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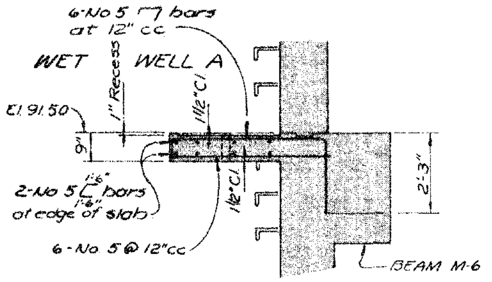

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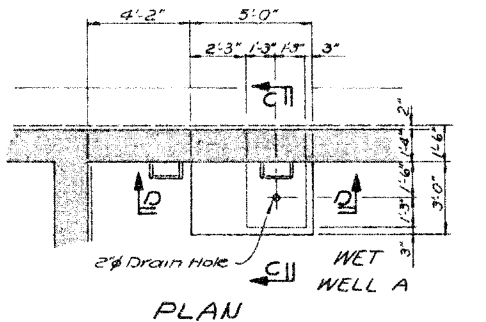
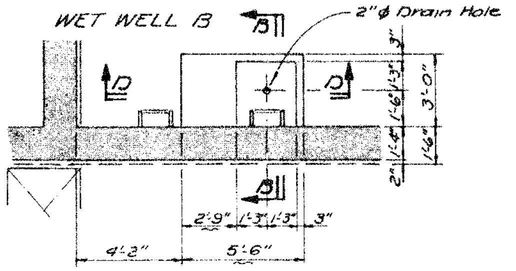
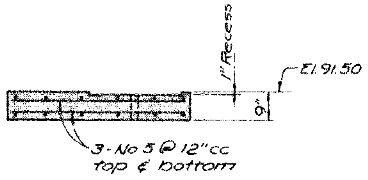


PLAN
Scale 1/4"=1'-0"

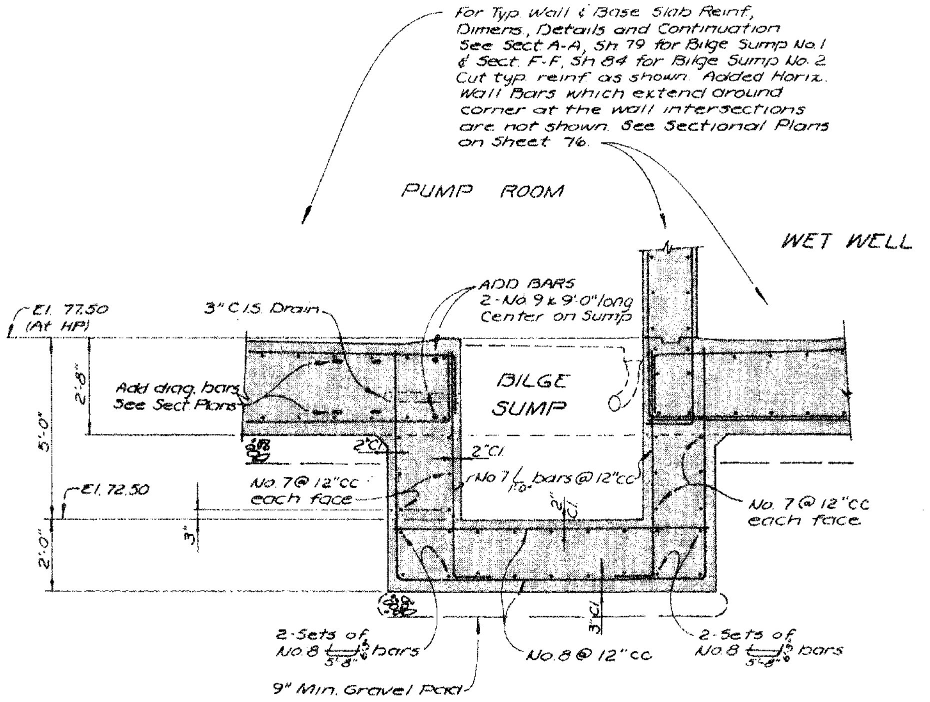


PLAN
Scale 1/4"=1'-0"

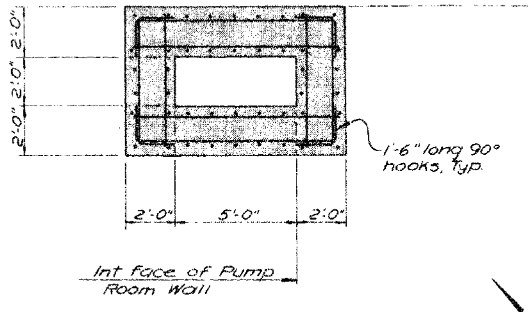


TYP SECTION D-D
Scale 3/8"=1'-0"

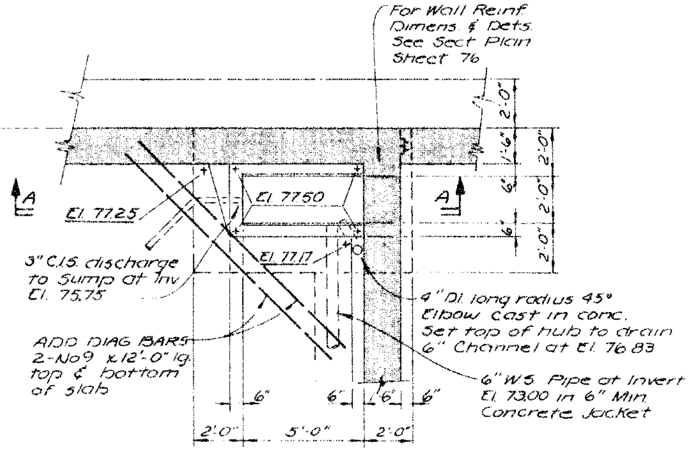
WET WELL LANDING DETAILS



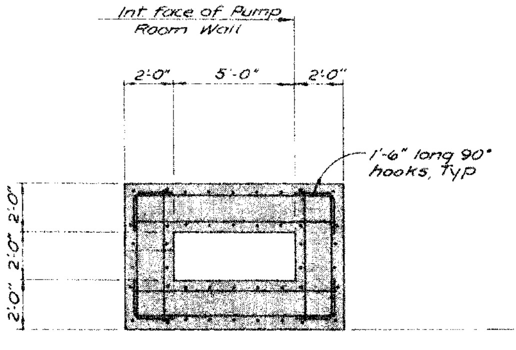
TYPICAL SECTION A-A
Scale 3/8"=1'-0"



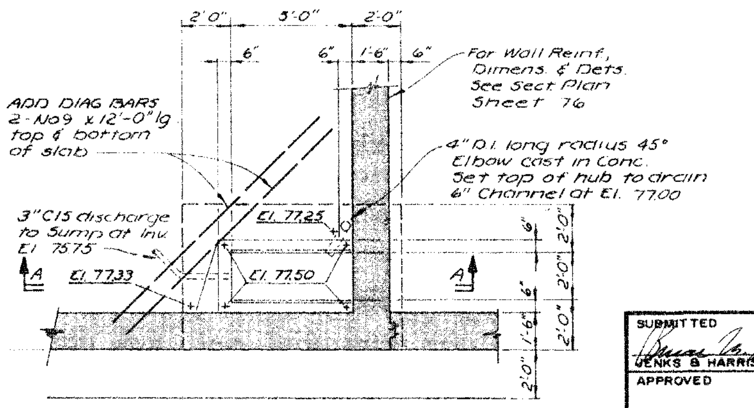
BILGE SUMP NO 1
SECT PLAN AT ELEV 74.0
Scale 1/4"=1'-0"



BILGE SUMP NO. 1
SECT PLAN AT ELEV 78.0
Scale 1/4"=1'-0"



BILGE SUMP NO 2
SECT PLAN AT ELEV 74.0
Scale 1/4"=1'-0"



BILGE SUMP NO. 2
SECT PLAN AT ELEV 78.0
Scale 1/4"=1'-0"

TYPICAL BILGE SUMP DETAILS

(REVISED SET JUNE 2006)

Record Drawing

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RECORD DRAWING, JUNE 1982.

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA
SUBREGIONAL WASTEWATER WORKS
SAN CARLOS PUMP STATION
STRUCTURAL
MISCELLANEOUS DETAILS
JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: MR EB	Scale: AS NOTED
Des/Chkd by: DAB	Date: 8-77/9-79

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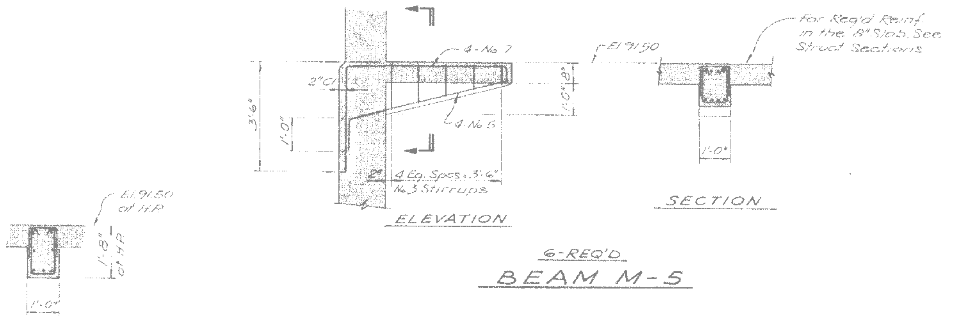
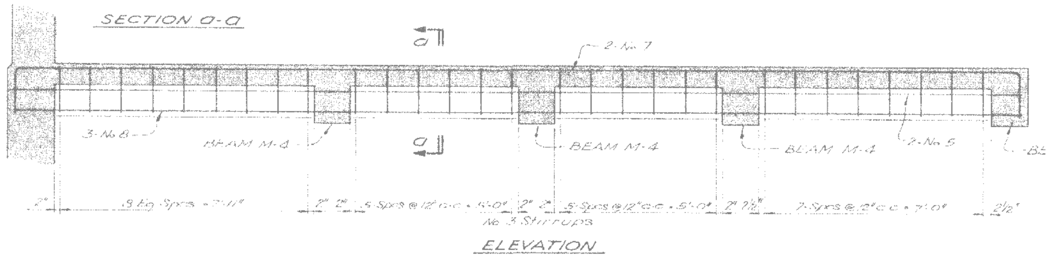


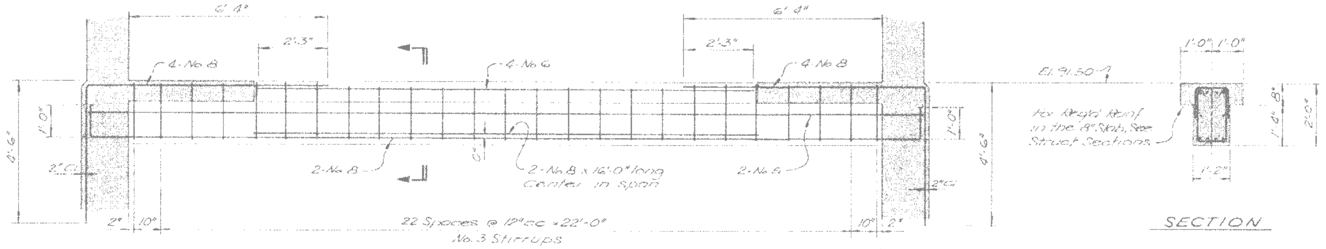
6-REQ'D

BEAM M-5



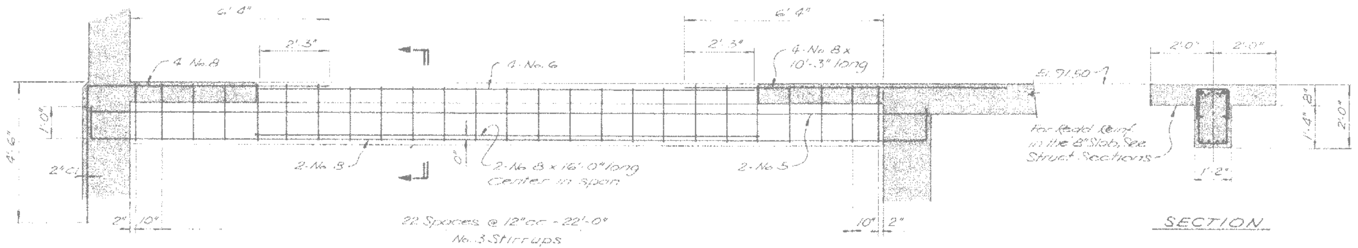
1-REQ'D

BEAM M-7



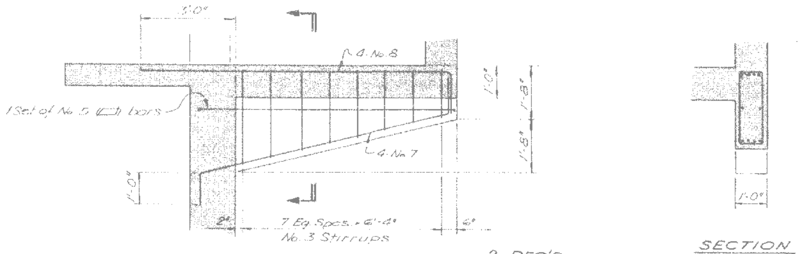
1-REQ'D

BEAM M-1



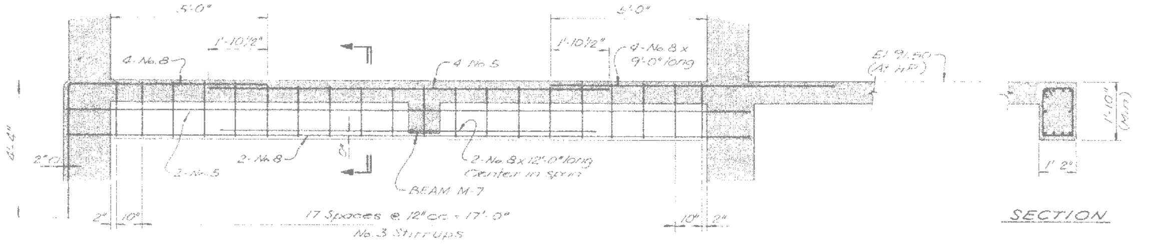
1-REQ'D

BEAM M-2



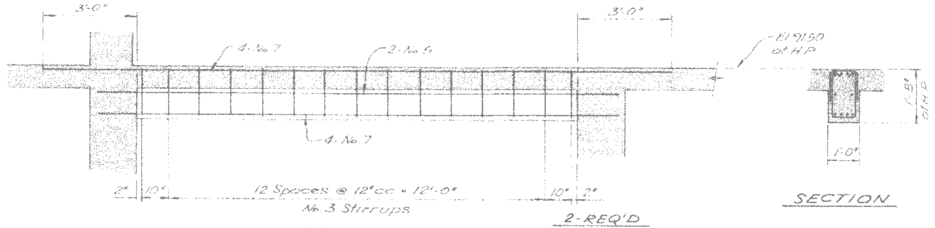
2-REQ'D

BEAM M-8



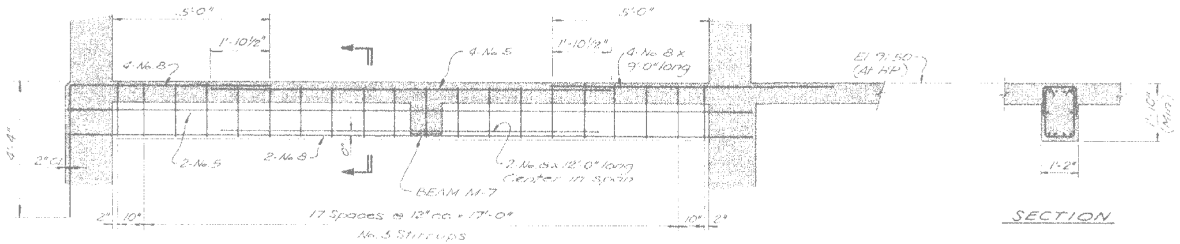
1-REQ'D

BEAM M-3



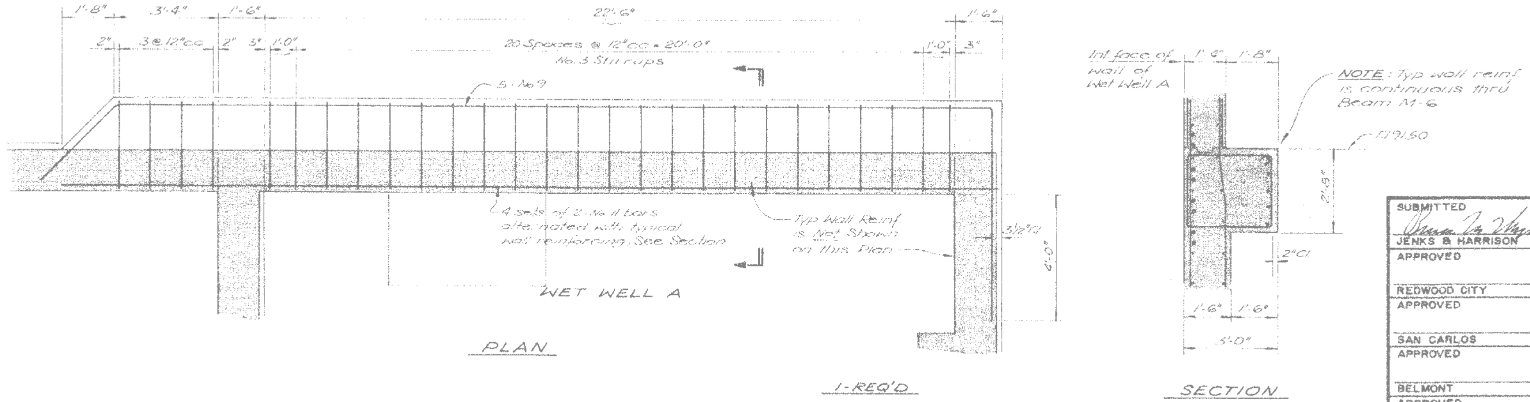
2-REQ'D

BEAM M-9



3-REQ'D

BEAM M-4



1-REQ'D

BEAM M-6

RECORD DRAWING, JUNE 1982

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION STRUCTURAL MOTOR ROOM BEAM DETAILS
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: MR CGS · Scale: 3/8"=1'-0" Des/Chkd by: AGE · Date: 8-77 / 9-79

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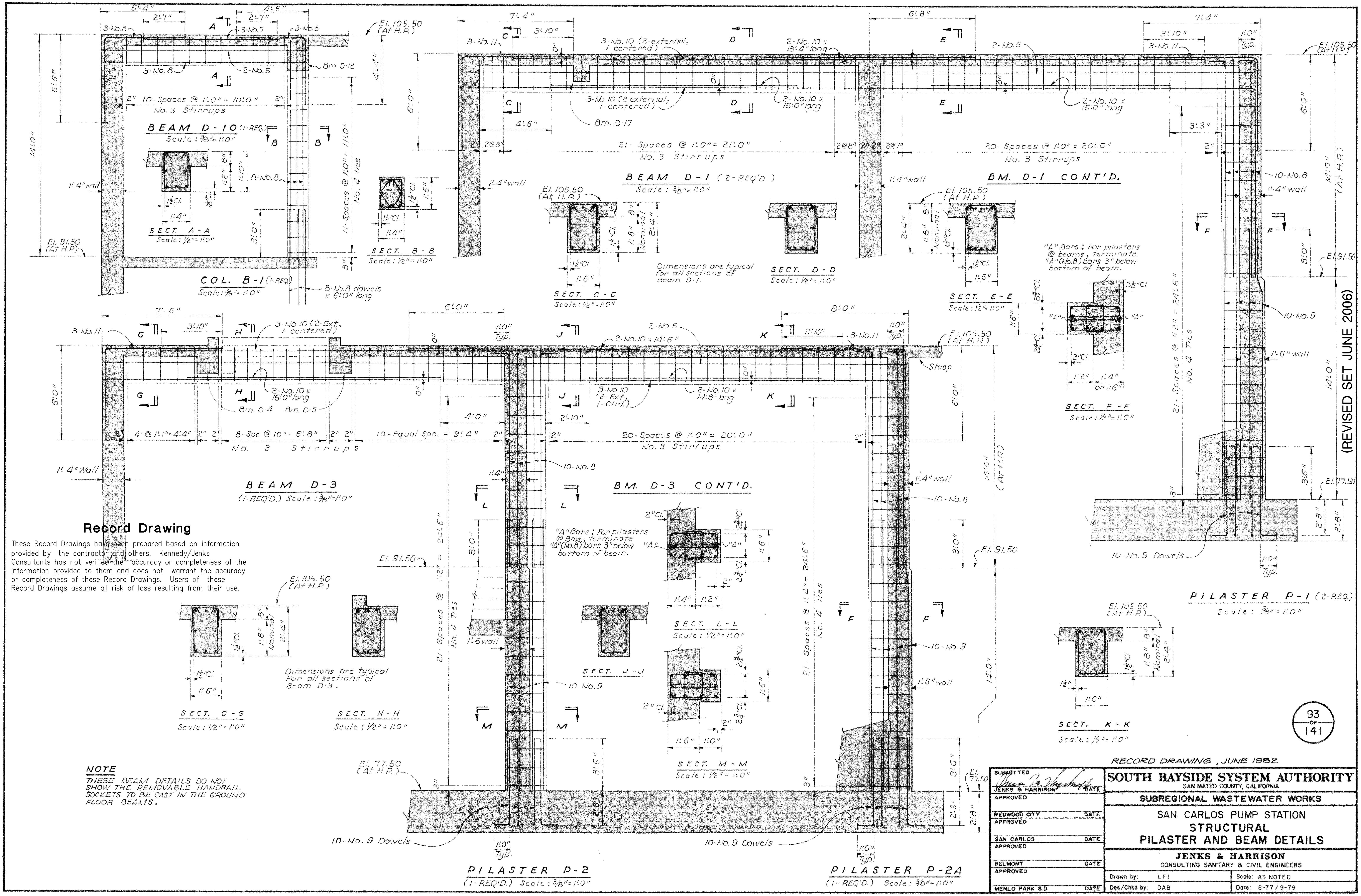
(REVISED SET JUNE 2006)



Record Drawing

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NOTE

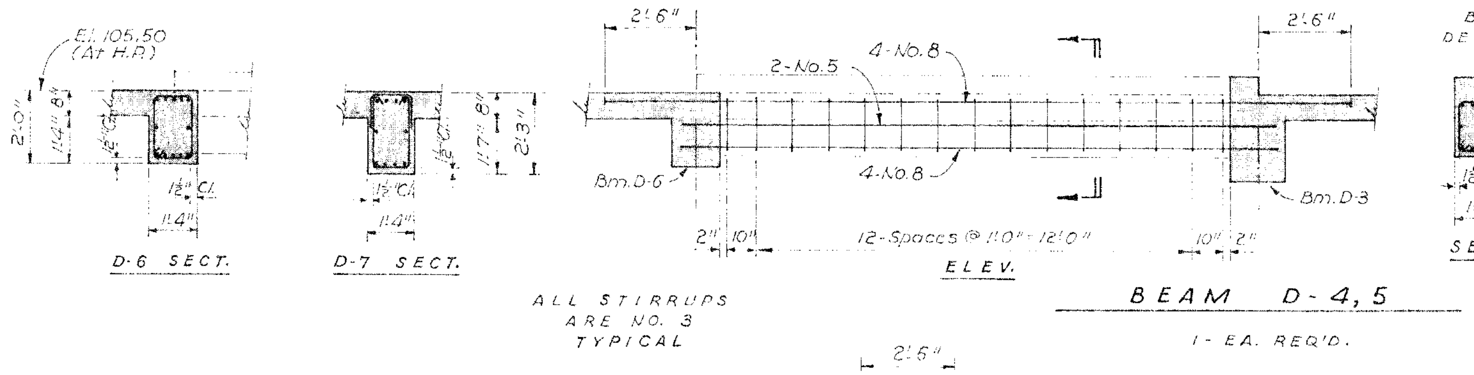
THESE BEAM DETAILS DO NOT SHOW THE REMOVABLE HANDRAIL SOCKETS TO BE CAST IN THE GROUND FLOOR BEAMS.

RECORD DRAWING, JUNE 1982

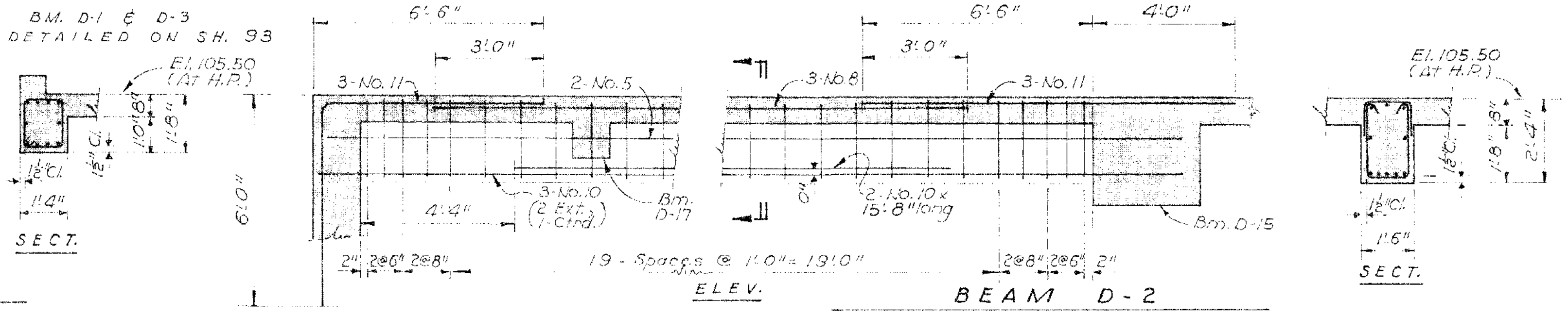
SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

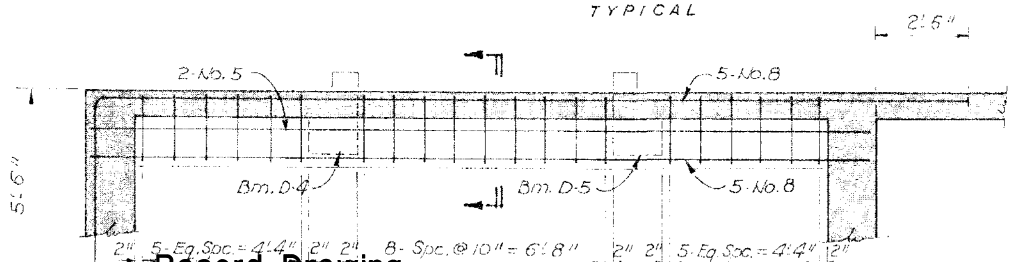
SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA
SUBREGIONAL WASTEWATER WORKS
SAN CARLOS PUMP STATION
STRUCTURAL
PILASTER AND BEAM DETAILS
JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: LFI
Des/Chkd by: DAB
Scale: AS NOTED
Date: 8-77/9-79



BM. D-1 & D-3 DETAILED ON SH. 93





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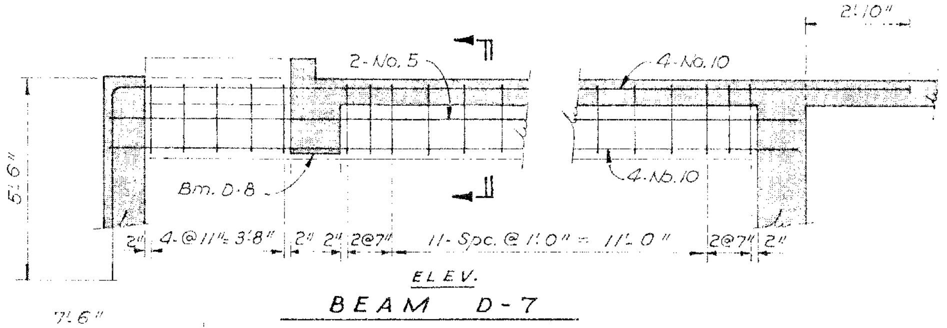
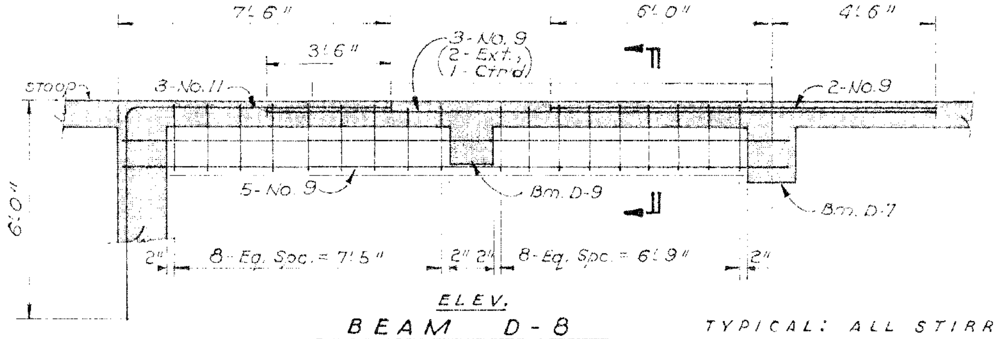
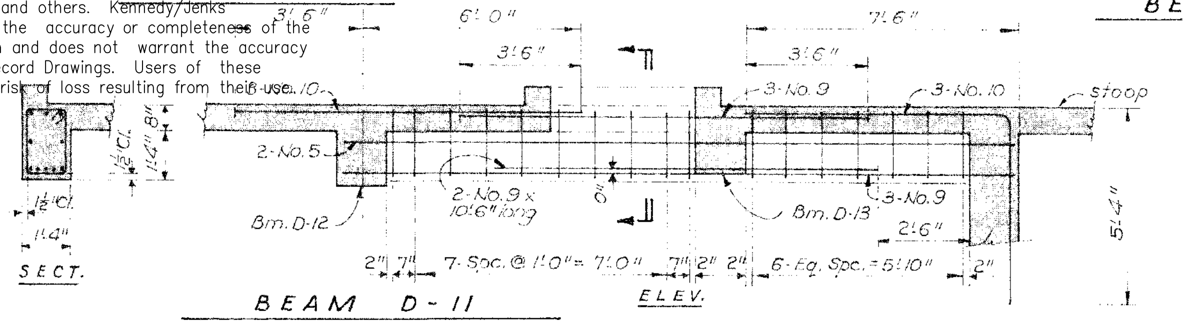
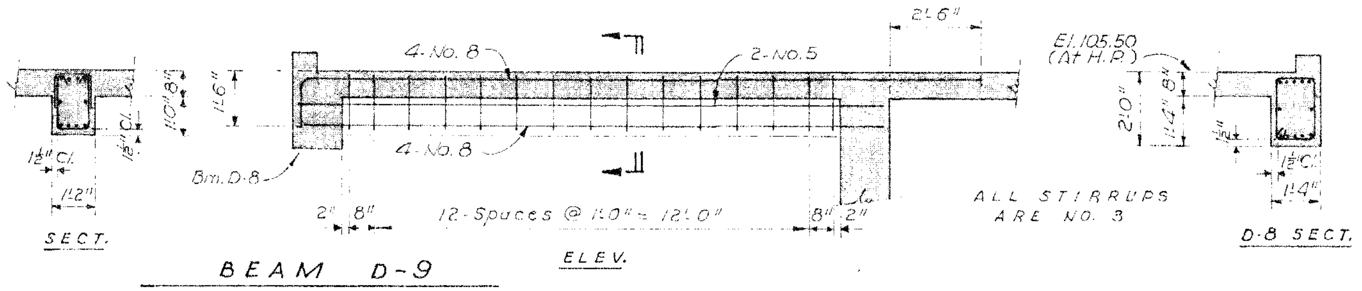


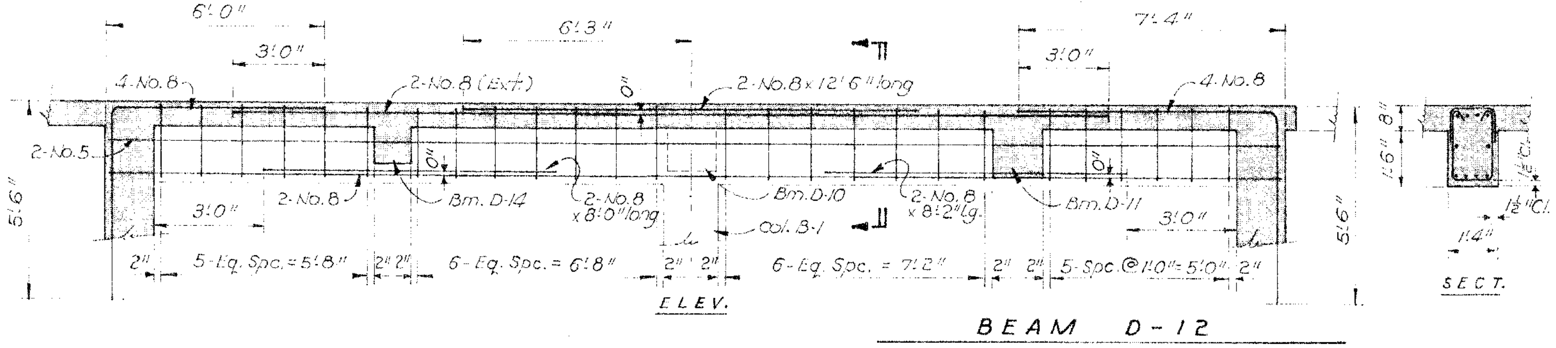


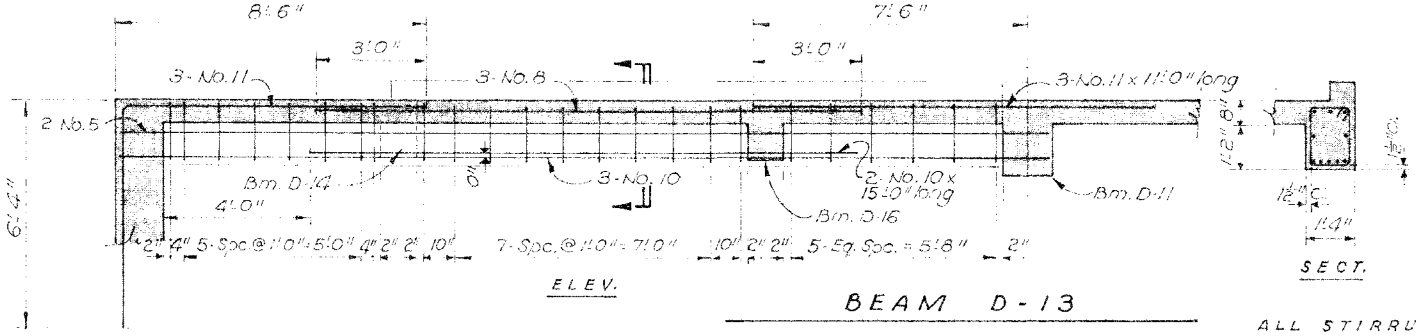
TYPICAL: ALL STIRRUPS ARE NO. 3



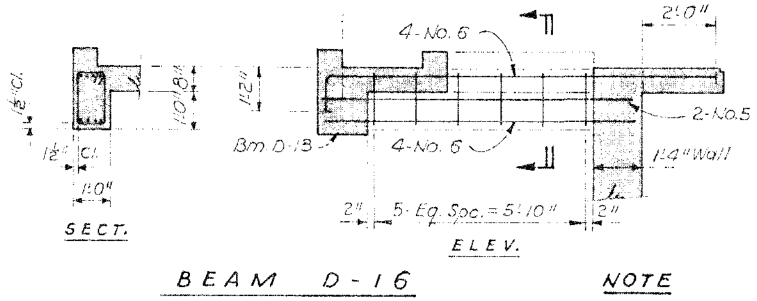
BM. D-10 DETAILED ON SH. 93







ALL STIRRUPS ARE NO. 3 TYPICAL



NOTE

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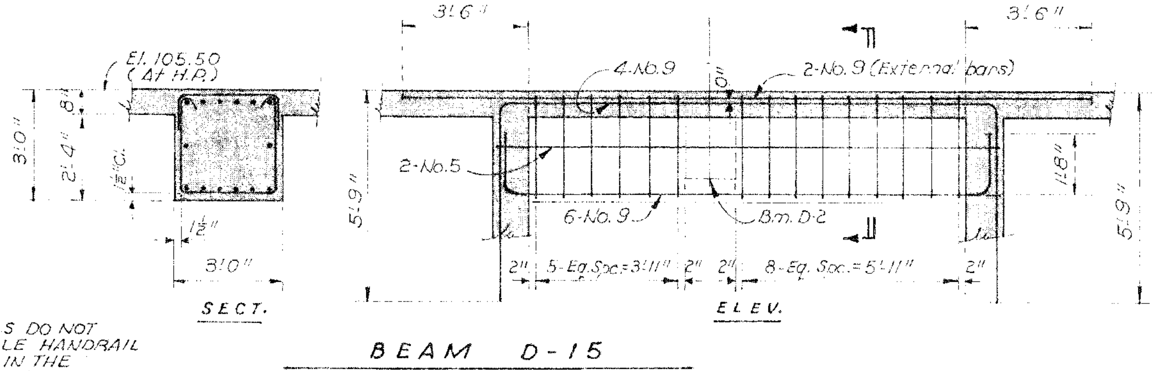
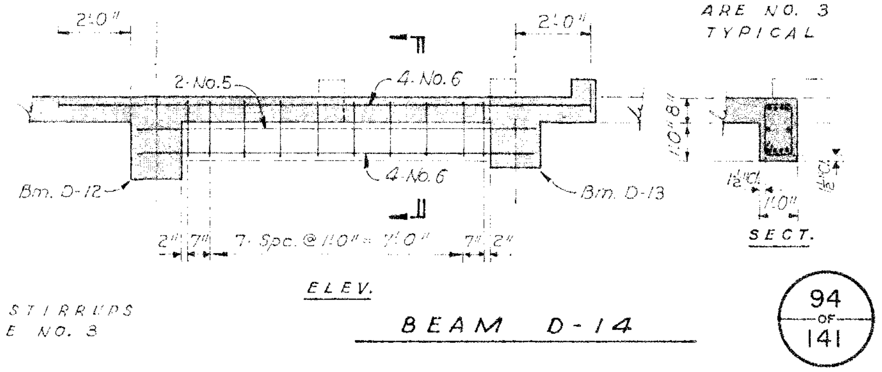
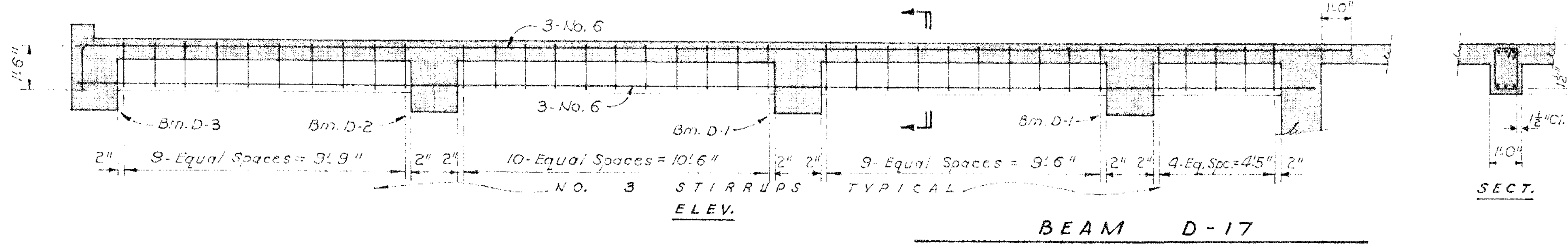


ALL STIRRUPS ARE NO. 3





(REVISED SET JUNE 2006)

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RECORD DRAWING, JUNE 1982

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

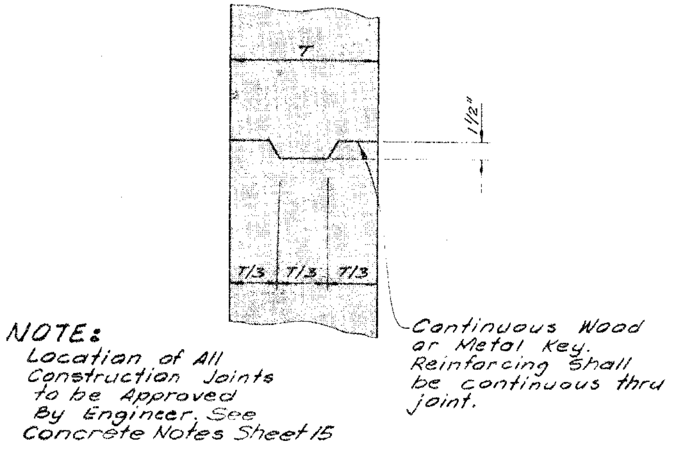
SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
STRUCTURAL
GROUND FLOOR BEAM DETAILS

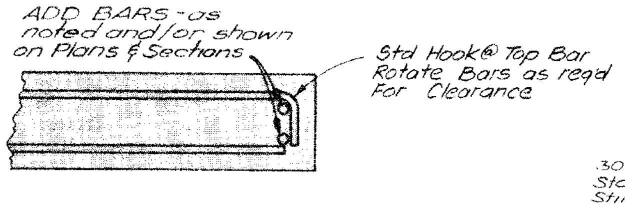
JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by:	L.F.I.	Scale:	3/8"=1'-0"
Des/Chkd by:	DAB	Date:	8-77/9-79

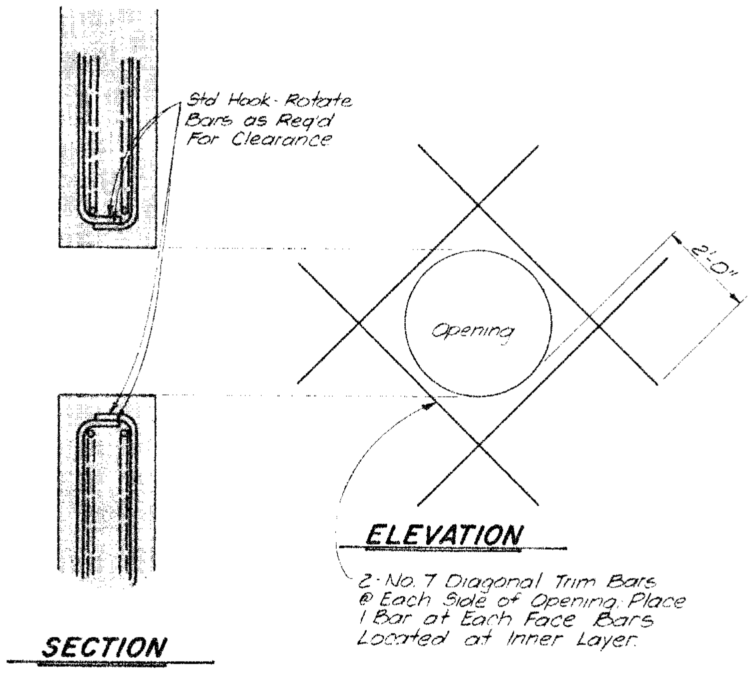


HORIZONTAL JOINT DETAIL

TYPICAL CONSTRUCTION JOINT



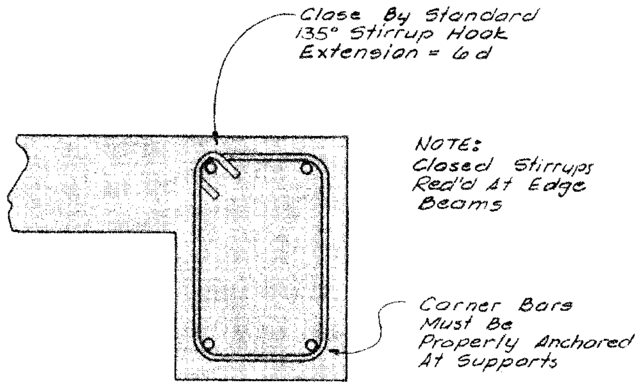
SLAB OPENING



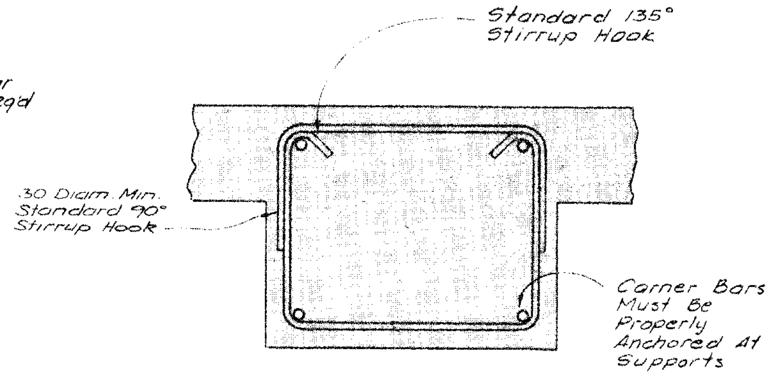
SECTION

ELEVATION

WALL OPENING



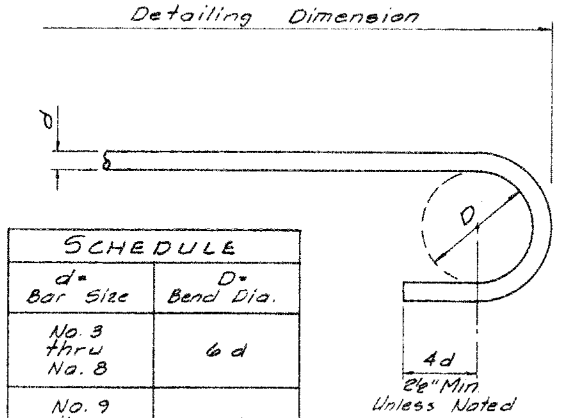
CLOSED STIRRUP



OPEN STIRRUP

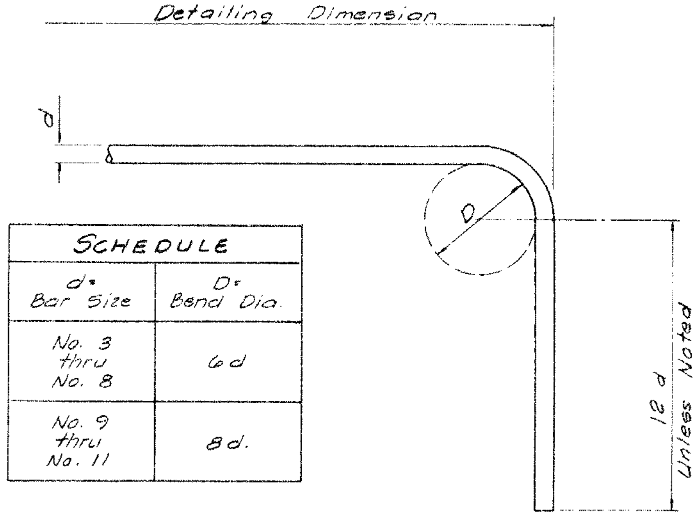
TYPICAL BAR CLEARANCES		
Footings & Slabs on Grade	Bottom & Side	3"
	Top	2"
Conc. Walls	Each Face	2"
Conc. Block Walls	Top Surfaces Each Face	1½" Min. 2½" Min.
Suspended Slabs	Top & Bottom	1½"
Beams	Each Face	1½"

NOTE: The above Typical Bar Clearances apply throughout these plans unless otherwise noted.



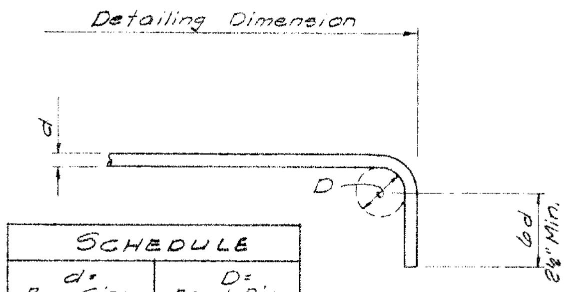
SCHEDULE	
d = Bar Size	D = Bend Dia.
No. 3 thru No. 8	6d
No. 9 thru No. 11	8d

STANDARD 180° HOOK



SCHEDULE	
d = Bar Size	D = Bend Dia.
No. 3 thru No. 8	6d
No. 9 thru No. 11	8d.

STANDARD 90° HOOK



SCHEDULE	
d = Bar Size	D = Bend Dia.
No. 3	1½"
No. 4	2"
No. 5	2½"
No. 6	3"

STD. STIRRUP & TIE HOOK

REINFORCING NOTES

Bar supports shall conform to the "Bar Support Specifications and Standard Nomenclature" as contained in "The Manual of Standard Practice for Reinforced Concrete Construction" as published by the Concrete Reinforcing Steel Institute.

Reinforcing bars to be embedded in concrete shall be free of oil, dirt, loose mill scale and loose rust. Reinforcing bars with rust, mill scale or a combination of both will be acceptable as being satisfactory without cleaning or brushing, provided that upon wire brushing the dimensions including height of deformations and weights of a cleaned sample shall not be less than the applicable ASTM specification requirements.

The contractor shall supply placing drawings and bar lists in accordance with "Manual of Standard Practice for Detailing Concrete Structures" (ACI Standard 315).

The placement of bars should conform to "Placing Reinforcing Bars" as published by the Concrete Reinforcing Steel Institute. Bars should be securely tied to prevent displacement during the pouring operation and all dowels must be wired in place before depositing concrete. Tie wire shall be 16 gauge or heavier, black annealed wire.

(REVISED SET JUNE 2006)

Record Drawing

RECORD DRAWING, JUNE 1982

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA
SUBREGIONAL WASTEWATER WORKS
SAN CARLOS PUMP STATION
STRUCTURAL
TYPICAL REINFORCING STEEL DETAILS
JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS
Drawn by: DJF
Scale: NONE
Des/Chkd by: RWC WEN
Date: 8-77/9-79

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Record Drawing

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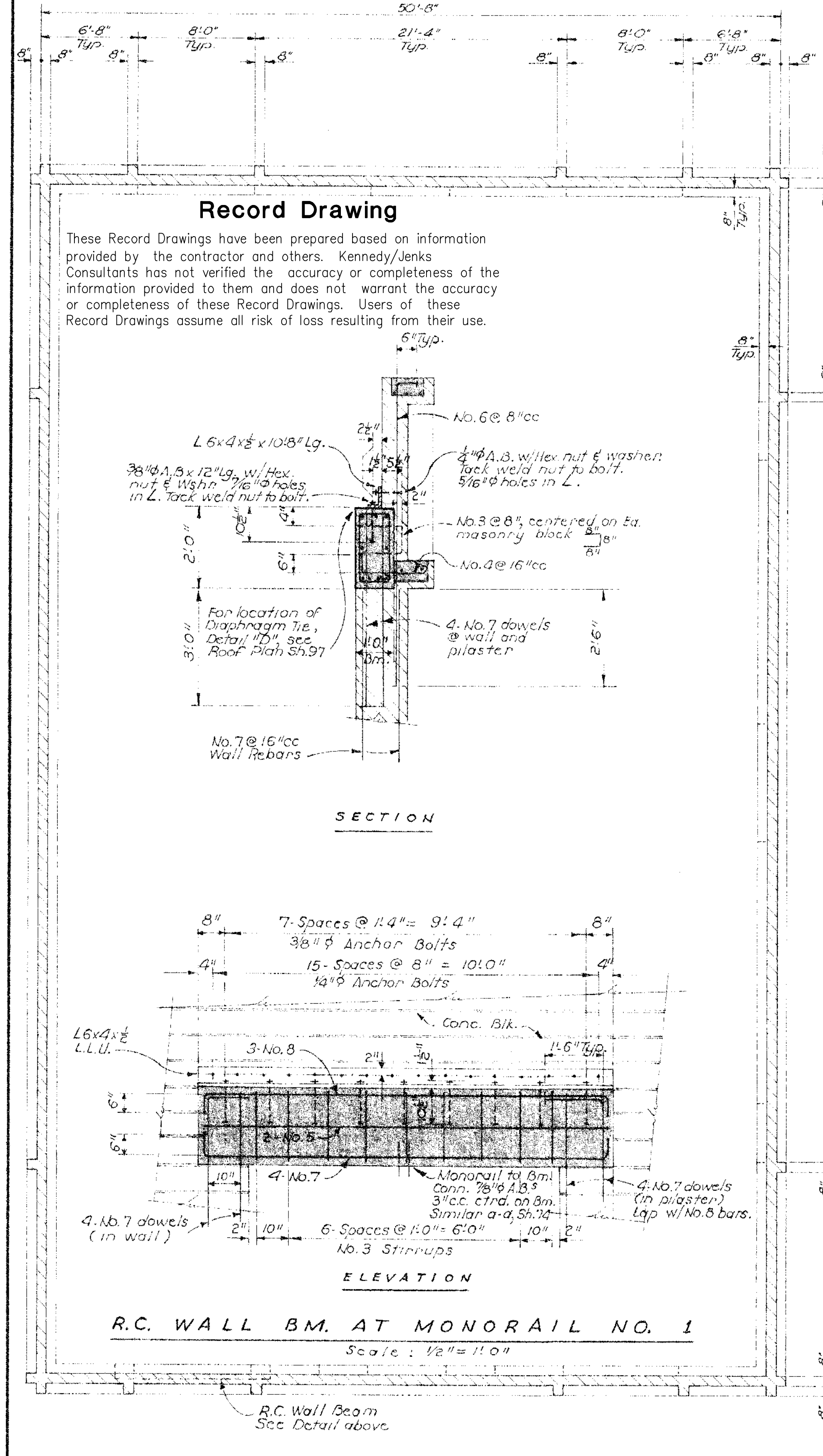
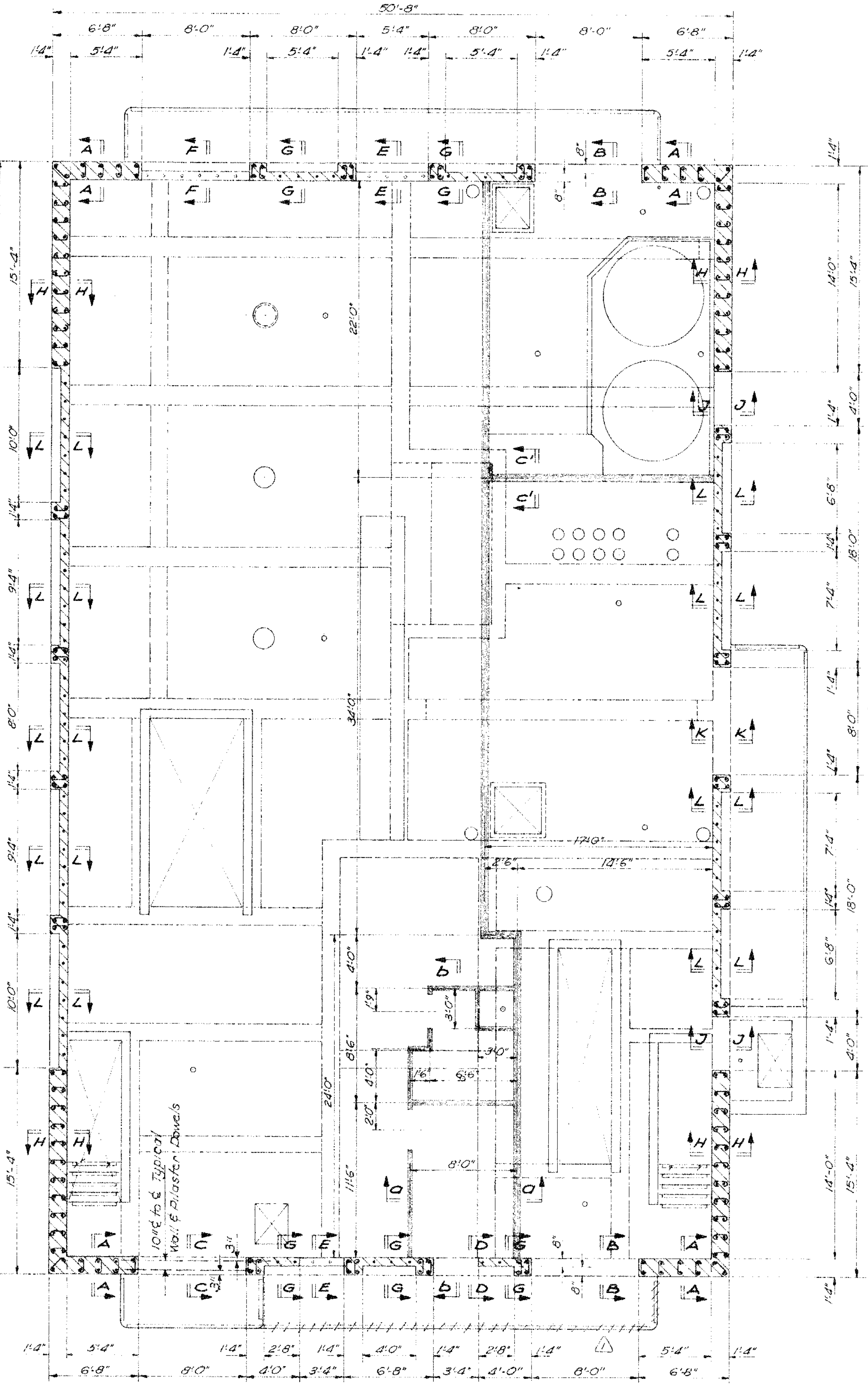


R.C. WALL BM. AT MONORAIL NO. 1

Scale: ½" = 1'-0"

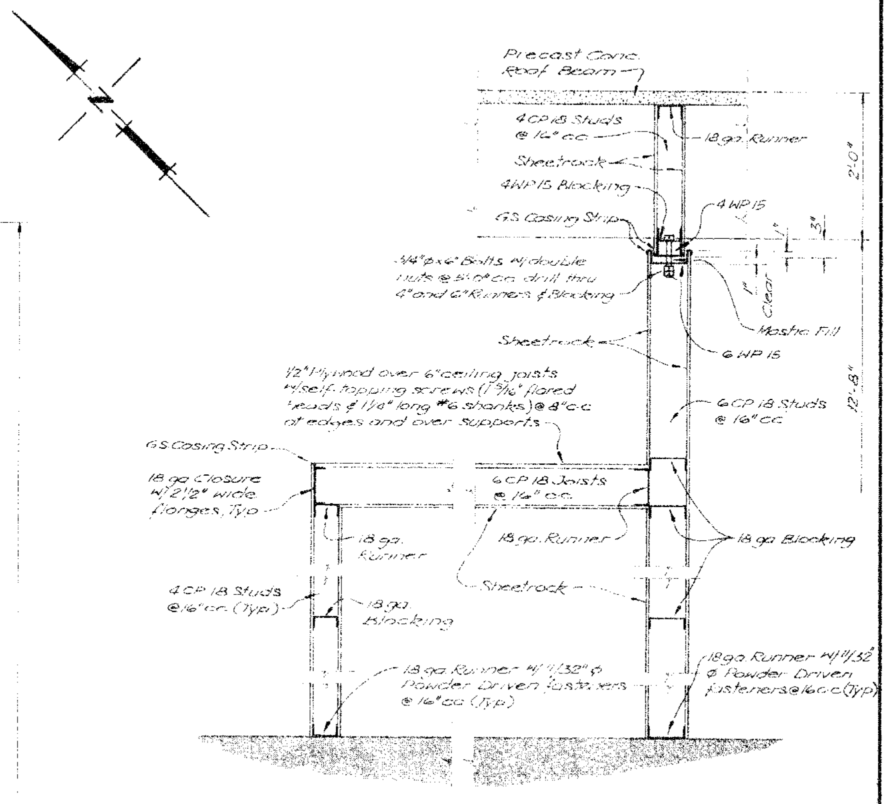
SECTIONAL PLAN AT EL. 120.0

Scale: 3/16" = 1'-0"



FLOOR PLAN

Scale: 3/16" = 1'-0"

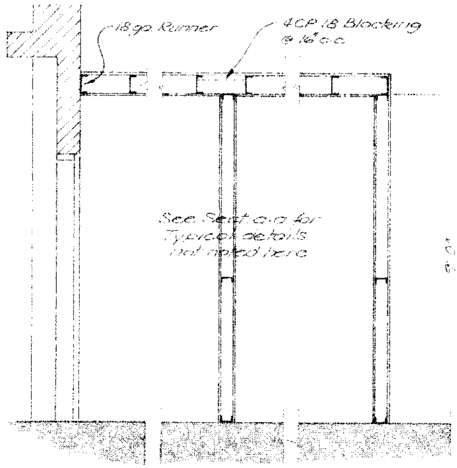


SECTION a-a

Scale: 3/4" = 1'-0"

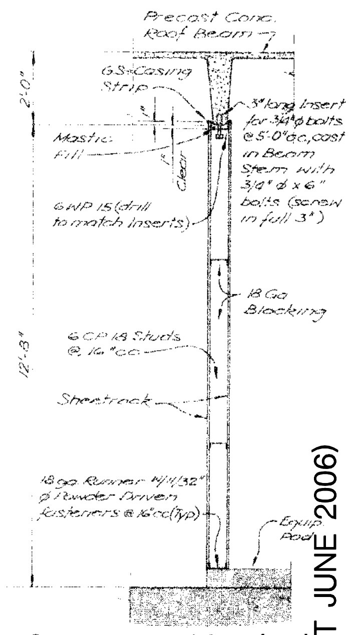
NOTE

The Contractor shall furnish and install a 2½" high vinyl Base Cove Molding at the intersection of the floor slab and all Superstructure wall interior surfaces except in Hypochlorite Storage Area



SECTION b-b

Scale: 3/8" = 1'-0"



SECTION c-c'

Scale: 3/8" = 1'-0"

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(REVISED SET JUNE 2006)

△1 RECORD DRAWING, JUNE 1982

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
SUPERSTRUCTURE
SECTIONAL PLANS AND SECTIONS

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: LLK CGS	Scale: AS NOTED
Des/Chkd by: DAB	Date: 8-77/9-79

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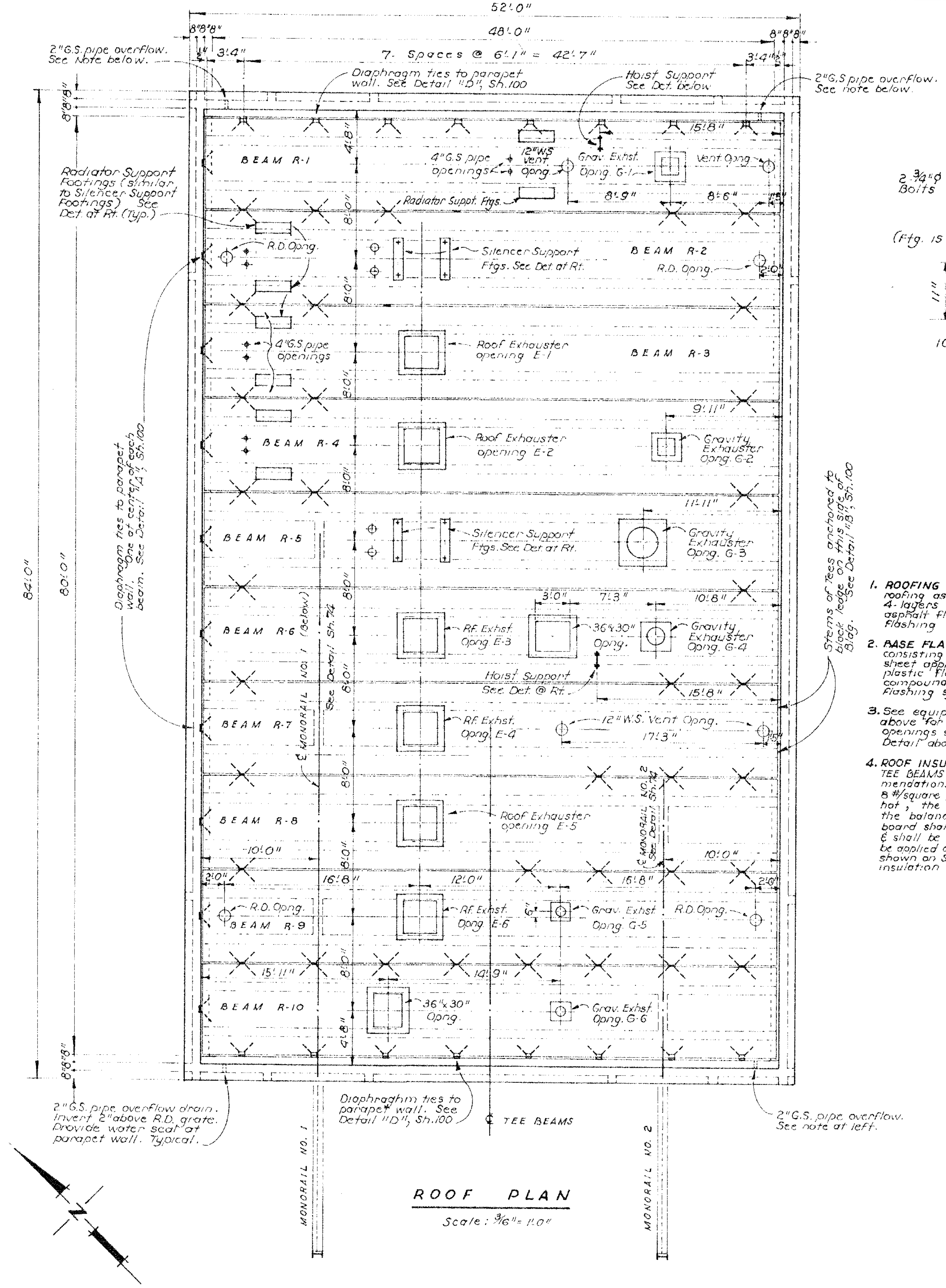
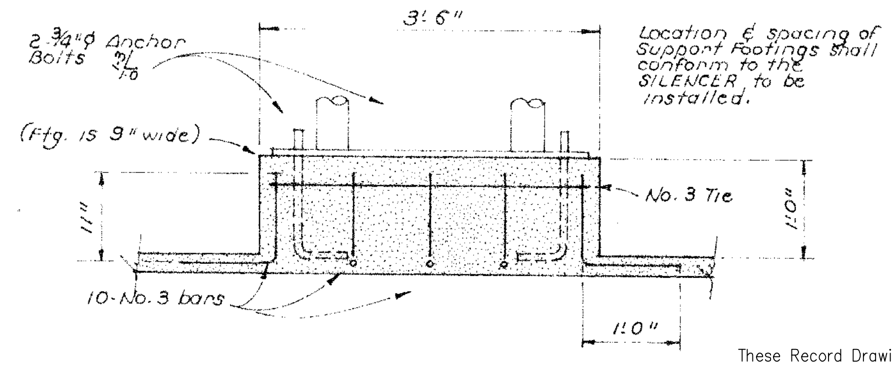


ROOF PLAN

Scale: 3/16" = 1'-0"

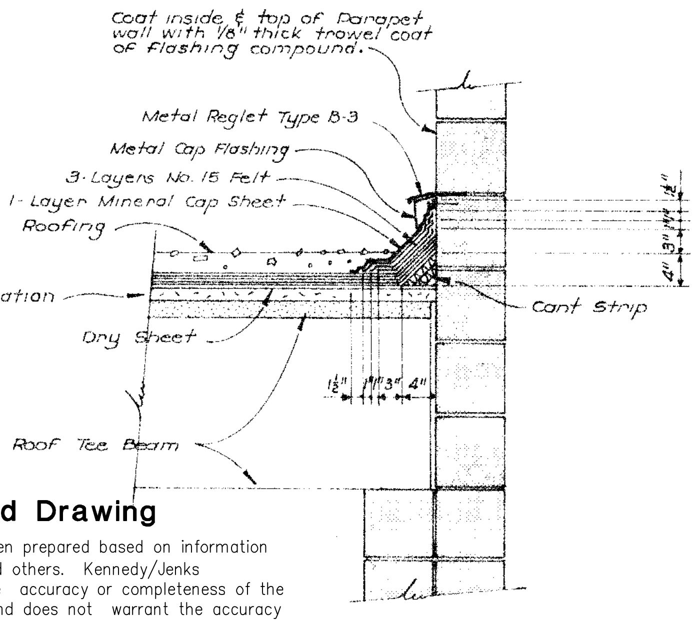
RADIATOR SUPPORT FOOTING

The Radiator Support Footing dimensions shall be similar to the Detail below and shall also conform to the radiator to be installed. The Radiator Support Footing reinforcing shall be similar to that detailed below. The Contractor shall submit details for approval prior to the fabrication of the "T-beams".



SILENCER SUPPT. FTG.

Scale: 1" = 1'-0"



Record Drawing

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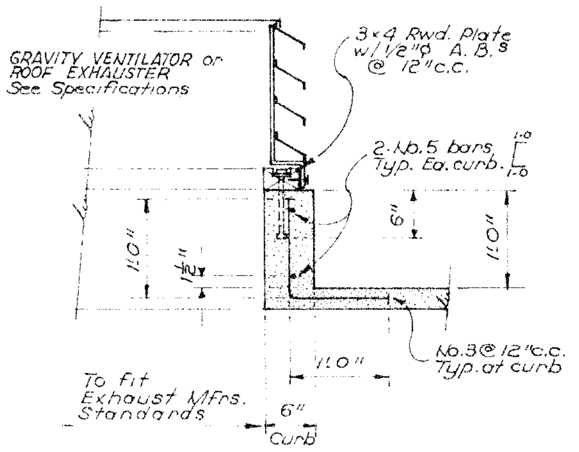
PARAPET DETAIL

Scale: 1" = 1'-0"

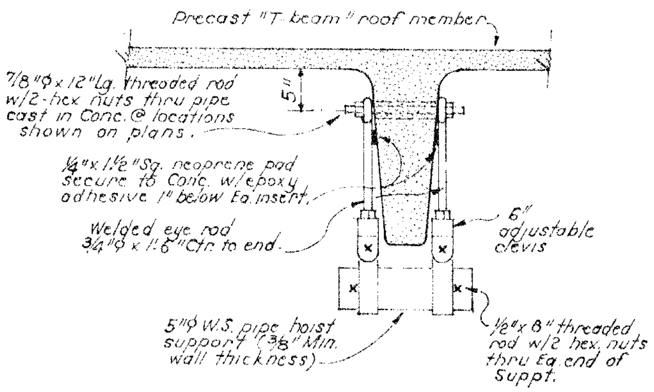
ROOF NOTES

1. **ROOFING NOTE** — The CONTRACTOR shall apply a "20 year", asphalt rag felt, built-up roofing as detailed above. The roofing shall consist of an asphalt spot mopping 10 #/square, 4-layers of 15 # asphalt saturated felt, 3-hot asphalt moppings between layers 75 #/square, asphalt flood coat 60 #/square and 300 #/square of cinder rock together with all necessary flashing and sealing.
2. **BASE FLASHING** — Prime wall with asphalt primer to reglet line. Apply base flashing consisting of 3-layers of No. 15 asphalt felt and one layer of mineral surfaced cap sheet applied in asphalt. Nail upper edge of cap sheet to wall. Apply a 3 course plastic flashing consisting of a 4" strip of "Glasfab" and two coarses of flashing compound sealing the upper edge of base flashing. The exposed surface of the flashing system shall receive a trowel coat of flashing compound 1/8" thick.
3. See equipment manufacturers drawings, Roof Plan Sh. 64, and the Roof Details above for required opening and curb sizes for roof exhausters and vents. All openings shall have an approved base flashing similar to that shown on the Parapet Detail above.
4. **ROOF INSULATION** — The CONTRACTOR shall apply a rigid board insulation over the precast concrete TEE BEAMS. The insulation shall be installed in accordance with the manufacturer's recommendations, but in no case shall the materials be less than the following: asphalt primer 8 #/square, hot asphalt mopping at 25 #/square to receive the rigid board insulation while hot, the insulation board, hot asphalt mopping at 25 #/square over the board and apply the balance of the roofing as indicated above over the entire roof area. The insulation board shall be a rigid urethane bonded each face to an asphalt impregnated skin, see Specs., & shall be compatible with roofing materials to be installed. The rigid urethane insulation shall be applied over an insulation board material which has a 1/8" per foot slope for roof drainage as shown on Sh.64. The insulation shall have a minimum of eight vents, as recommended by insulation and/or roofing manufacturers.



EXHAUST OPNG. CURB DETAIL

Scale: 1" = 1'-0"



HOIST SUPPORT DETAIL

Scale: 1" = 1'-0"

(REVISED SET JUNE 2006)

RECORD DRAWING, JUNE 1982.

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION SUPERSTRUCTURE ROOF PLAN AND DETAILS
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: LFI — Scale: AS NOTED Des/Chkd by: DAB — Date 8-77/9-79

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DOORS

DOOR ① Door pair shall be 7'8"x 12'6" steel w/ 14 Ga. stretcher leveled steel faces on both sides ; solid styrofoam core ; 1¾"x 4"x 16 Ga. cold formed steel tube stiles & rails ; frame mitered & welded , all corners and intersections ground smooth ; faces rigidly attached by welding. Frame shall be C7x 9.8 w/ 1" x ¾" F.B. stops & suitable anchors made to fit an 8'0"x 12'8" rough masonry opening. Notch door as required for Monorail Track. Two Door pair Req'd. Each pair to have : Flat bar Astragal on outside of "active" (right hand) leaf ; Richards - Wilcox 216 or Pemco 315 weatherstripping on bottom ; two R-W 470 or Allith recessed pulls ; R-W 2120 or National chain bolts top & bottom of inactive leaf ; R-W 517 x 427 or National Cremone Bolt w/ cylinder lock & outside operating handle on active leaf ; five pair McKinney T4B3786 or Hager 5"x 4½" ball bearing NRP full mortise hinges ; latch hole in slab to hold door in open position.

DOOR ② All same as Door ① except without Monorail Cutout.

DOOR ③ All same as Door ② except size shall be 7'8"x 9'10" with frame to fit 8'0"x 10'0" rough masonry opening.

DOOR ④ Shall be a 1¾"x 3'0"x 7'2" full Flush , 16 Ga. steel door with full rigid urethane foam core , and shall be hung in a 16 Ga. x 2"x 5¾" double rabbeted steel frame to fit a 3'4"x 7'4" rough masonry opening. Door to have : Schlage C-51PD "Orbit" or Falcon lockset with 630 finish and 5" backset ; LCN 4114 or Norton Closer , 630 finish ; 1½ pair McKinney TA2314 or Stanley ball bearing NRP butts , 630 finish ; Quality 331 ES or Builders Brass door stop ; weatherstripping all four sides and 4" aluminum threshold.

DOOR ⑤ All same as Door ④ except size shall be 1¾"x 3'0"x 6'8" with frame suitable for steel stud & plaster wall. Hardware shall omit door closer, weatherstripping and threshold.

DOOR ⑥ All same as Door ④ except size shall be 1¾"x 2'6"x 6'8" with frame suitable for steel stud & plaster wall. Hardware shall be Schlage C-405 "Orbit" or Falcon privacy lock with 630 finish and 5" backset ; 1½ pair McKinney TA 2314 or Stanley ball bearing butts , 630 Finish ; Quality 331 ES or Builders Brass door stop.

NOTE : All doors and frames shall be factory prime coated and job site spray painted with colors as selected by the Engineer.

LOUVERS

LOUVER Ⓐ to fit an 8'0" wide x 6'0" high rough masonry opening.

LOUVER Ⓑ to fit a 5'4" wide x 6'0" high rough masonry opening.

LOUVER Ⓒ to fit a 3'4" wide x 6'0" high rough masonry opening.

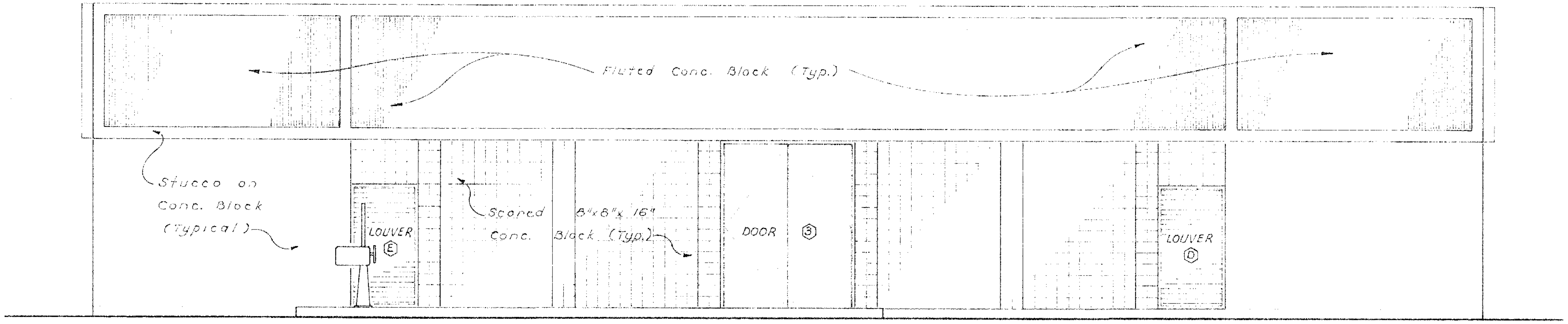
LOUVER Ⓓ to fit a 4'0" wide x 7'4" high rough masonry opening.

LOUVER Ⓔ same as Louver Ⓓ.

NOTE : All louvers shall have a dark bronze anodized finish , shall be of types and sizes shown , supplied with aluminum birdscreen in folded U aluminum frame , all anodized to match louver.

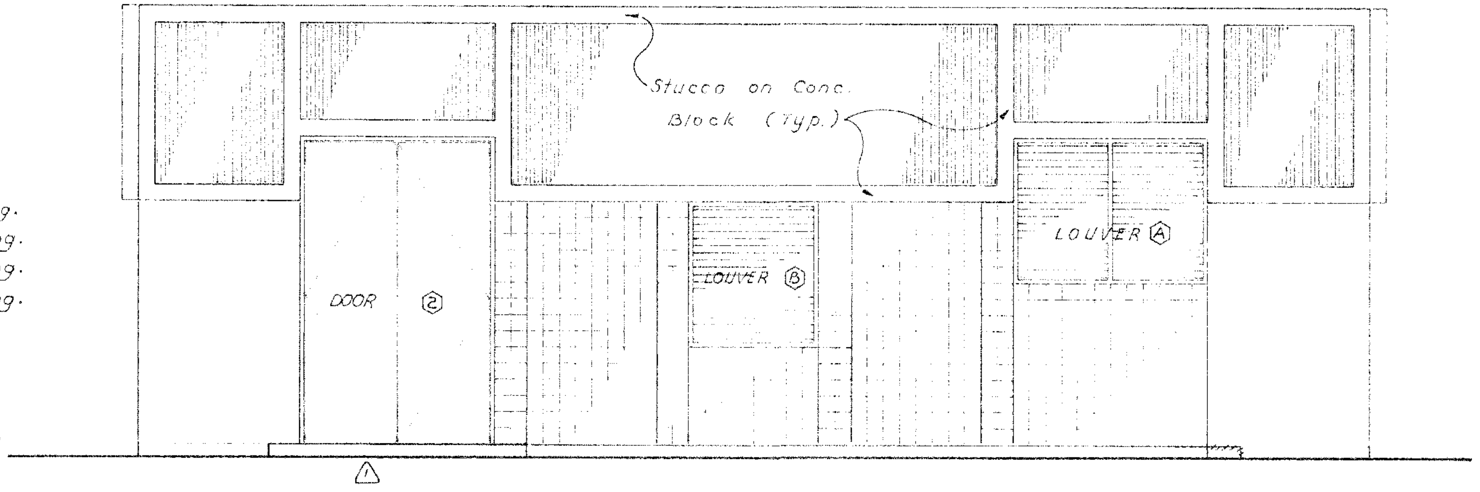
Louvers shall be 6" deep , with extruded aluminum blades Min. 0.081" thick , on 3½" cc , integral downspouts to drain off water.

Louvers shall pass 625 fpm face velocity with less than 0.15" pressure drop , and bear the AMCA Certified Ratings Seal.

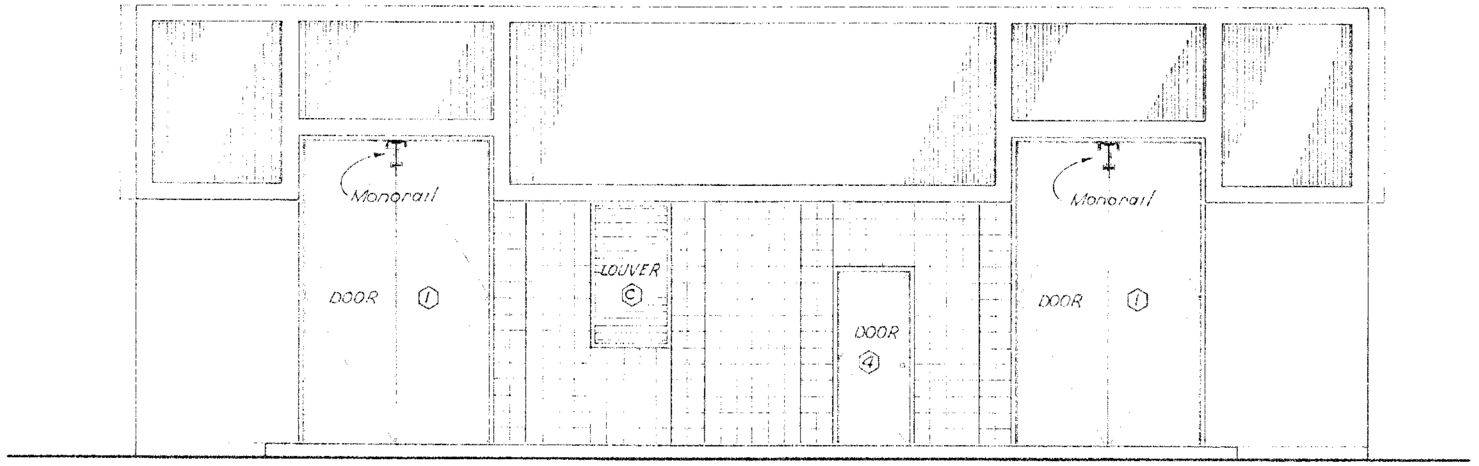


SOUTHEAST ELEVATION

(NORTHWEST ELEVATION SIMILAR)



NORTHEAST ELEVATION



SOUTHWEST ELEVATION

EXTERIOR COLOR SCHEDULE

FLUTED CONC. BLOCK ...... BASALT N-14
SCORED CONC. BLOCK ...... BASALT N-14
STUCCO ...... NAVAJO WHITE
LOUVERS ...... BRONZE ANODIZED
DOORS ...... BURNT ORANGE

THE CONTRACTOR SHALL SUBMIT FOR APPROVAL SAMPLES & COLORS OF ALL UNITS PROPOSED FOR THIS PUMP STATION.

Record Drawing

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(REVISED SET JUNE 2006)

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⚠1 RECORD DRAWING , JUNE 1982.

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APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: LLK LFI · Scale: 1/4"=1'-0" Des/Chkd by: DAB · Date: 8-77/9-79

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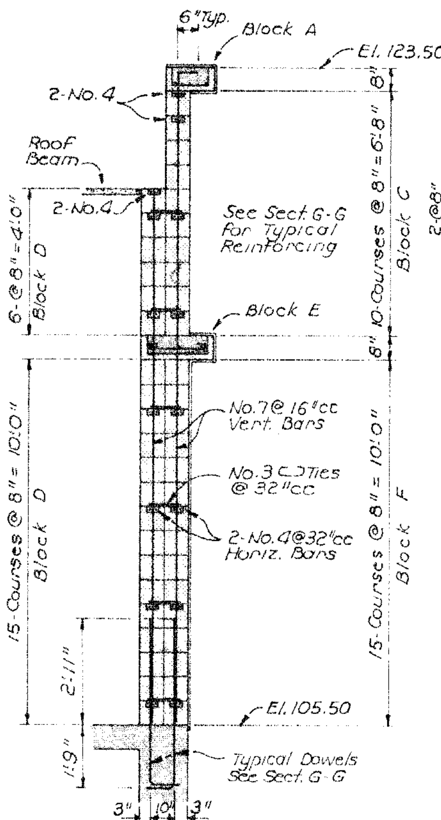
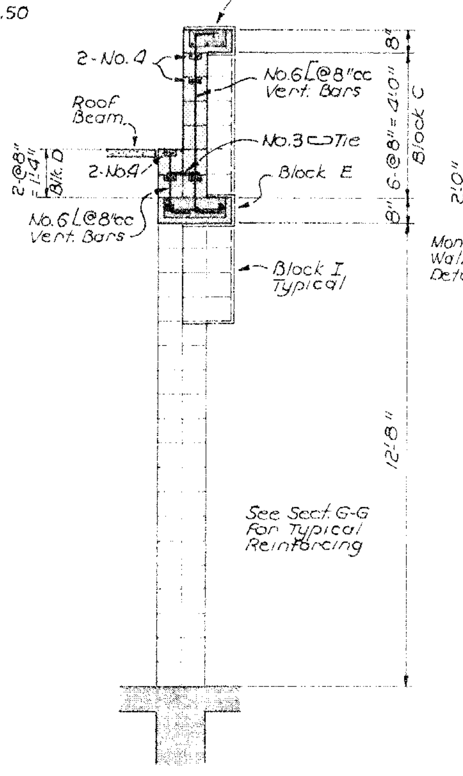
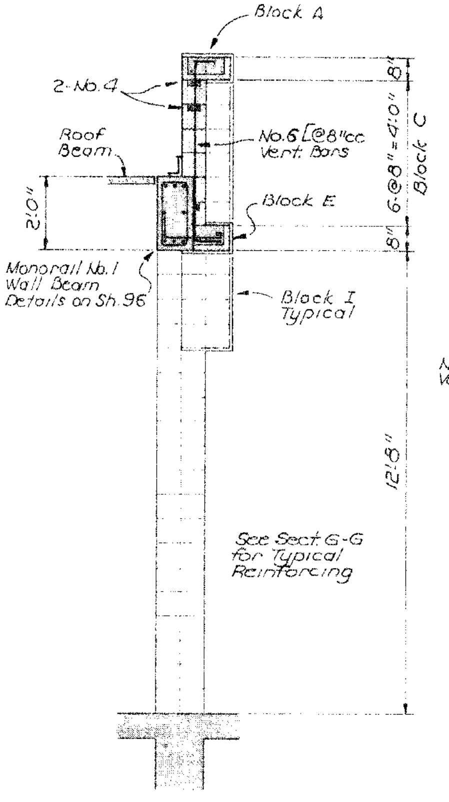


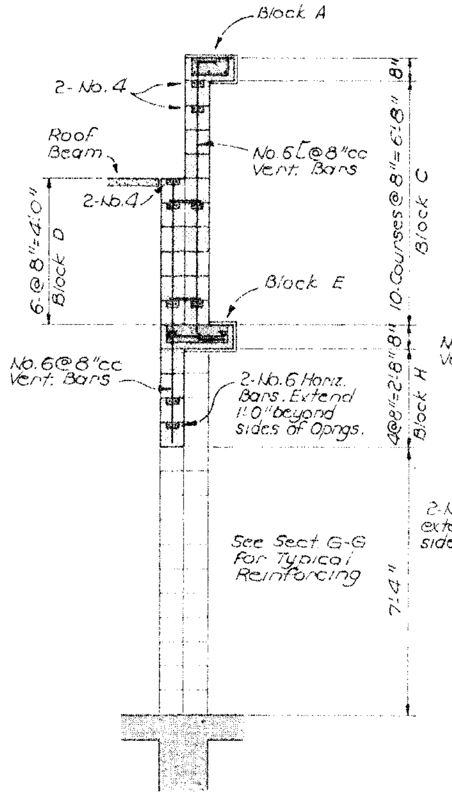
SECT. A-A



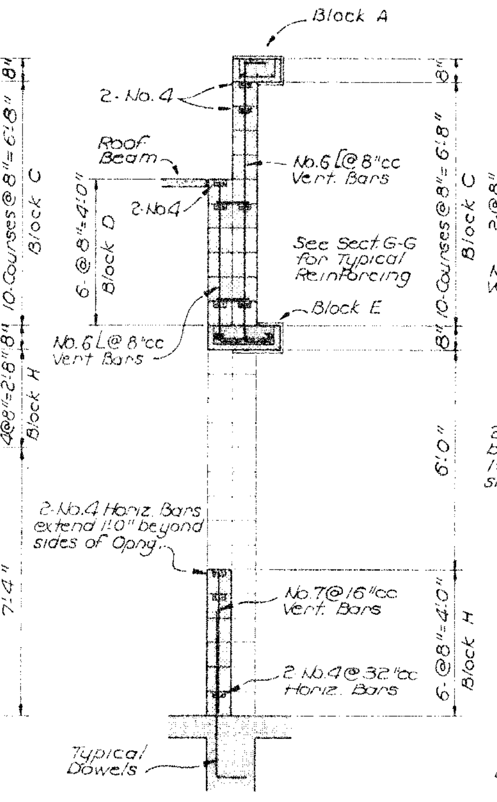
SECT. B-B



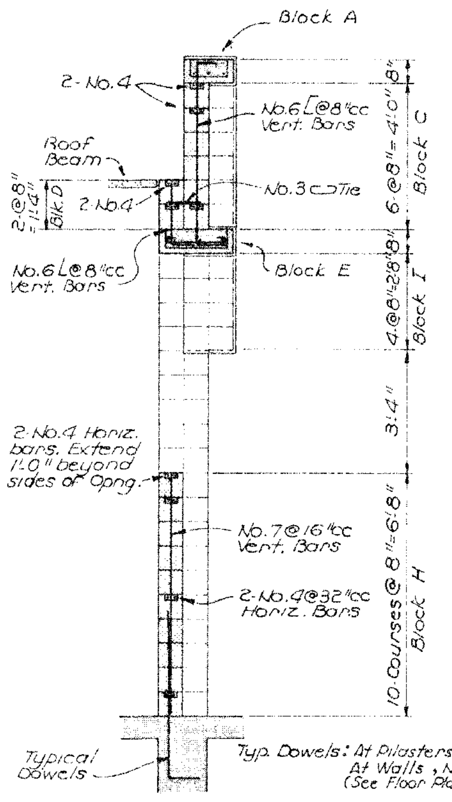
SECT. C-C



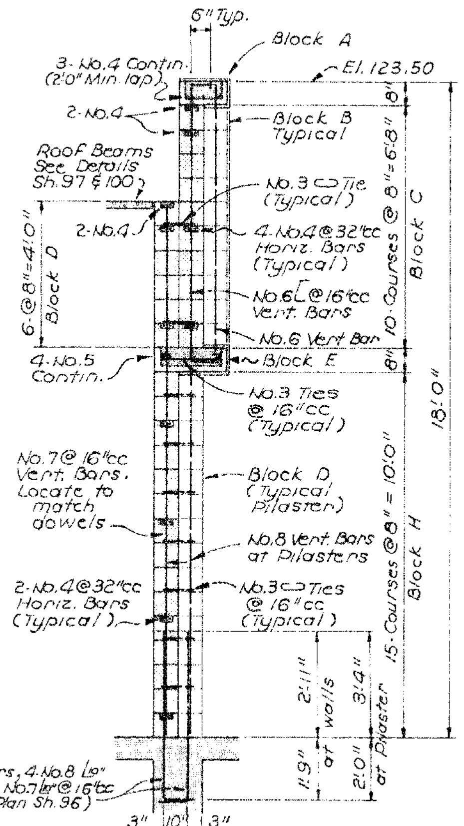
SECT. D-D



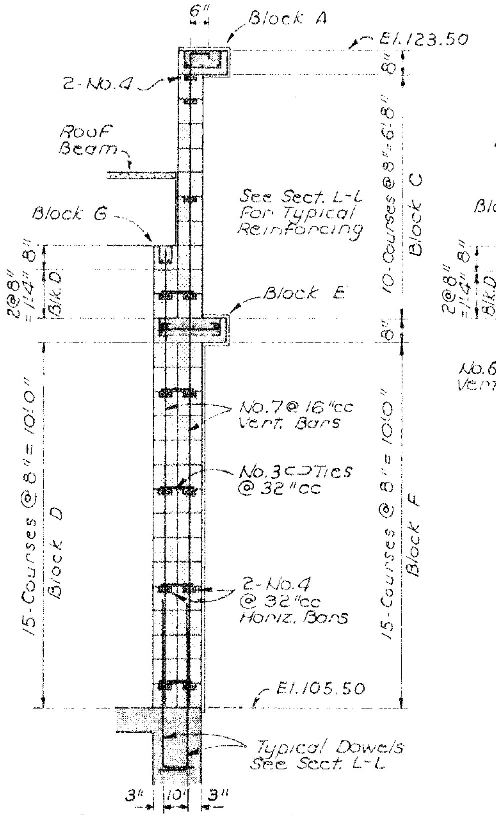
SECT. E-E



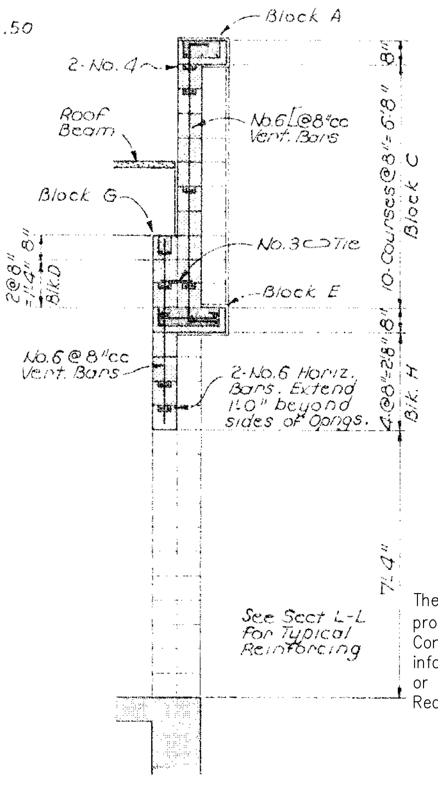
SECT. F-F



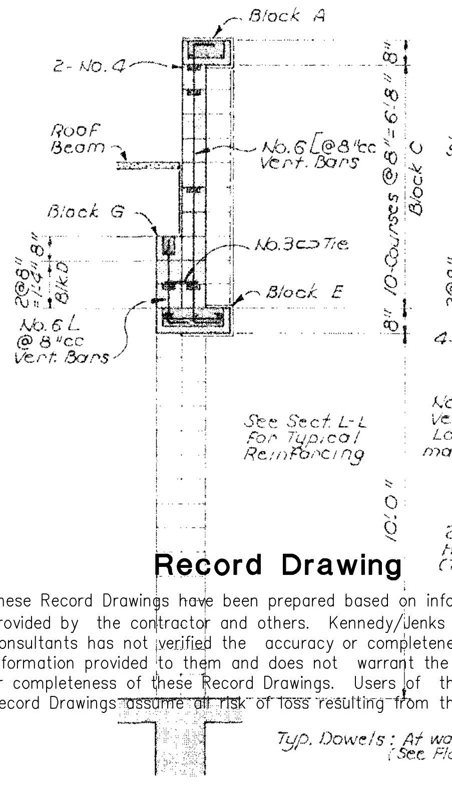
SECT. G-G



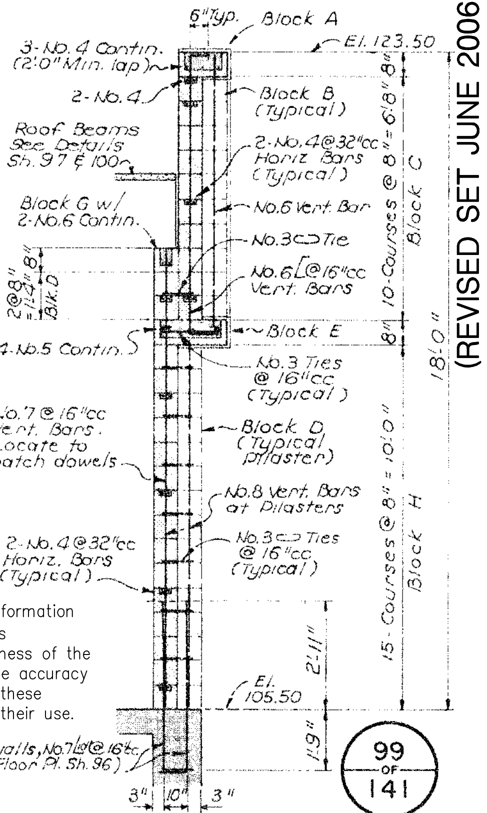
SECT. H-H



SECT. J-J



SECT. K-K



SECT. L-L

Record Drawing

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CONCRETE BLOCK WALL NOTES

CONCRETE BLOCK EXTERIOR WALLS

The exterior walls of the Superstructure of this Pump Station shall be 8" concrete block construction using hollow masonry units as shown at the right and listed below, laid in a "common bond" pattern and poured solid with grout. The 3/8" mortar joints shall have a tooled, concave, weathered finish. See Specifications for additional requirements.

CONCRETE BLOCK WALL REINFORCING

The typical reinforcing shall be as follows, except where otherwise noted or shown on the list below and/or the Sections at the right, and/or Plan Sheet 96.

VERTICAL — Poured concrete studs reinforced with 2-Reinf. bars at each corner, at the ends of walls or pilasters, at each side of each opening, & one bar at a maximum spacing of 16" cc between, except at 8"cc above all openings.

HORIZONTAL — Poured concrete in bond beam units reinforced with two No. 4 bars at the top of the wall, above and below louver openings, and at a maximum spacing of 32"cc.

LAPS — All bars shall be lapped 40 diameters minimum at splices and corners, unless otherwise noted or shown.

CONCRETE BLOCK LIST SEE SECTIONS AT RIGHT AND EXTERIOR ELEVATIONS, SH. 98.

BLOCK "A" — 8"x8"x16" open center pilaster alternate masonry units. Reinforce with 3-No.4 continuous bars as shown at right and coat exterior surfaces (3 faces) with exterior cement plaster. The unsupported exposed portion of each block shall be anchored to the reinforcing steel using approved metal ties.

BLOCK "B" — 8"x8"x16" hollow masonry units. Reinforce with 1-No.6 vertical bar as shown at right and coat exterior surfaces (3 faces) with exterior cement plaster.

BLOCK "C" — 8"x8"x16" hollow masonry units with a split face / 4 flute exterior surface design. Reinforce with No.6 vertical bars to match typical wall reinforcing and 2-No.4 horizontal bars in bond beam units @ 32"cc as shown at right. See Roof Plan Sh. 97 and Roof Details Sh. 100 for required anchors cast in the block wall.

BLOCK "D" — 8"x8"x16" hollow masonry units with typical wall reinforcing and details. Tie to Block "C" & Block "I" Vert. bars with No.3 ⊂⊃ ties, located as shown at the right. Also used as Pilaster block w/ No.8 Vert. bars & No.3 ⊂⊃ ties.

BLOCK "E" — 8"x8"x24" open center pilaster alternate masonry unit. Reinforce with 4-No.5 continuous bars and No.3 ⊂⊃ ties @ 16"cc as shown at right and coat exterior surfaces (3 faces) with exterior cement plaster. Unsupported exposed portions of each block shall be anchored to the reinforcing steel using approved metal ties.

BLOCK "F" — 8"x8"x16" hollow masonry units with typical wall reinforcing. Coat exterior surface with exterior cement plaster. These blocks are located in each corner of the building extending 6'-8" on the Northeast & Southwest walls, & 15'-4" on the Southeast & Northwest walls.

BLOCK "G" — 8"x8"x8" U-Beam masonry units. Reinforce with 2-No. 6 bars, See Details Sheet 100 for required steel plate and anchor cast in block wall.

BLOCK "H" — 8"x8"x16" hollow masonry units with the exterior face center scored to produce an 8" square pattern. Reinforce with typical wall reinforcing.

BLOCK "I" — 8"x8"x24" (or from standard 8" units in common bond pattern) hollow masonry units. Reinforce exterior cells with 1-No.6 vertical bar and No.3 ⊂⊃ ties @ 16"cc.

EXTERIOR CEMENT PLASTER

The exterior cement plaster (on the exterior masonry walls) shall be a ½" minimum thickness cement plaster applied in two coats in accordance with Section 4708 of the 1976 Uniform Building Code. The texture and color of the finish coat shall be as directed by the ENGINEER.

CONCRETE MASONRY NOTES

1. All masonry units shall conform to ASTM Designation C 90 and shall have a minimum ultimate compressive strength of 2500 psi.
2. All mortar and grout shall have a 28 day minimum compressive strength of 2500 psi.
3. All masonry work, including grouting, shall conform to the 1976 Edition of the Uniform Building Code.

RECORD DRAWING, JUNE 1982.

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APPROVED MENLO PARK S.D. DATE	Drawn by: LLK LFI — Scale: 3/8"=1'-0" Des/Chkd by: DAB — Date: 8-77 / 9-79

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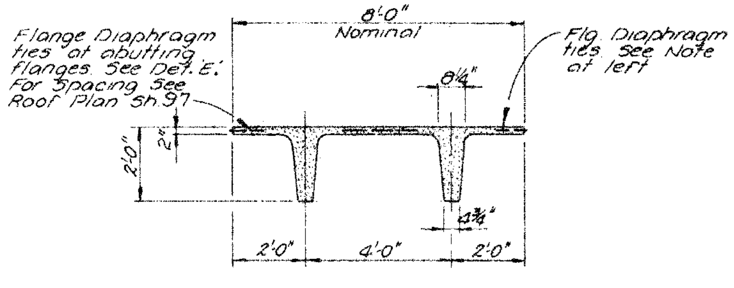
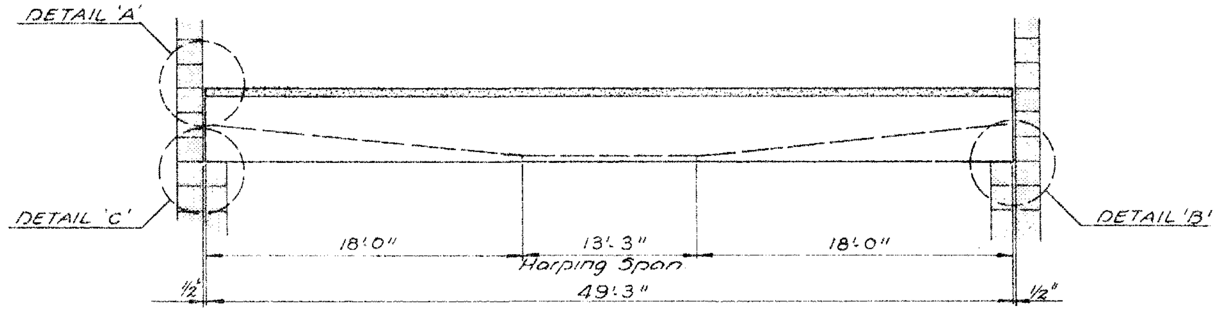
Record Drawing



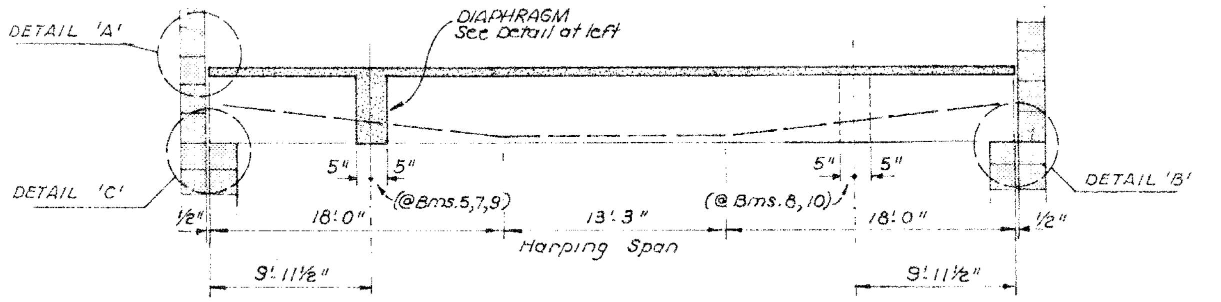
DOUBLE 'T'

TYPICAL ROOF BEAM SECTION

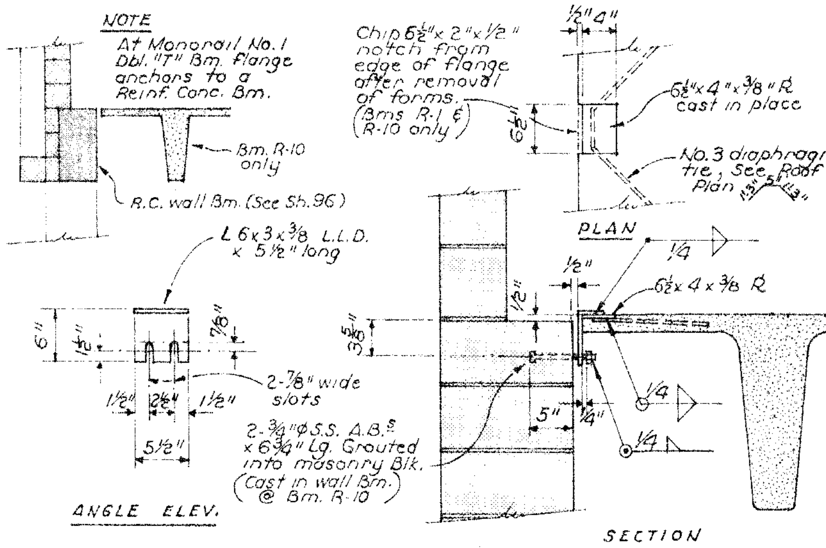
Scale ⅜" = 1'-0"



RF. BMS. R-1, R-2, R-3, R-4, R-6

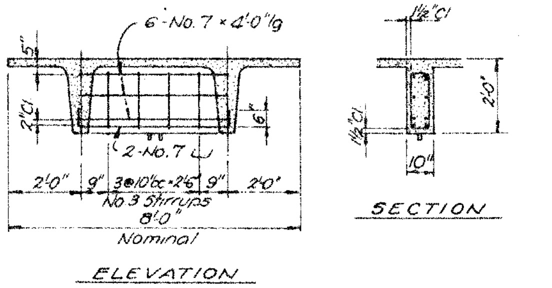


ROOF BEAMS R-5, R-7, R-9 R-8, R-10



DETAIL "D"

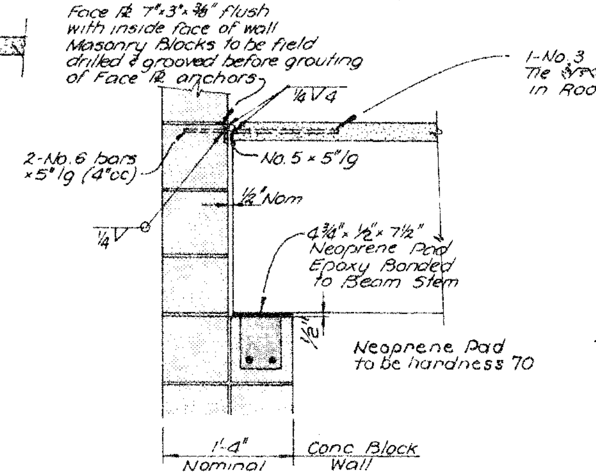
Scale: 1" = 1'-0"



DIAPHRAGM

(SEE NOTE 3)

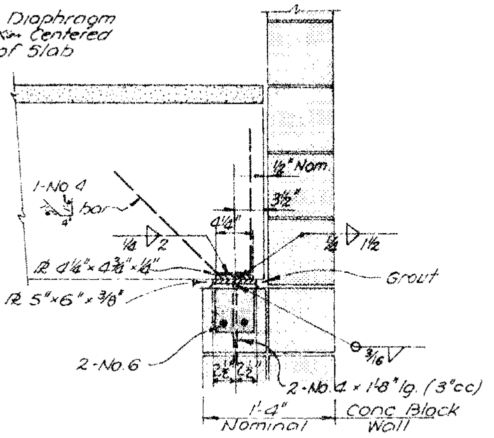
Scale ⅜" = 1'-0"



DETAIL 'A' (TOP)

DETAIL 'C' (BOTTOM)

Scale 1" = 1'-0"

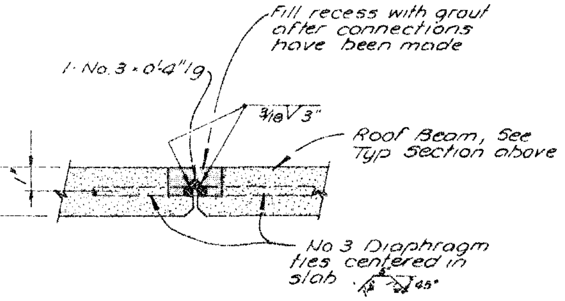


DETAIL 'B'

Scale 1" = 1'-0"

BEAM	BEAM D.L.	S.D.L.	U.L.L.	MONORAIL EQUIV. U.L.L.	CAMBER
R-1	46 psf	13 psf	16 psf	—	0.43"
R-2	"	14 psf	"	—	0.44"
R-3	"	12 psf	"	—	0.41"
R-4	"	"	"	—	0.41"
R-5	47 psf*	11 psf	"	64 psf	1.34"
R-6	46 psf	"	"	—	0.40"
R-7	47 psf*	10 psf	"	64 psf	1.32"
R-8	47 psf*	"	"	27 psf	0.78"
R-9	47 psf*	"	"	64 psf	1.32"
R-10	47 psf*	"	"	27 psf	0.78"

*Includes Equiv. uniform D.L. of diaphragms



FLG. DIAPH. TIE CONNECTION

DETAIL 'E'

Scale 3" = 1'-0"

NOTES

1. All harping spans shown may be varied by the manufacturer to control camber and/or concrete stresses.
2. The values given for cambers are those required to offset the deflections resulting from superimposed dead and live loads. The Engineer should be notified for cases where the final camber, resulting from initial prestress, exceeds the given values by greater than 35%.
3. For location and details of Monorail anchors at Diaphragm, see Sh. 74.

(REVISED SET JUNE 2006)

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RECORD DRAWING, JUNE 1982

SUBMITTED
JENKS & HARRISON DATE
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CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: LFI
Scale: AS NOTED
Des/Chkd by: DAB
Date: 8-77 / 9-79

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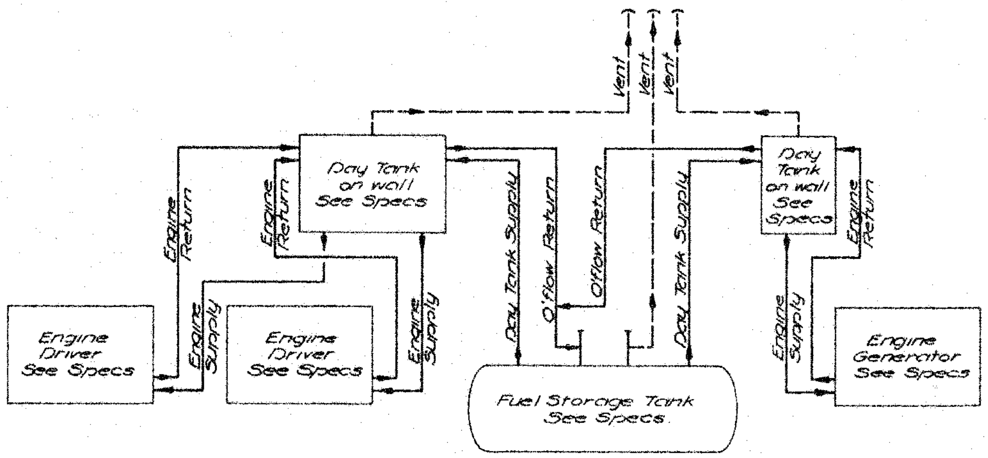
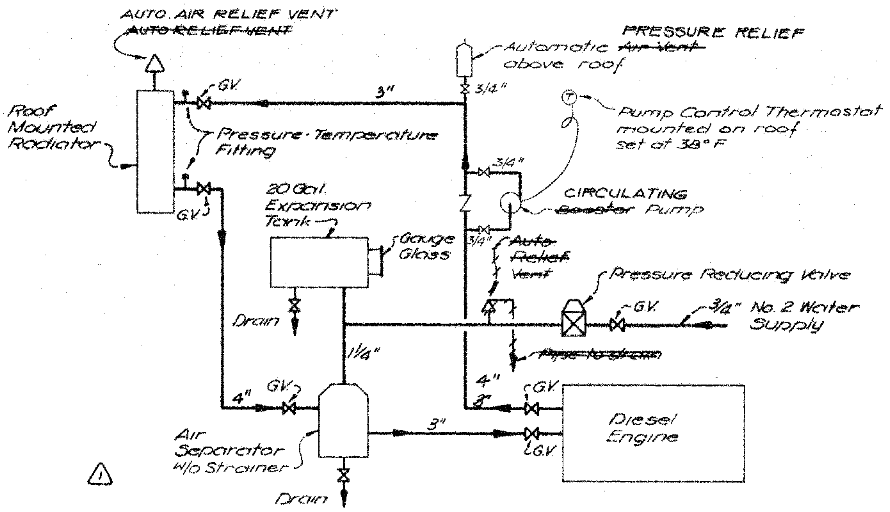


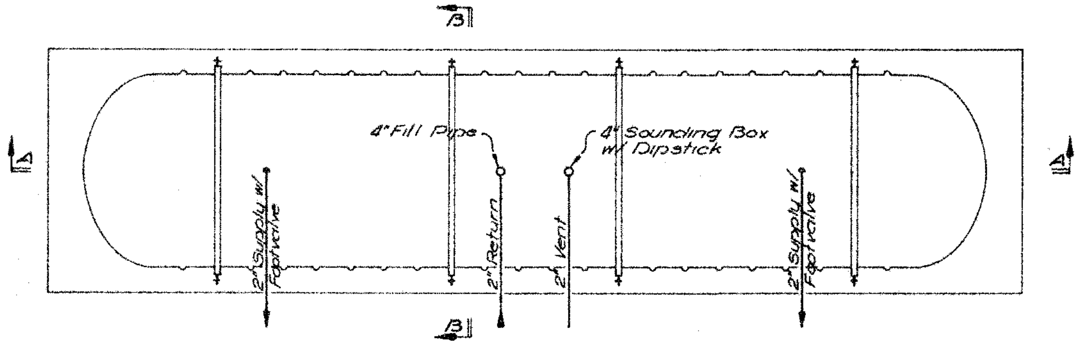
DIESEL FUEL SYSTEM DIAGRAM

No Scale

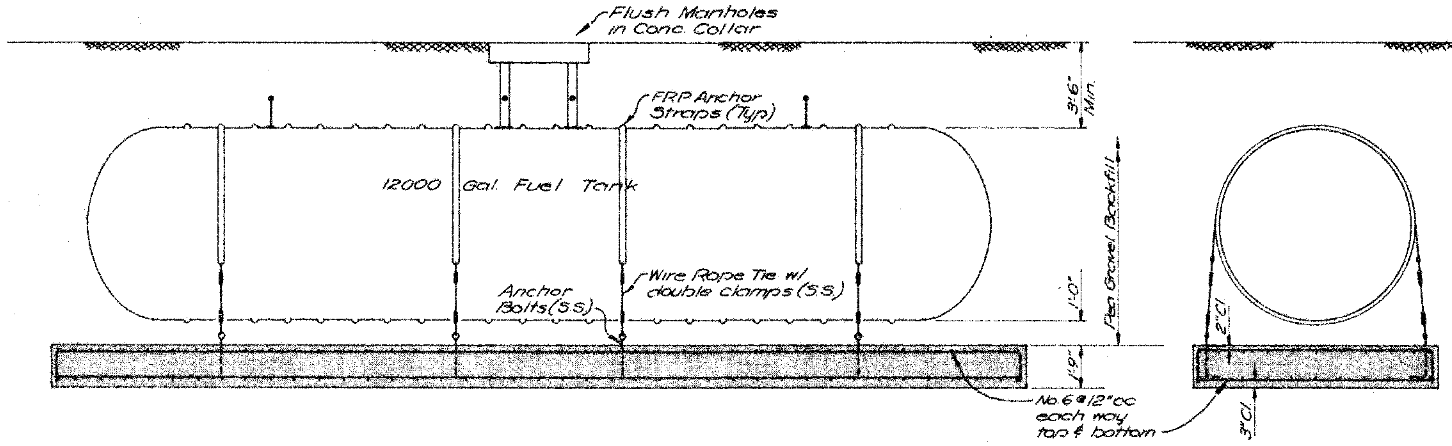


TYPICAL ENGINE COOLING SYSTEM DIAGRAM

No Scale



PLAN

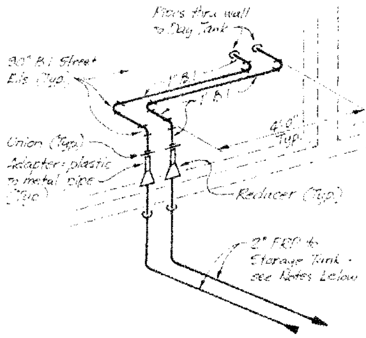


SECTION A-A

SECTION B-B

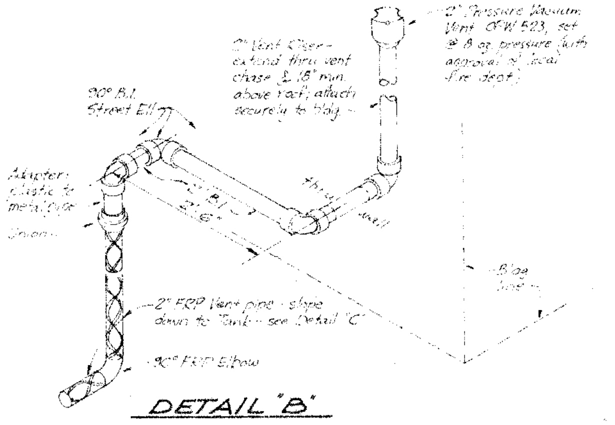
DIESEL FUEL STORAGE TANK

Scale ¼" = 1'-0"



DETAIL "A"

SWING JOINT DIAGRAM



DETAIL "B"

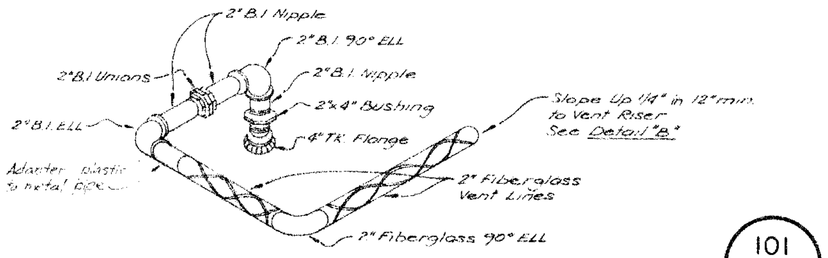
VENT RISER ASSEMBLY

NOTES

1. All diesel fuel piping shall be either Standard Schedule 40 Black Iron Pipe or Fiberglass Pipe as delineated on this drawing. Black Iron Pipe shall be used for diesel fuel inside of the Pump Station Structure and Fiberglass Pipe shall be used for diesel fuel in the ground all as detailed on this drawing. Where black iron pipe and fittings are installed under the ground; they shall be plastic coated. Uncoated Black Iron Pipe and Fittings shall not be exposed to the soil.

2. Install swing joints at all locations in the fuel piping system where horizontal pipe runs change to vertical pipe runs and where pipe runs enter the structure as detailed on this drawing.

3. Keep all fuel system lines to a minimum height at the Storage Tank to permit maximum slope to the Tank.



DETAIL "C"

VENT ASSEMBLY

Record Drawing

(REVISED SET JUNE 2006)

⚠ RECORD DRAWING, JUNE 1982

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
DIESEL ENGINE AND FUEL SYSTEM
MISCELLANEOUS DETAILS

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

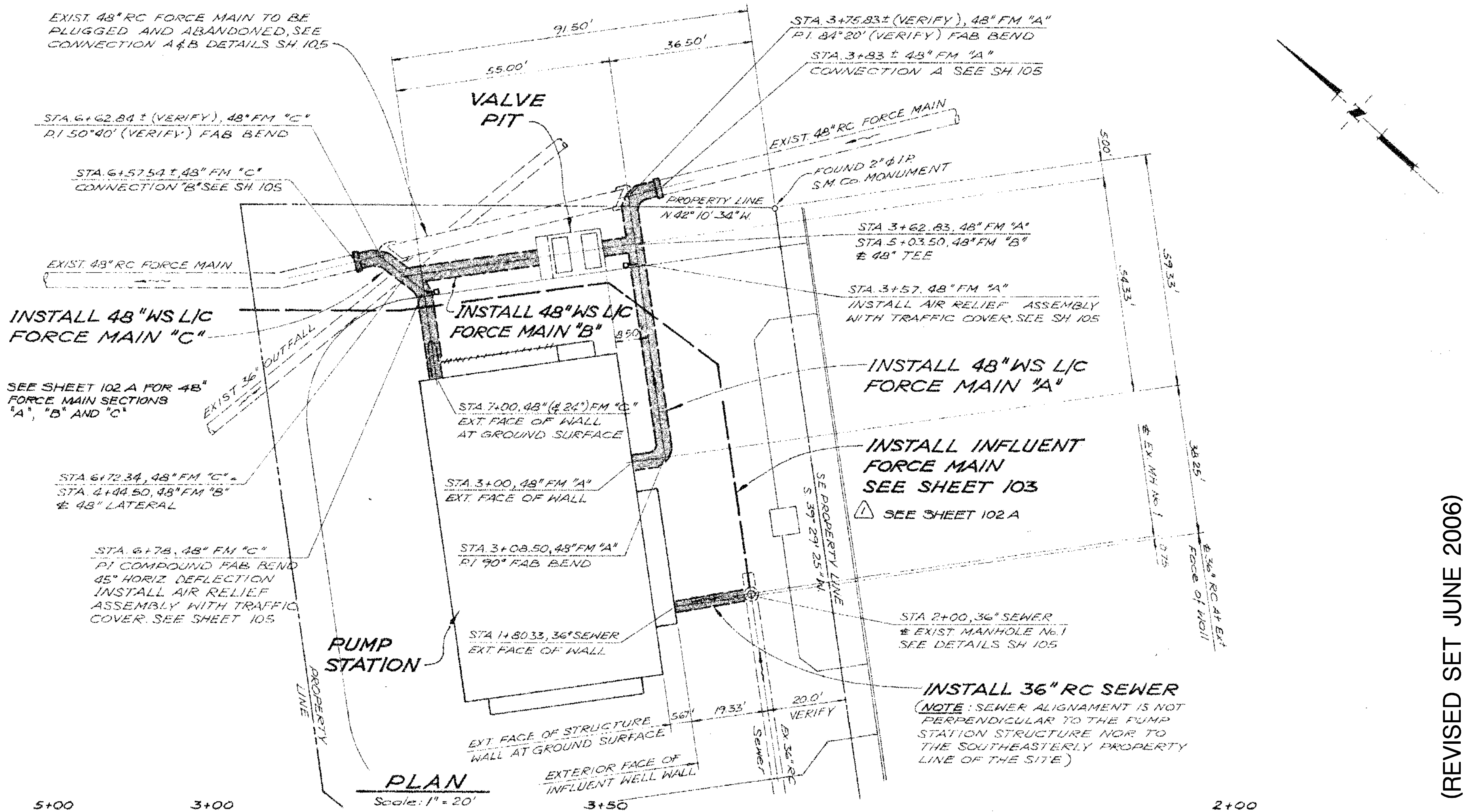
Drawn by: LLK CGS
Scale: AS NOTED
Des/Chkd by: DAB
Date: 8-77/9-79

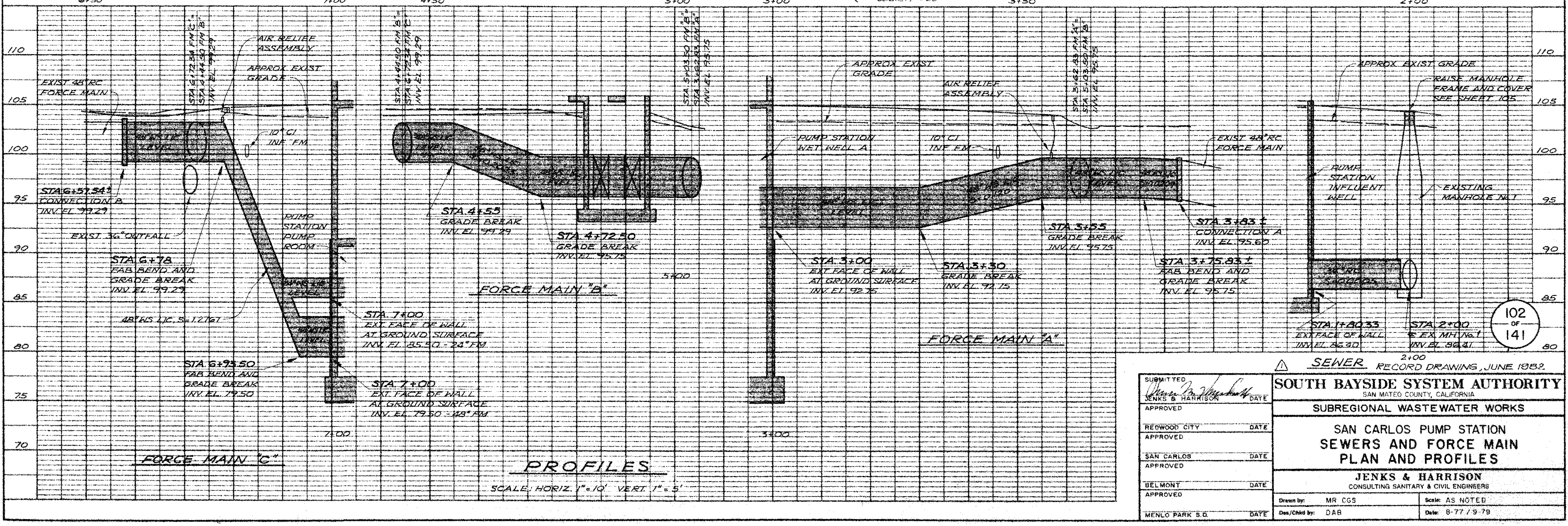
NOTES

1. THE SEWER AND FORCE MAIN CONSTRUCTION SCHEDULE AND TIE-IN SHALL CONFORM TO THE REQUIREMENTS DESCRIBED IN SECTION B OF THE SPECIFICATIONS.
2. THE FORCE MAIN LOCATION CONTROL LINES ARE PARALLEL AND/OR PERPENDICULAR TO THE SOUTHEASTERLY PROPERTY LINE OF THE SITE
3. THE CONTRACTOR'S ATTENTION IS DIRECTED TO THE SAN CARLOS PUMP STATION PIPEWORK AND EQUIPMENT DRAWINGS SHEETS 64 TO 75 FOR ADDITIONAL REQUIREMENTS AND DETAILS FOR THE SEWERS AND FORCE MAINS SHOWN ON THIS DRAWING. ALL NEW FORCE MAIN PIPE JOINTS AND CONNECTIONS (EXCEPT CONNECTIONS A ⊄ B) SHALL INCLUDE TENSION ANCHORS AS DETAILED ON SHEET 75.
4. THE CONTRACTOR SHALL UNCOVER AND EXPOSE THE EXISTING FORCE MAIN AND OUTFALL IN THE AREA OF THIS WORK AND SHALL THEN LAY OUT THE PUMP STATION FORCE MAIN IN THE FIELD TO ACCURATELY DETERMINE THE REQUIRED PIPING LENGTHS, ELEVATIONS AND DEFLECTIONS. THE CONTRACTOR SHALL COMPLETE THIS LAYOUT WORK AND SHALL SUBMIT IT FOR APPROVAL PRIOR TO THE FABRICATION OF THIS PIPEWORK.

Record Drawing

These Record Drawings have been prepared based on information provided by the contractor and others. Kennedy/Jenks Consultants has not verified the accuracy or completeness of the information provided to them and does not warrant the accuracy or completeness of these Record Drawings. Users of these Record Drawings assume all risk of loss resulting from their use.





(REVISED SET JUNE 2006)

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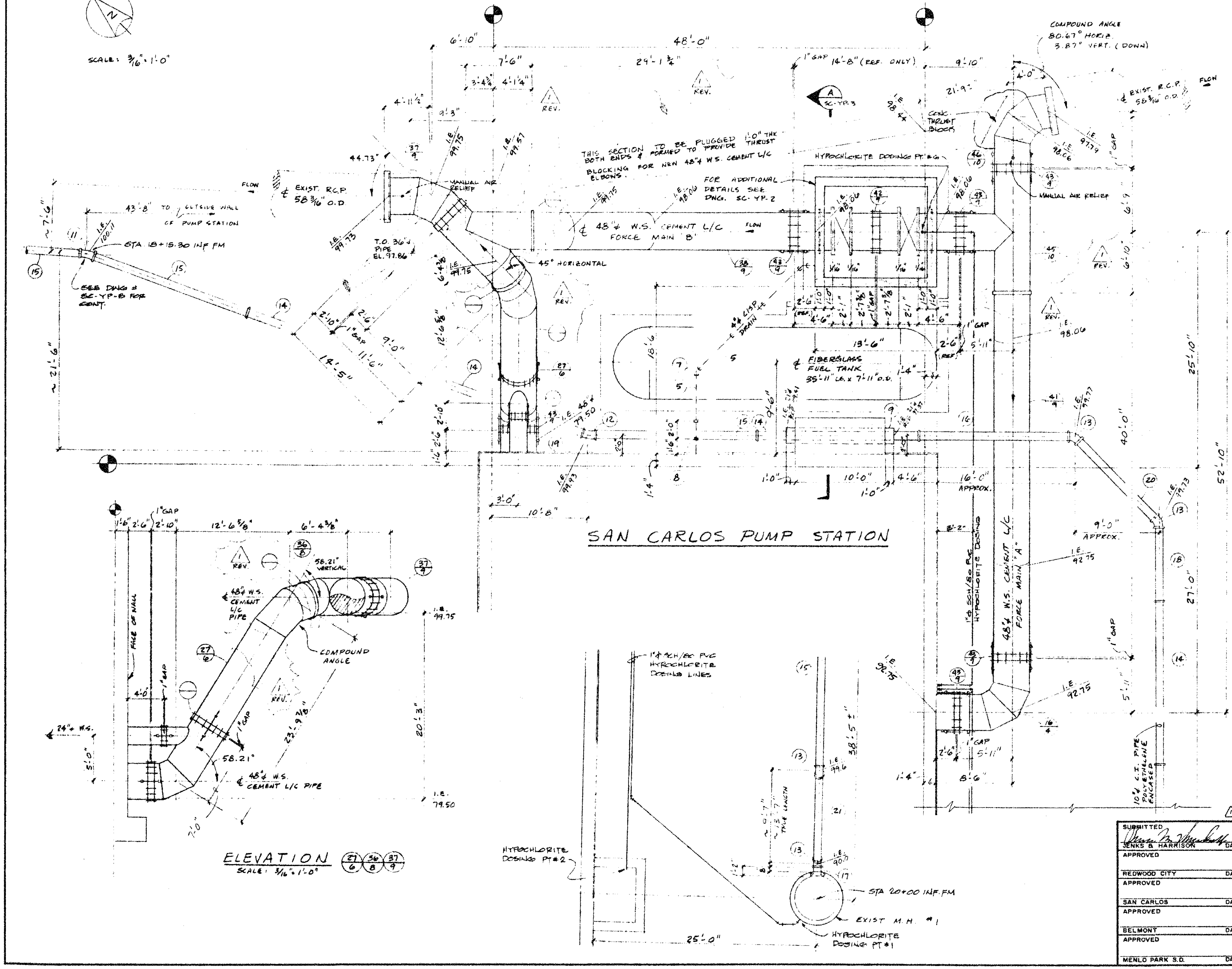
⚠ SEWER 2+00 RECORD DRAWING, JUNE 1982

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION SEWERS AND FORCE MAIN PLAN AND PROFILES
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: MR CGS — Scale: AS NOTED Des/Chkd by: DAB — Date: 8-77 / 9-79



Record Drawing

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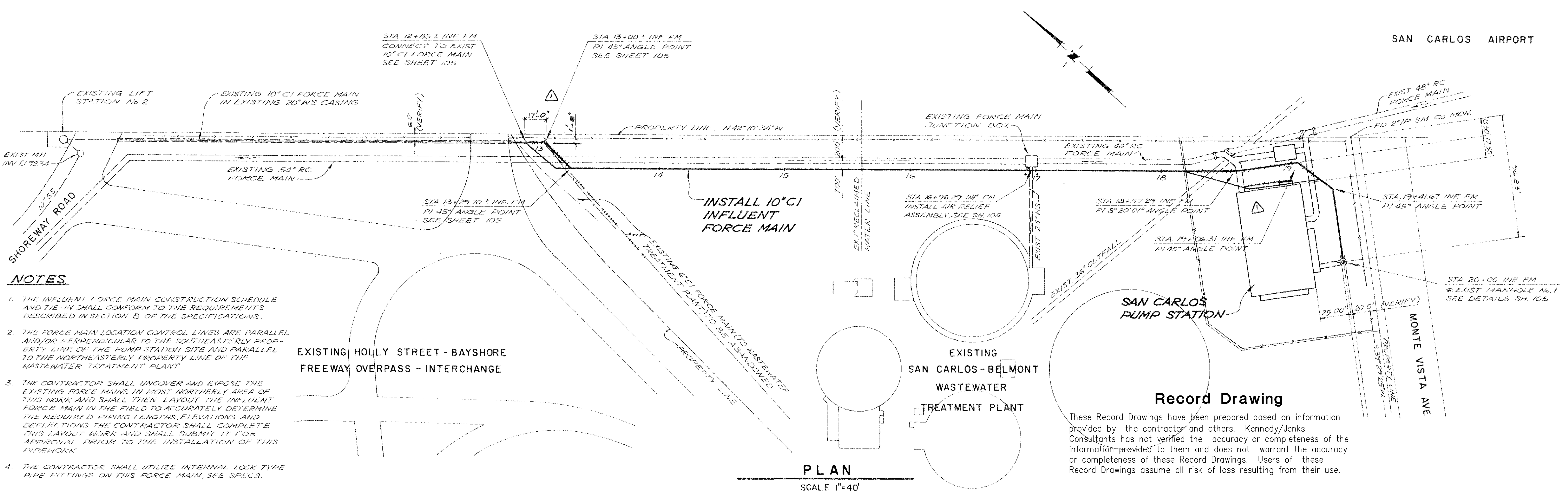
(REVISED SET JUNE 2006)

⚠ NOTE:

1. I.E. = INVERT ELEVATION
2. ALL FLANGE BOLT HOLES TO STRADDLE VERT. & HORIZ. CENTERLINES

⚠ RECORD DRAWING, JUNE 1982

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION SEWERS AND FORCE MAIN PLAN AND PROFILES
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: MR CGS Scale: AS NOTED Des/Chkd by: DAB Date: 8-77 / 9-79



NOTES

1. THE INFLUENT FORCE MAIN CONSTRUCTION SCHEDULE AND TIE-IN SHALL CONFORM TO THE REQUIREMENTS DESCRIBED IN SECTION B OF THE SPECIFICATIONS.
2. THE FORCE MAIN LOCATION CONTROL LINES ARE PARALLEL AND/OR PERPENDICULAR TO THE SOUTHEASTERLY PROPERTY LINE OF THE PUMP STATION SITE AND PARALLEL TO THE NORTHEASTERLY PROPERTY LINE OF THE WASTEWATER TREATMENT PLANT.
3. THE CONTRACTOR SHALL UNCOVER AND EXPOSE THE EXISTING FORCE MAINS IN MOST NORTHERLY AREA OF THIS WORK AND SHALL THEN LAYOUT THE INFLUENT FORCE MAIN IN THE FIELD TO ACCURATELY DETERMINE THE REQUIRED PIPING LENGTHS, ELEVATIONS AND DEFLECTIONS THE CONTRACTOR SHALL COMPLETE THIS LAYOUT WORK AND SHALL SUBMIT IT FOR APPROVAL PRIOR TO THE INSTALLATION OF THIS PIPEWORK
4. THE CONTRACTOR SHALL UTILIZE INTERNAL LOCK TYPE PIPE FITTINGS ON THIS FORCE MAIN, SEE SPECS.

PLAN
SCALE 1"=40'

Record Drawing

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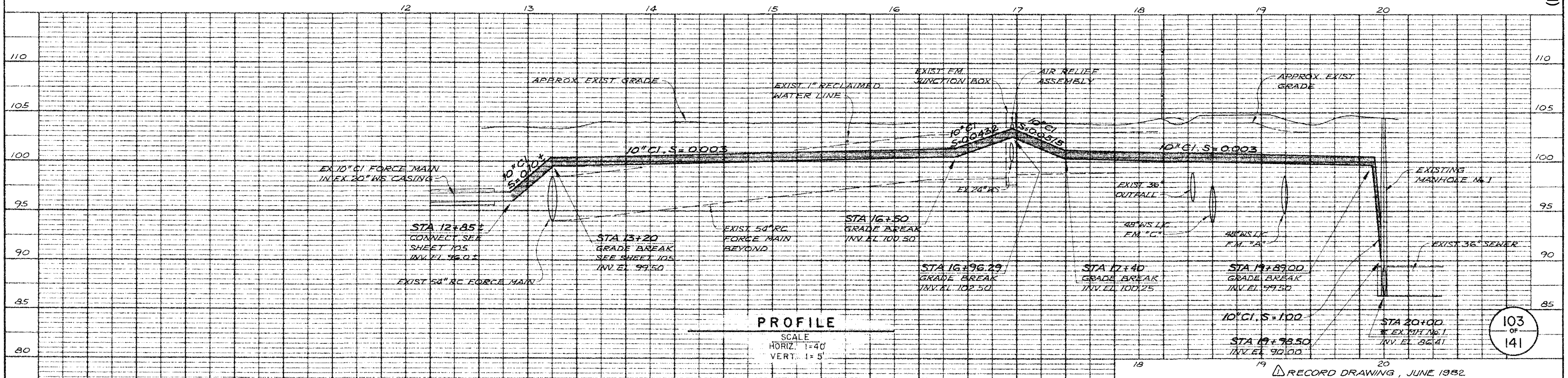
(REVISED SET JUNE 2006)



PROFILE
SCALE
HORIZ. 1"=40'
VERT. 1"=5'

103
OF
141

⚠ RECORD DRAWING, JUNE 1982.

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
INFLUENT FORCE MAIN
PLAN AND PROFILE

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: MR CGS
Scale: AS NOTED
Des/Chkd by: DAB
Date: 8-77 / 9-79

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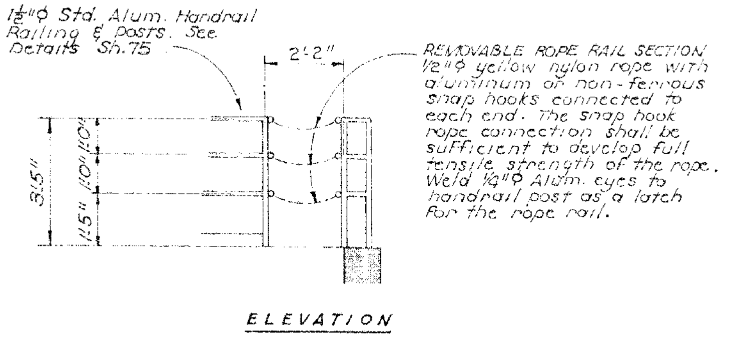
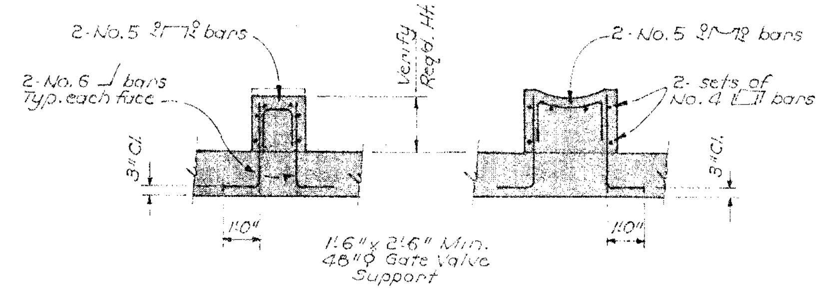


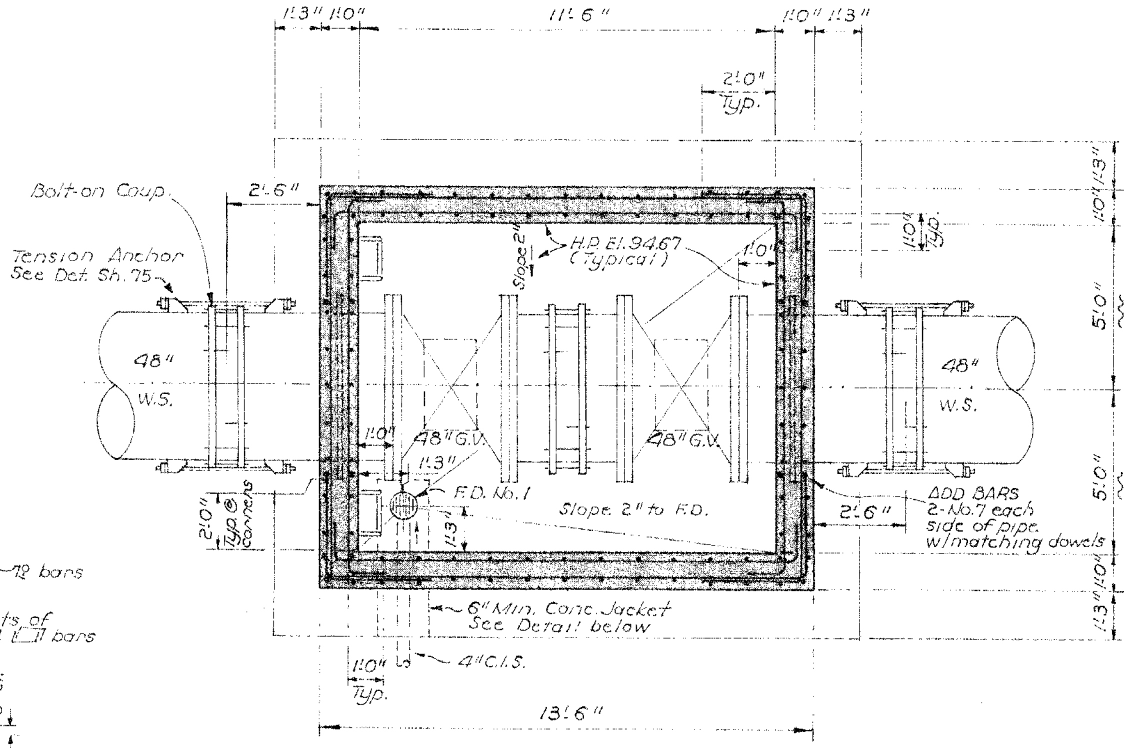
ELEVATION

REMOVABLE ROPE RAIL DETAIL

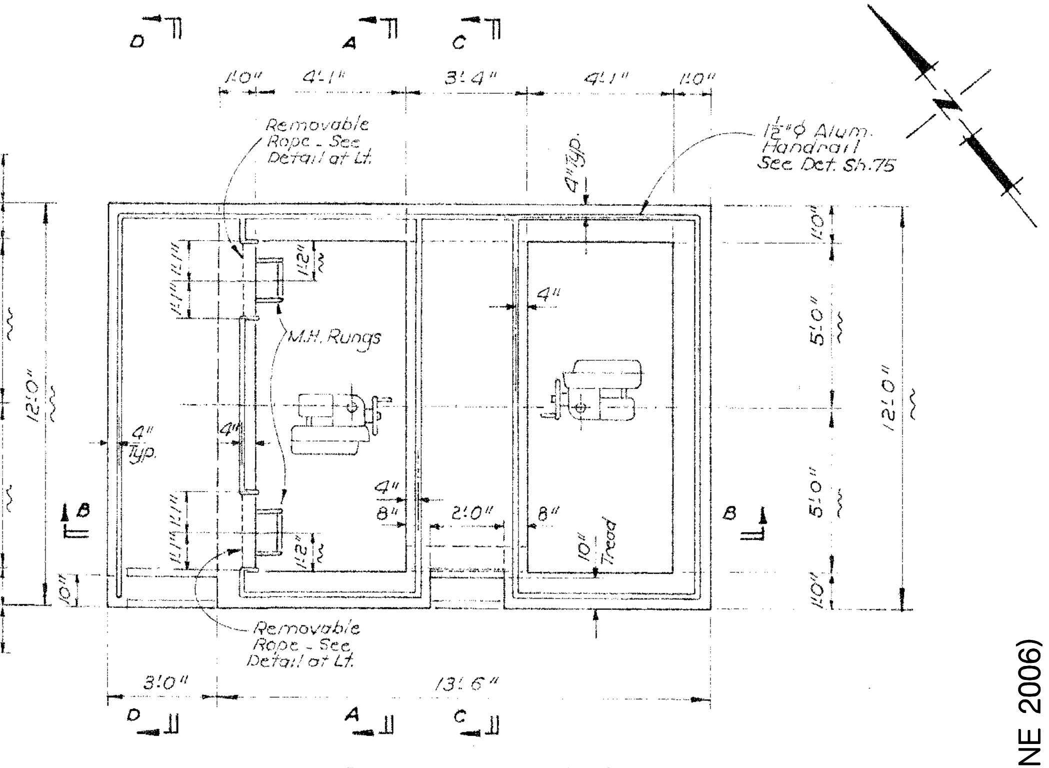


TYPICAL SECTIONS

48"ϕ GATE VALVE SUPPORT DETAILS

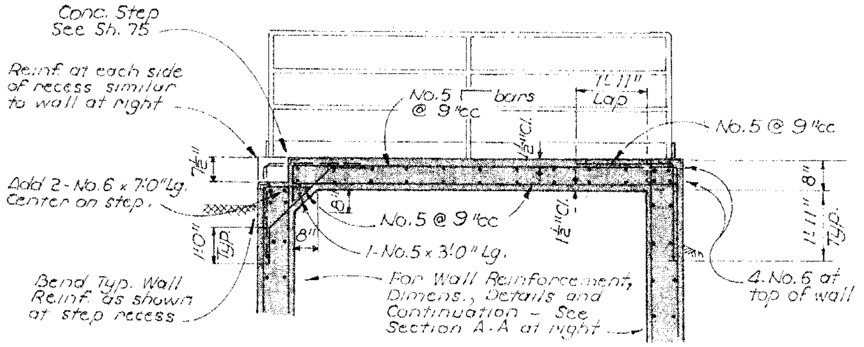


SECTIONAL PLAN

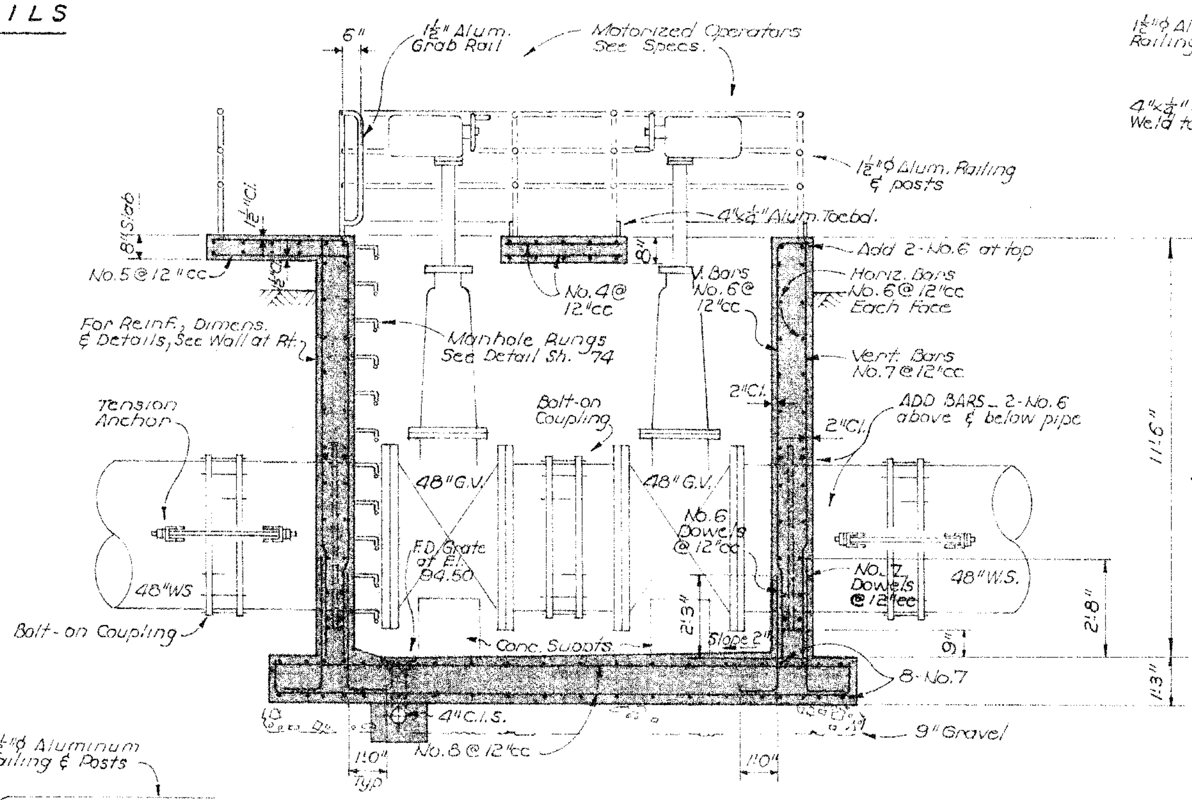


DECK PLAN

(REVISED SET JUNE 2006)

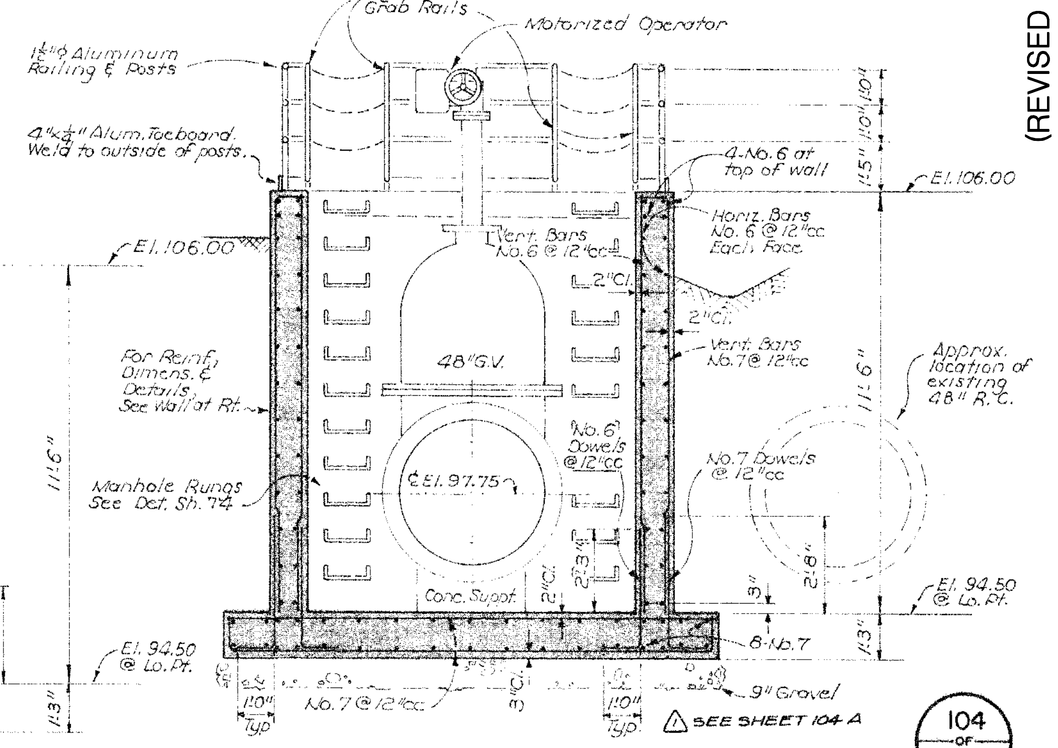


SECTION C – C



SECTION B – B

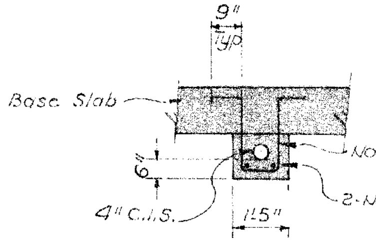
⚠ SEE SHEET 104-A



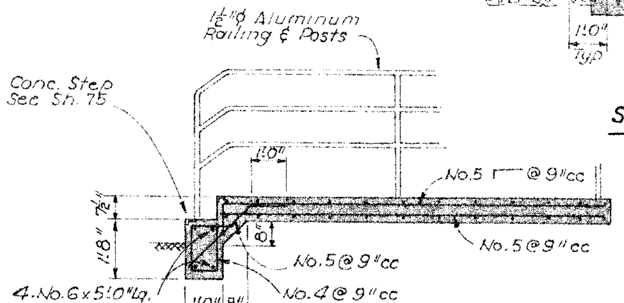
SECTION A – A

⚠ SEE SHEET 104-A

104 of 141



CONCRETE JACKET DETAIL



SECTION D – D

⚠ RECORD DRAWING, JUNE 1982

Record Drawing

These Record Drawings have been prepared based on information provided by the contractor and others. Kennedy/Jenks Consultants has not verified the accuracy or completeness of the information provided to them and does not warrant the accuracy or completeness of these Record Drawings. Users of these Record Drawings assume all risk of loss resulting from their use.

SUBMITTED
JENKS & HARRISON — DATE
APPROVED
REDWOOD CITY — DATE
APPROVED
SAN CARLOS — DATE
APPROVED
BELMONT — DATE
APPROVED
MENLO PARK S.D. — DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
VALVE PIT
PLANS, SECTIONS AND DETAILS

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by:	LFI	Scale:	3/8"=1'-0"
Des/Chkd by:	DAB	Date:	8-77 / 9-79

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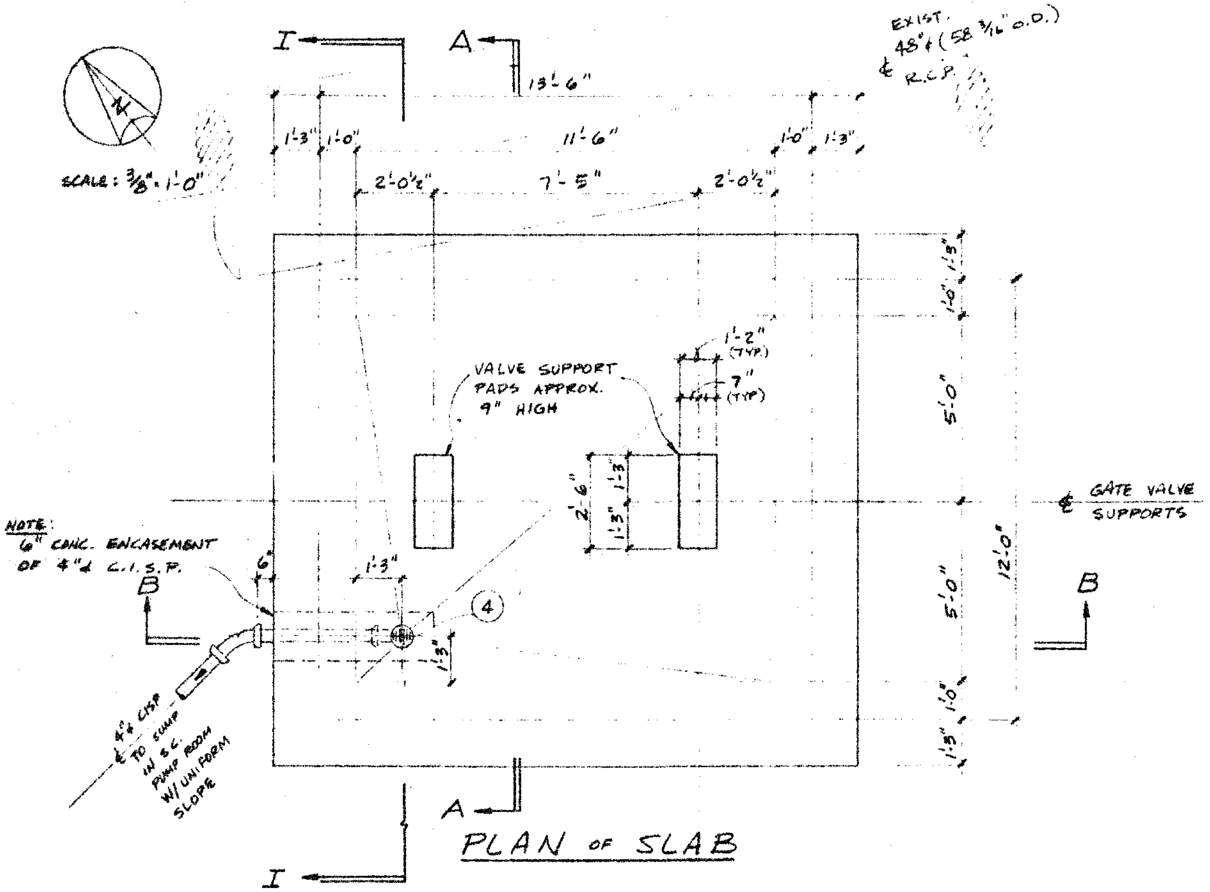
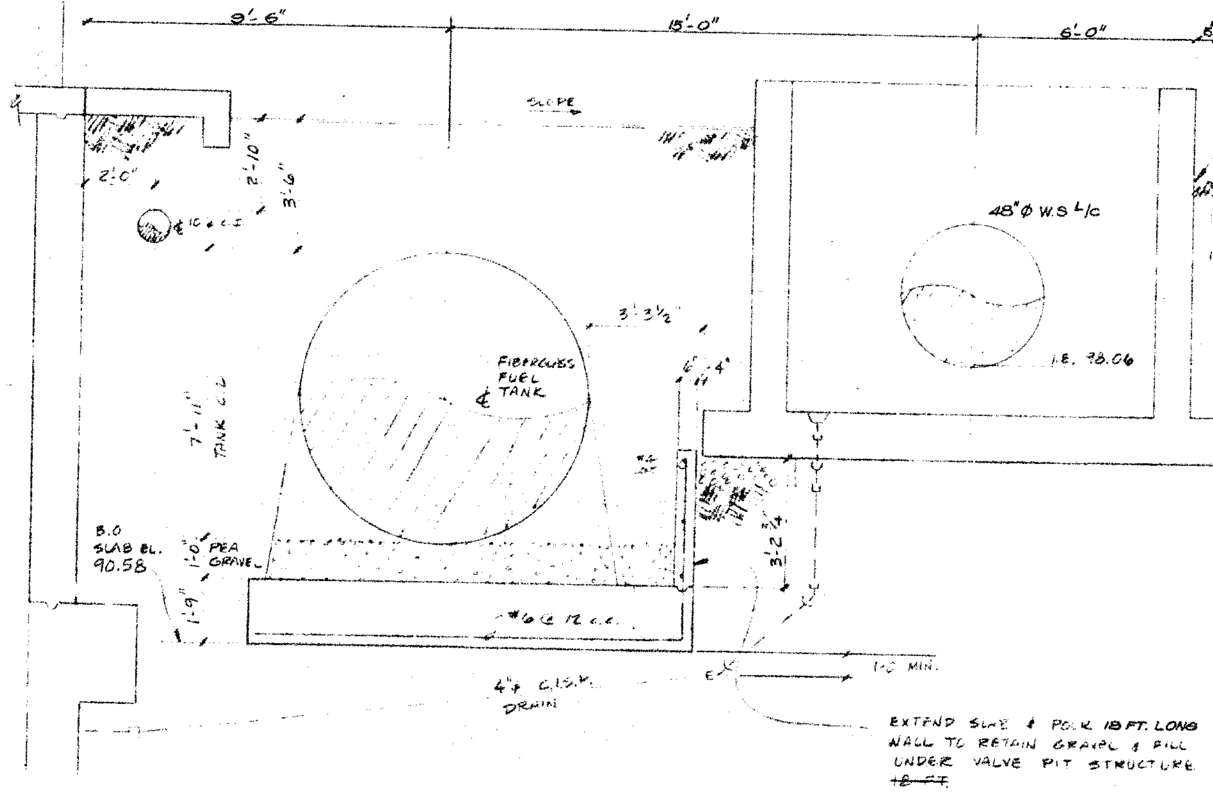
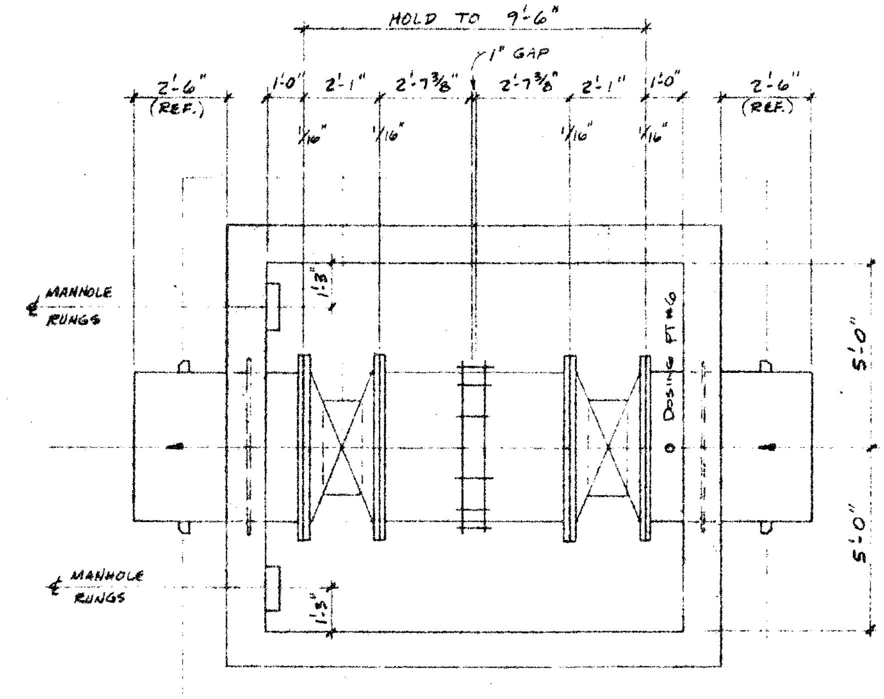


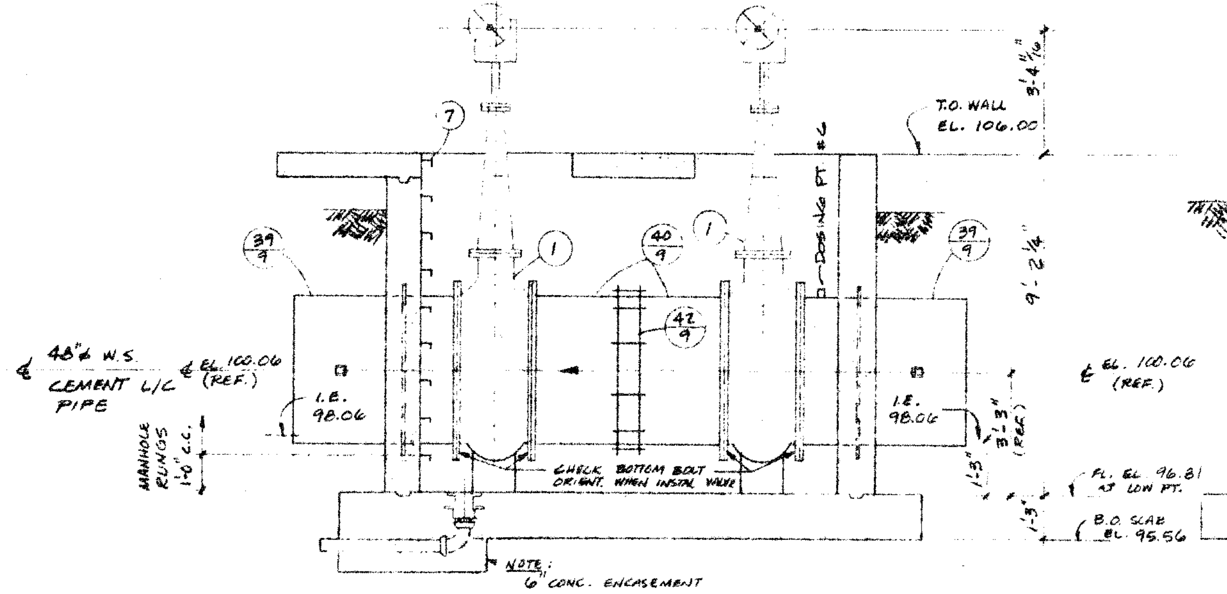
PLAN OF SLAB



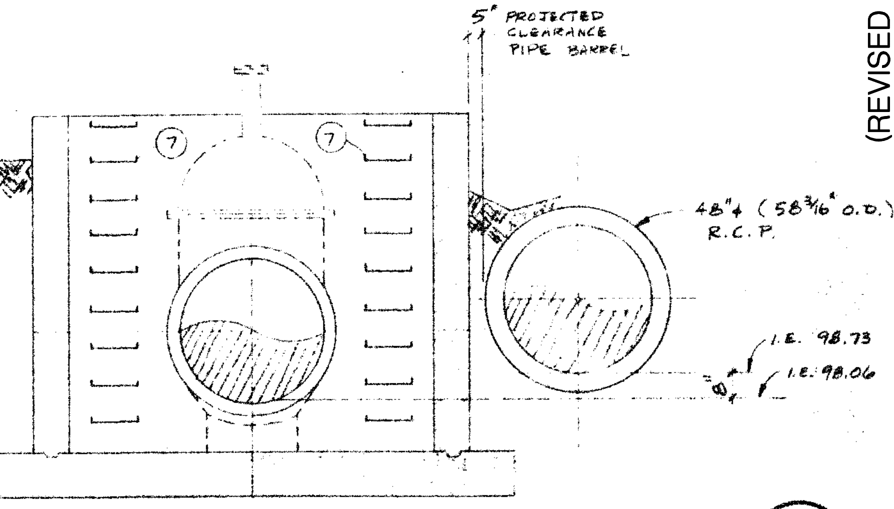
SECTION I-I



SECTIONAL PLAN



SECTION A/B-B
SCALE: 3/8" = 1'-0"



SECTION B/A-A
SCALE: 3/8" = 1'-0"

104A OF 141

(REVISED SET JUNE 2006)

⚠1 RECORD DRAWING, JUNE 1982

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION VALVE PIT PLANS, SECTIONS AND DETAILS
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.O. DATE	Drawn by: LFI — Scale: 3/8" = 1'-0" Des/Chkd by: DAB — Date: 8-77 / 9-79

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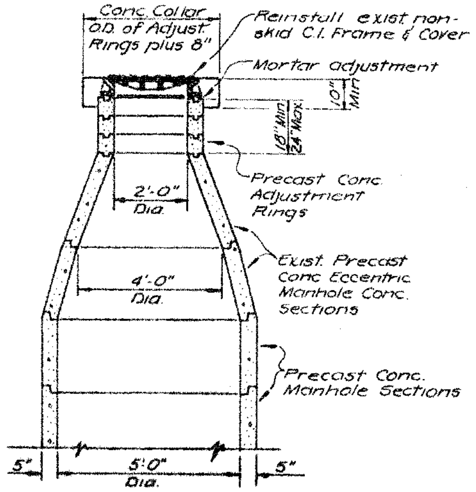
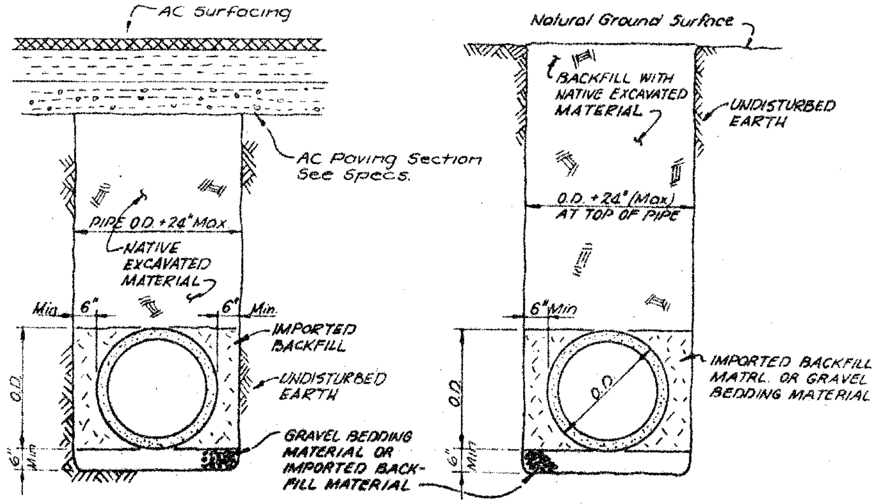


TYPICAL PRECAST MANHOLE DETAILS

Scale 3/8"=1'-0"



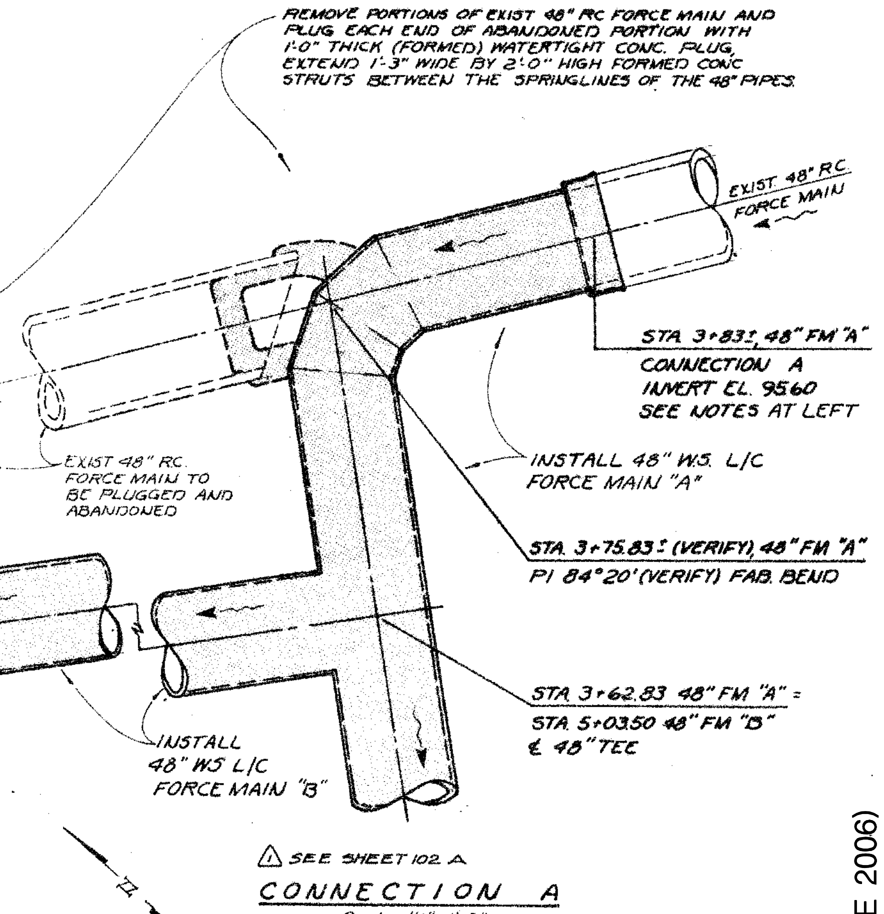
SURFACED AREAS "UNSURFACED" AREAS

TYPICAL TRENCH SECTIONS

No Scale

NOTES

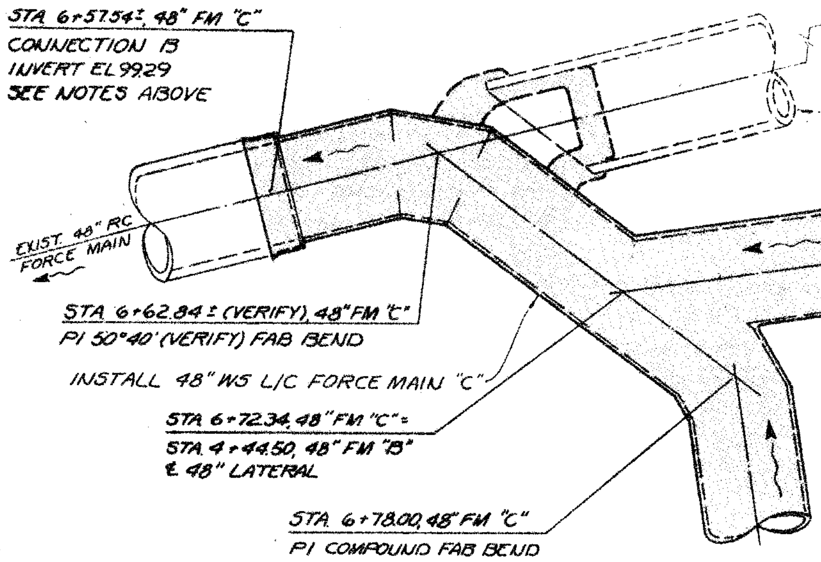
1. THE CONTRACTOR SHALL UNCOVER AND EXPOSE THE EXISTING FORCE MAIN AND SHALL THEN LAYOUT THE PUMP STATION FORCE MAINS AND FORCE MAIN CONNECTIONS. THE CONTRACTOR SHALL COMPLETE THIS LAYOUT WORK AND SHALL SUBMIT IT FOR APPROVAL PRIOR TO THE FABRICATION OF THIS PIPEWORK.
2. THE LOCATIONS OF THESE CONNECTIONS HAVE BEEN ESTIMATED TO CONFORM TO THE CONNECTION INVERT ELEVATIONS AS SHOWN. THE FINAL CONNECTION LOCATIONS SHALL BE ESTABLISHED IN THE FIELD TO UTILIZE STANDARD RUBBER GASKET JOINTS CONNECTING THE NEW FORCE MAIN TO THE EXISTING FORCE MAIN AT EXISTING JOINTS. THE CONTRACTOR SHALL DETERMINE THE LOCATIONS, DIMENSIONS AND CONFIGURATIONS OF THE EXISTING FORCE MAIN JOINTS AND SHALL INCREASE THE LENGTHS OF THE NEW FORCE MAINS AS REQUIRED TO CONFORM TO THESE JOINTS.



⚠ SEE SHEET 102 A

CONNECTION A

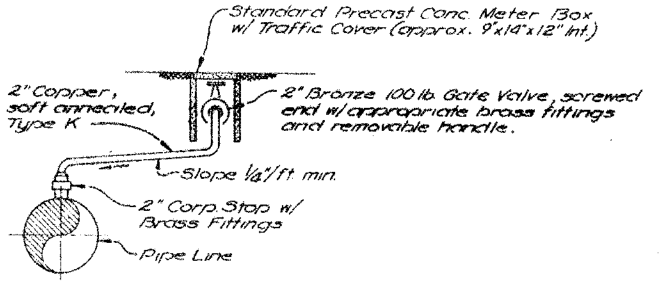
Scale 1/4"=1'-0"



⚠ SEE SHEET 102 A

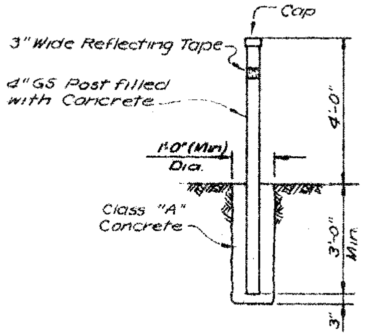
CONNECTION B

Scale 1/4"=1'-0"



AIR RELIEF ASSEMBLY

No Scale



PROTECTION POST DETAIL

Scale 3/8"=1'-0"

Record Drawing

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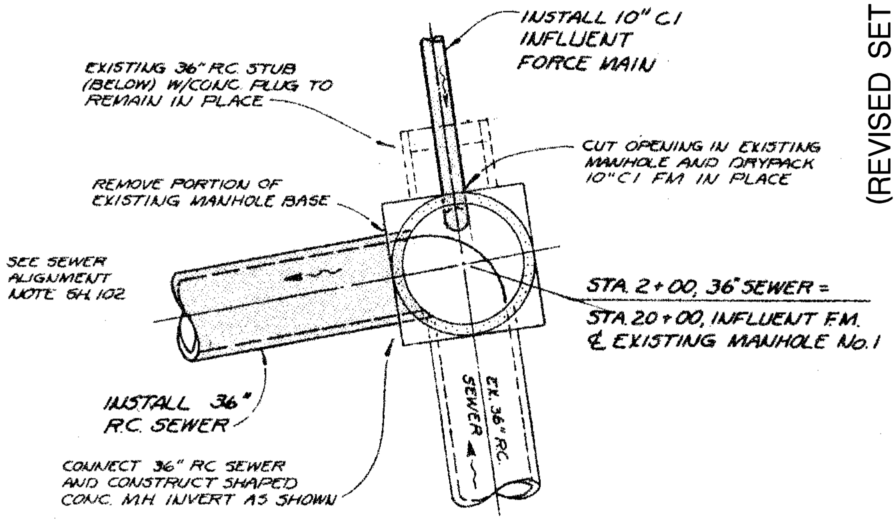
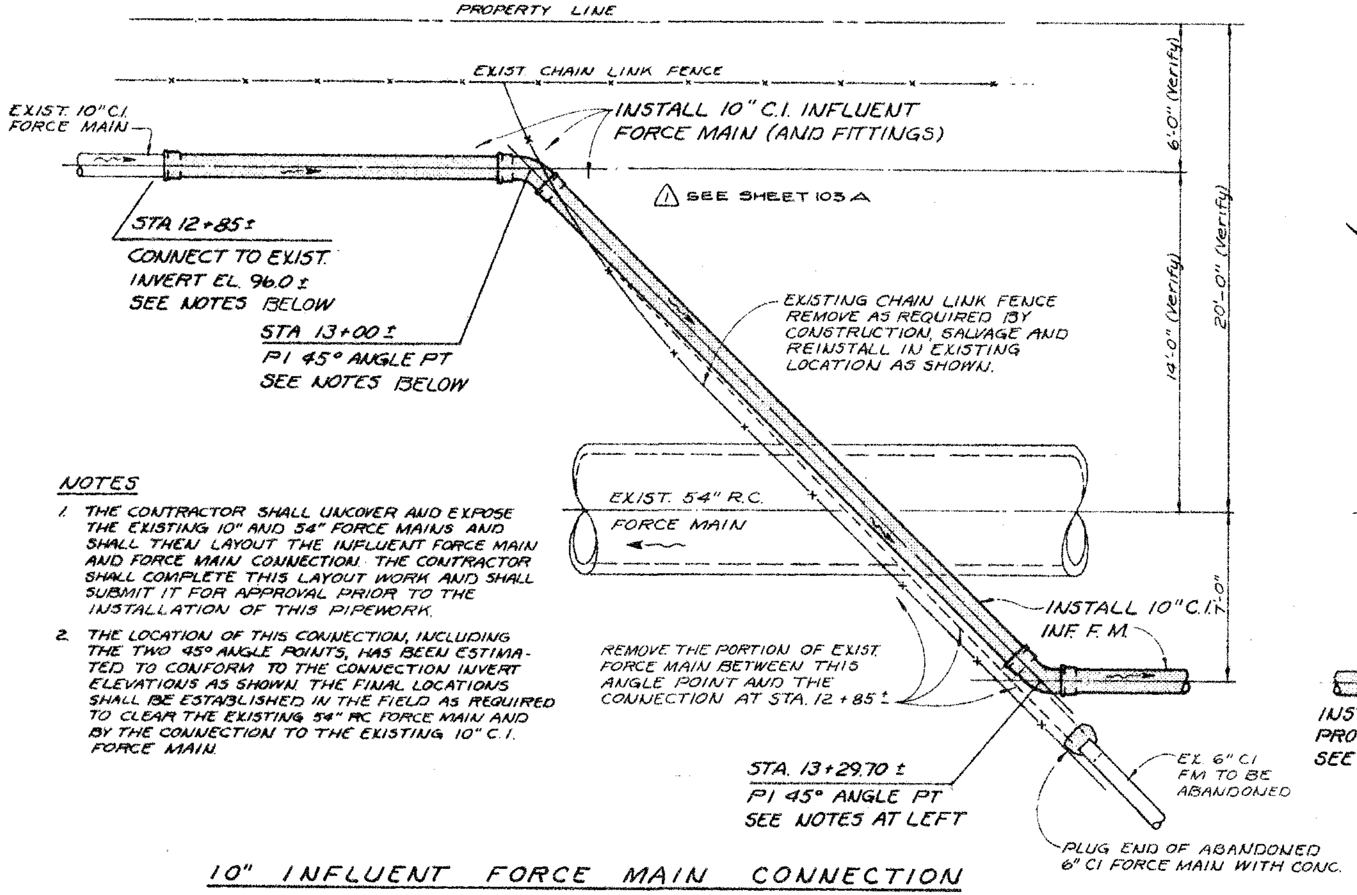


NOTE - THE CONTRACTOR SHALL RAISE THE MANHOLE FRAME AND COVER OF THIS EXISTING MANHOLE TO THE NEW FINISHED GRADE. THE REVISED MANHOLE SHALL CONFORM TO THE TYPICAL PRECAST MANHOLE DETAIL ON THIS SHEET AT THE LEFT.

EXISTING MANHOLE No. 1 DETAIL

Scale 1/4"=1'-0"

⚠ RECORD DRAWING, JUNE 1982



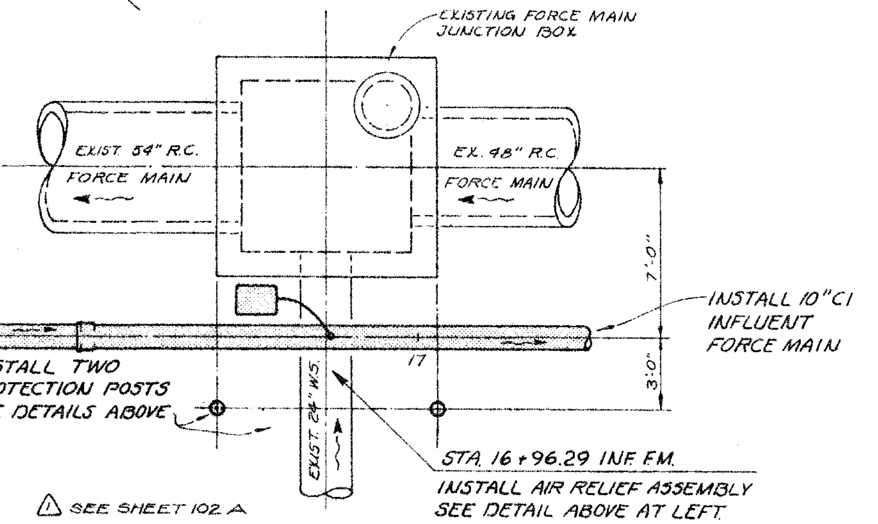
⚠ SEE SHEET 103 A

NOTES

1. THE CONTRACTOR SHALL UNCOVER AND EXPOSE THE EXISTING 10" AND 54" FORCE MAINS AND SHALL THEN LAYOUT THE INFLUENT FORCE MAIN AND FORCE MAIN CONNECTION. THE CONTRACTOR SHALL COMPLETE THIS LAYOUT WORK AND SHALL SUBMIT IT FOR APPROVAL PRIOR TO THE INSTALLATION OF THIS PIPEWORK.
2. THE LOCATION OF THIS CONNECTION, INCLUDING THE TWO 45° ANGLE POINTS, HAS BEEN ESTIMATED TO CONFORM TO THE CONNECTION INVERT ELEVATIONS AS SHOWN. THE FINAL LOCATIONS SHALL BE ESTABLISHED IN THE FIELD AS REQUIRED TO CLEAR THE EXISTING 54" RC FORCE MAIN AND BY THE CONNECTION TO THE EXISTING 10" C.I. FORCE MAIN.

10" INFLUENT FORCE MAIN CONNECTION

Scale 1/4"=1'-0"



⚠ SEE SHEET 102 A

PLAN AT EXISTING FORCE MAIN JUNCTION BOX

Scale 1/4"=1'-0"

105 OF 141

(REVISED SET JUNE 2006)

SUBMITTED Bruce M. Weyerhaeff JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION MISCELLANEOUS DETAILS AND TRENCH SECTIONS
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: LLK EB · Scale: AS NOTED Des/Chkd by: DAB · Date: 8-77/9-79

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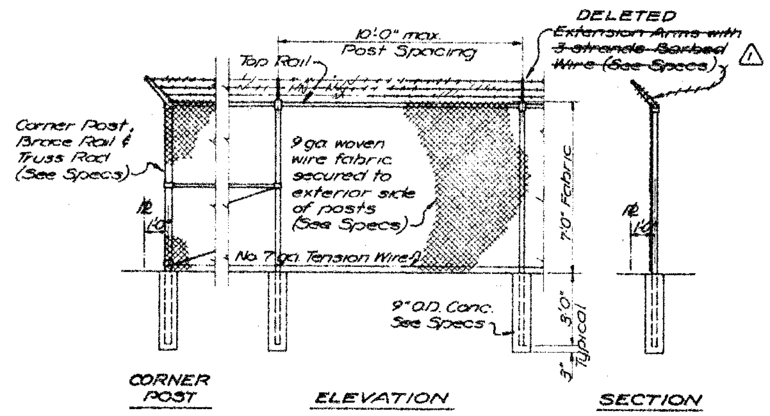
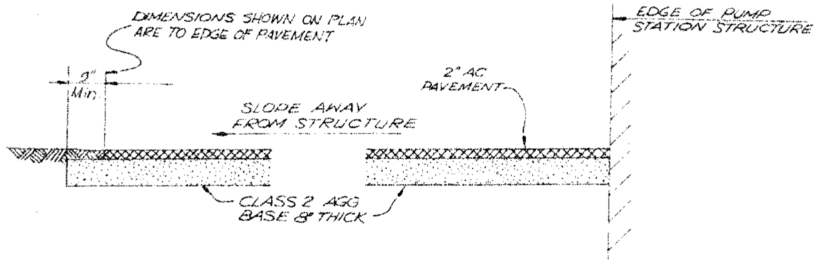


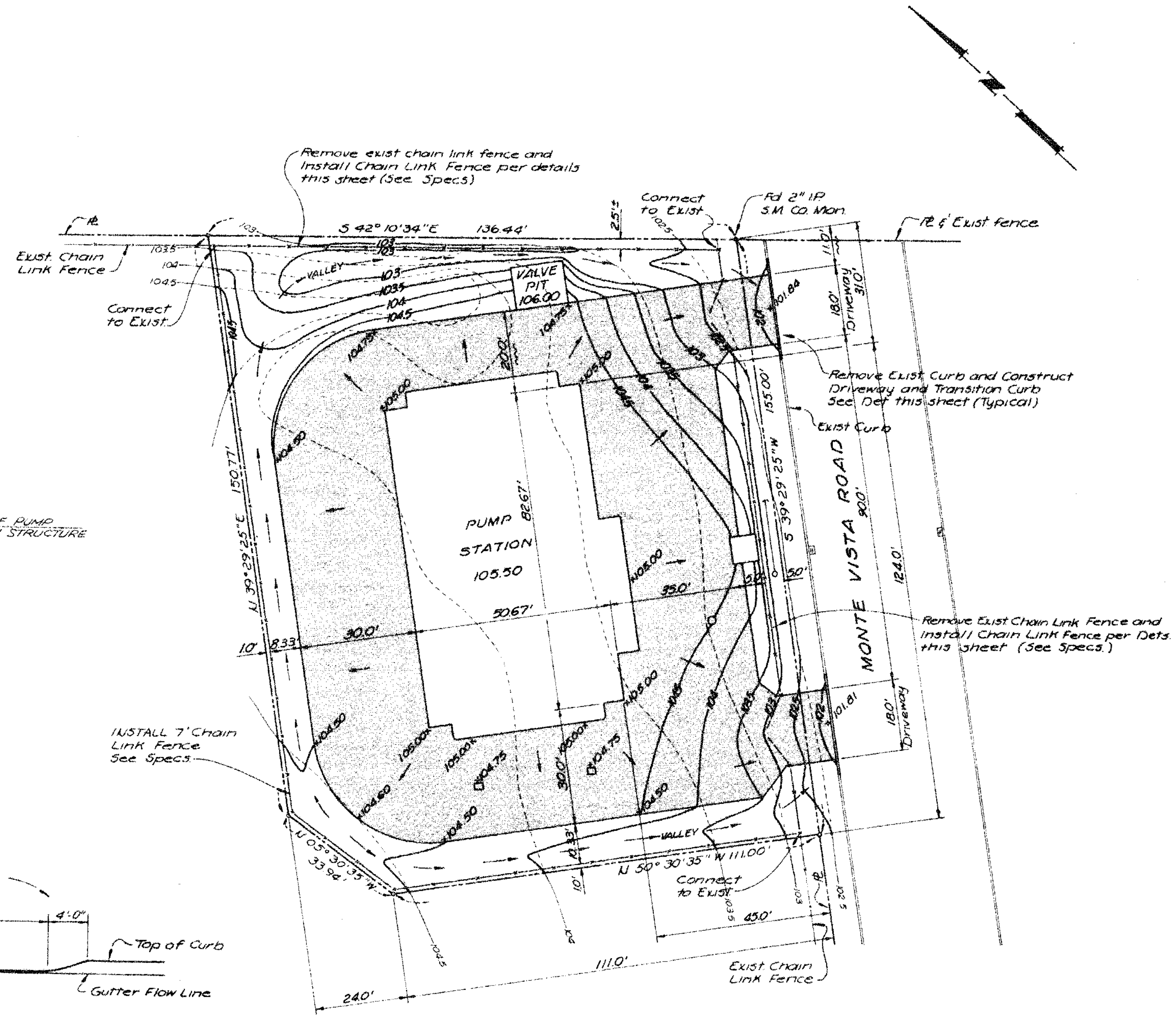
CHAIN LINK FENCE DETAILS

Scale 1/4"=1'-0"



TYPICAL AREA PAVING

Scale 1/2"=1'-0"



GRADING & PAVING PLAN

Scale 1"=20'

LEGEND

- - 107 - - Indicates Existing Ground Contour

——107—— Indicates Finished Surface Contour

×107.25 Indicates Finished Surface Elevation

▨ Indicates Area to be surfaced with 2" thickness of Asphaltic Concrete over 8" compacted Aggregate Base

Record Drawing

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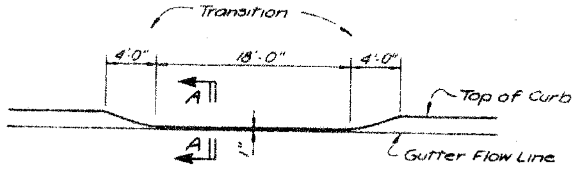
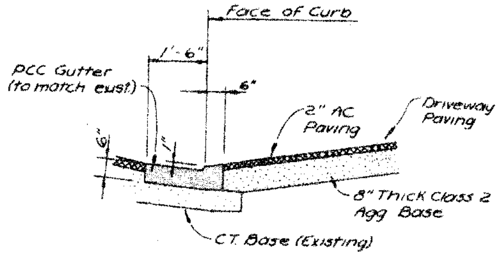


FRONT ELEVATION



SECTION A-A

TYP DRIVEWAY CURB DETAIL

No Scale

1 RECORD DRAWING, JUNE 1982

106 OF 141

SUBMITTED JENKS & HARRISON DATE	SOUTH BAYSIDE SYSTEM AUTHORITY SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION GRADING AND PAVING PLAN AND SECTIONS
APPROVED BELMONT DATE	JENKS & HARRISON CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: LLK, EB — Scale: AS NOTED Des/Chkd by: DAB — Date: 6-77/9-79

(REVISED SET JUNE 2006)

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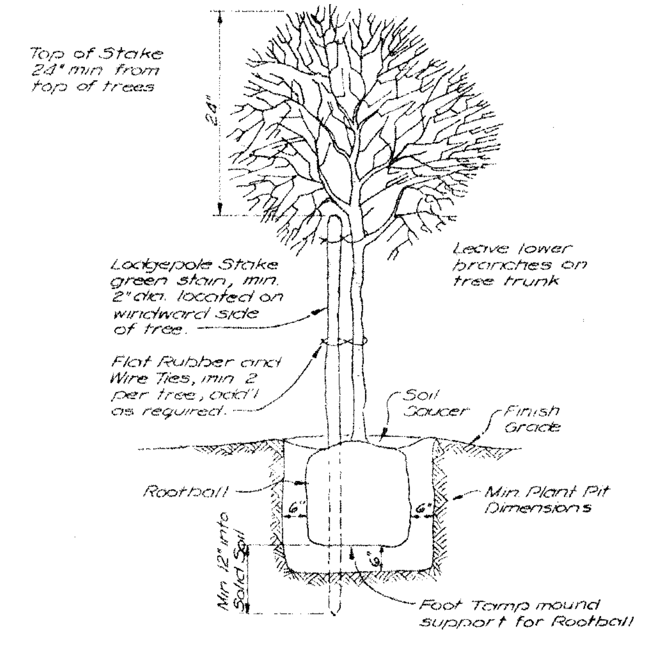
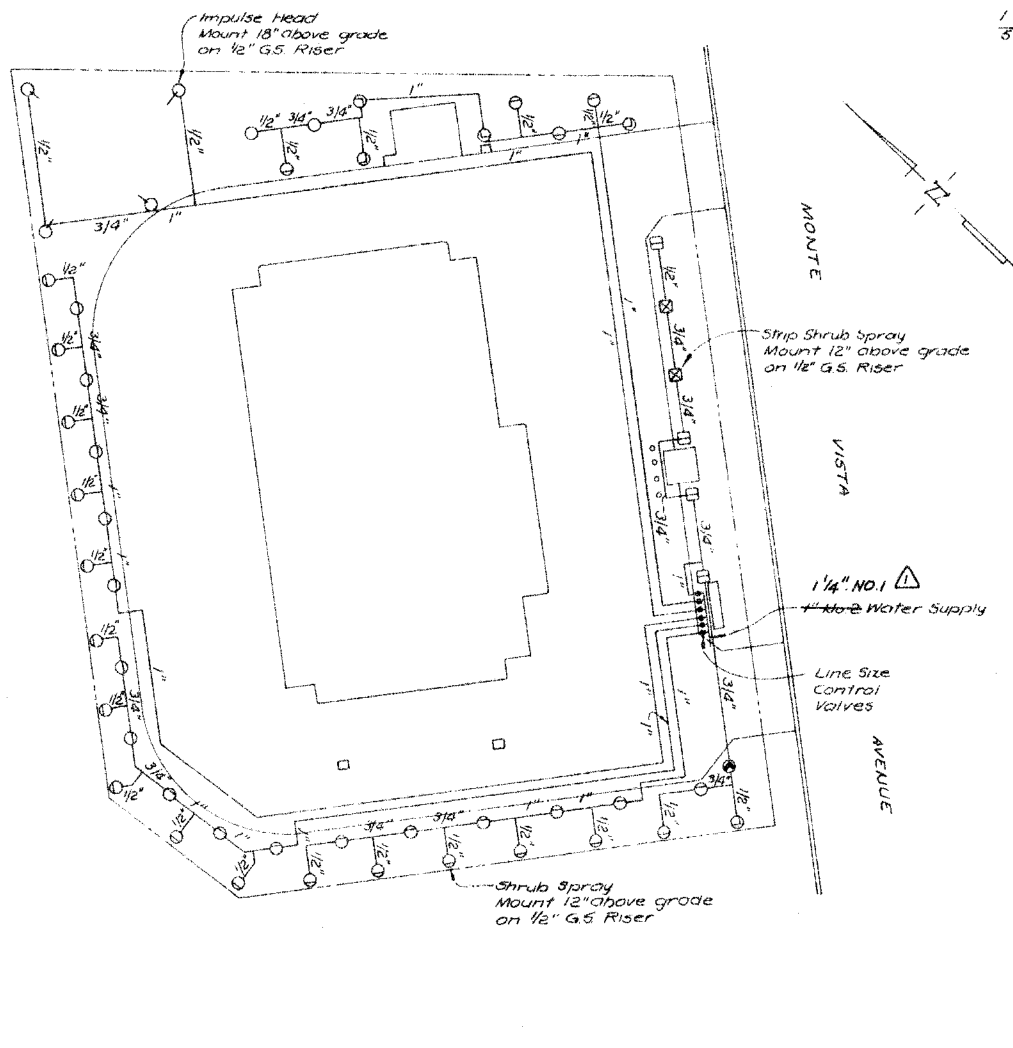


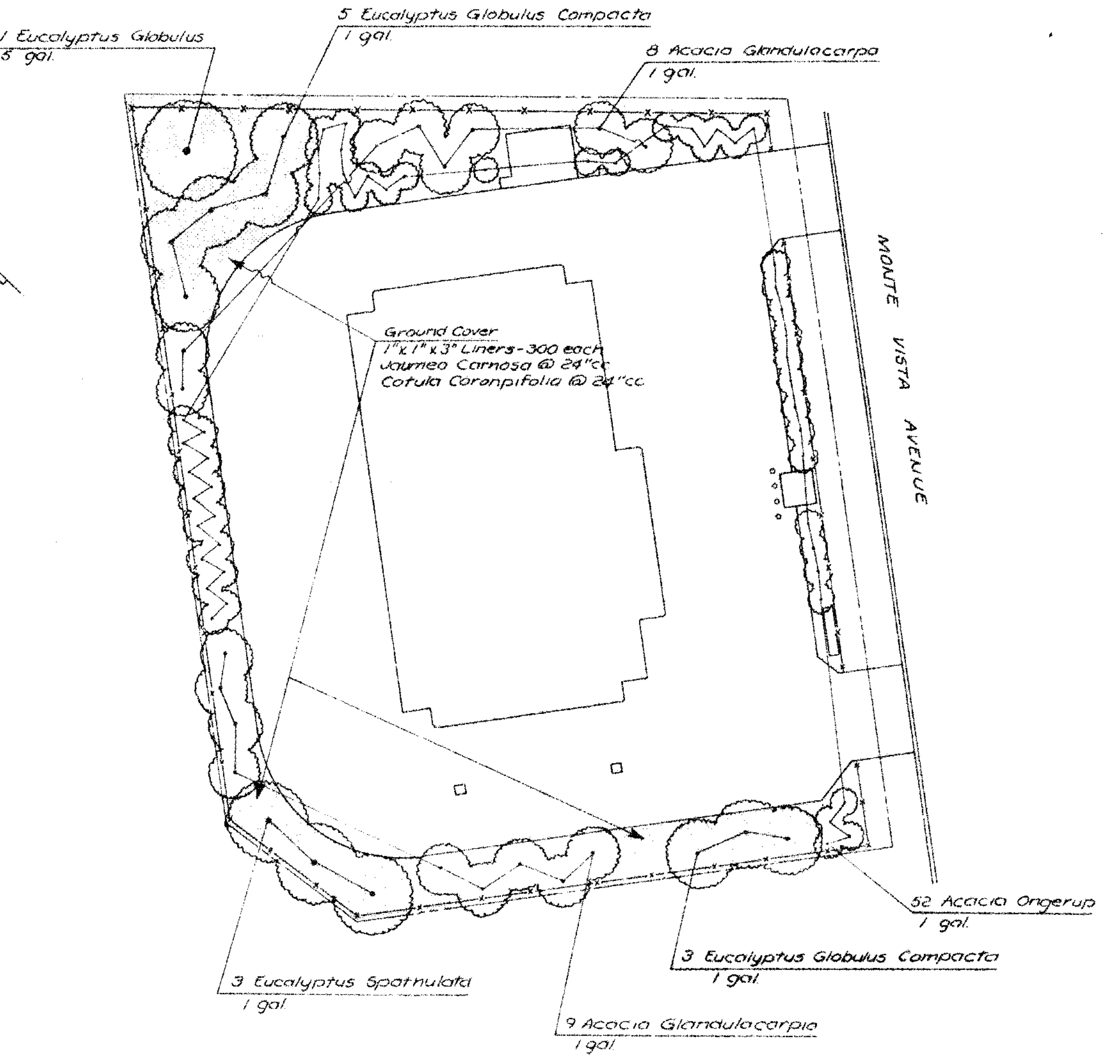
TREE STAKING DETAIL

No Scale



IRRIGATION PLAN

Scale 1"=20'



PLANTING PLAN

Scale 1"=20'

Record Drawing

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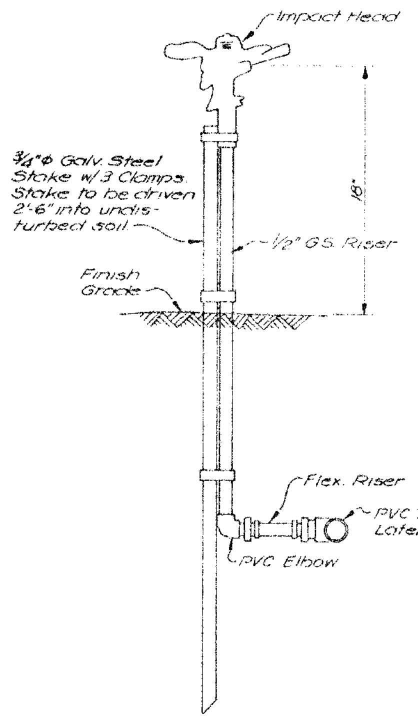
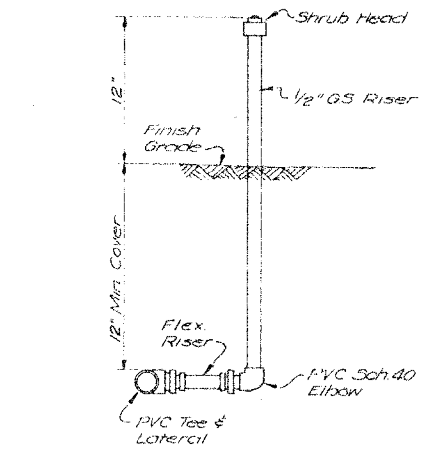


IMPULSE HEAD INSTALLATION

No Scale

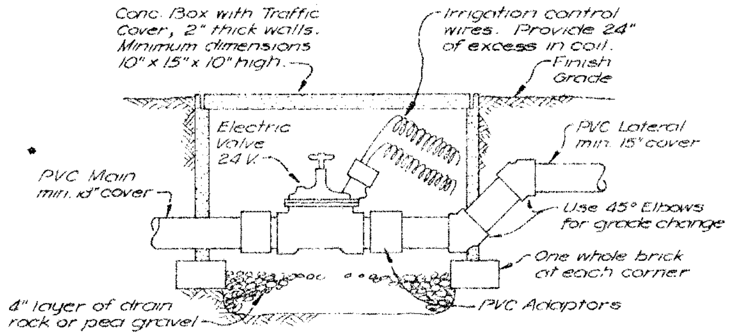


NOTE

All pipe and fittings between lateral & head shall match the spray head size

SHRUB SPRAY HEAD INSTALLATION

No Scale



One Valve / box. No debris or soil inside box. Finish grade inside and outside box as shown. All valves to be equipped with flow control & wing nut and pet cock. Box shall not rest upon or touch valve or lateral at any point. "Teflon" tape required on all threaded joints, metal or plastic. All threaded fittings shall be PVC sch. 40 heavy wall.

TYPICAL VALVE BOX

No Scale

(REVISED SET JUNE 2006)

107 OF 141

⚠ RECORD DRAWING, JUNE 1982

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION LANDSCAPING PLANTING & IRRIGATION PLANS
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: LLK EB — Scale: AS NOTED Des/Chkd by: DAB — Date: 8-77/ 9-79

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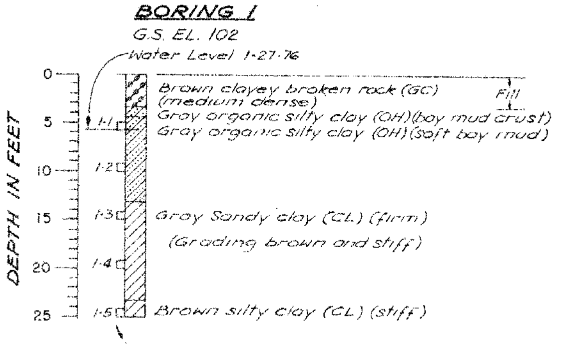


Denotes an undisturbed sample taken in a 2½" φ, split-tube barrel, driven into the soil by a drop weight.

SAMPLE DATA(1)

No.	STRENGTH DATA				MOISTURE-DENSITY DATA	
	TYPE OF STRENGTH	TEST SURCHARGE PRESSURE LBS/SQ.FT.	TEST MOISTURE CONTENT %	SHEAR STRENGTH LBS/SQ.FT.	NATURAL MOISTURE CONTENT %	DRY DENSITY LBS/CU.FT.
1-1	DS	500	Natural	600	75.5	54
1-2	DS	600	Natural	180	99.4	45
1-3	DS	900	Natural	1100	24.9	102
1-4	DS	1200	Natural	1400	17.9	114
1-5	DS	1500	Natural	1400	35.8	85

(1) REFERS TO BORING LOG TITLED "BORING 1"

LABORATORY NOTES AND ABBREVIATIONS

The tabulated shear strengths are yield point values

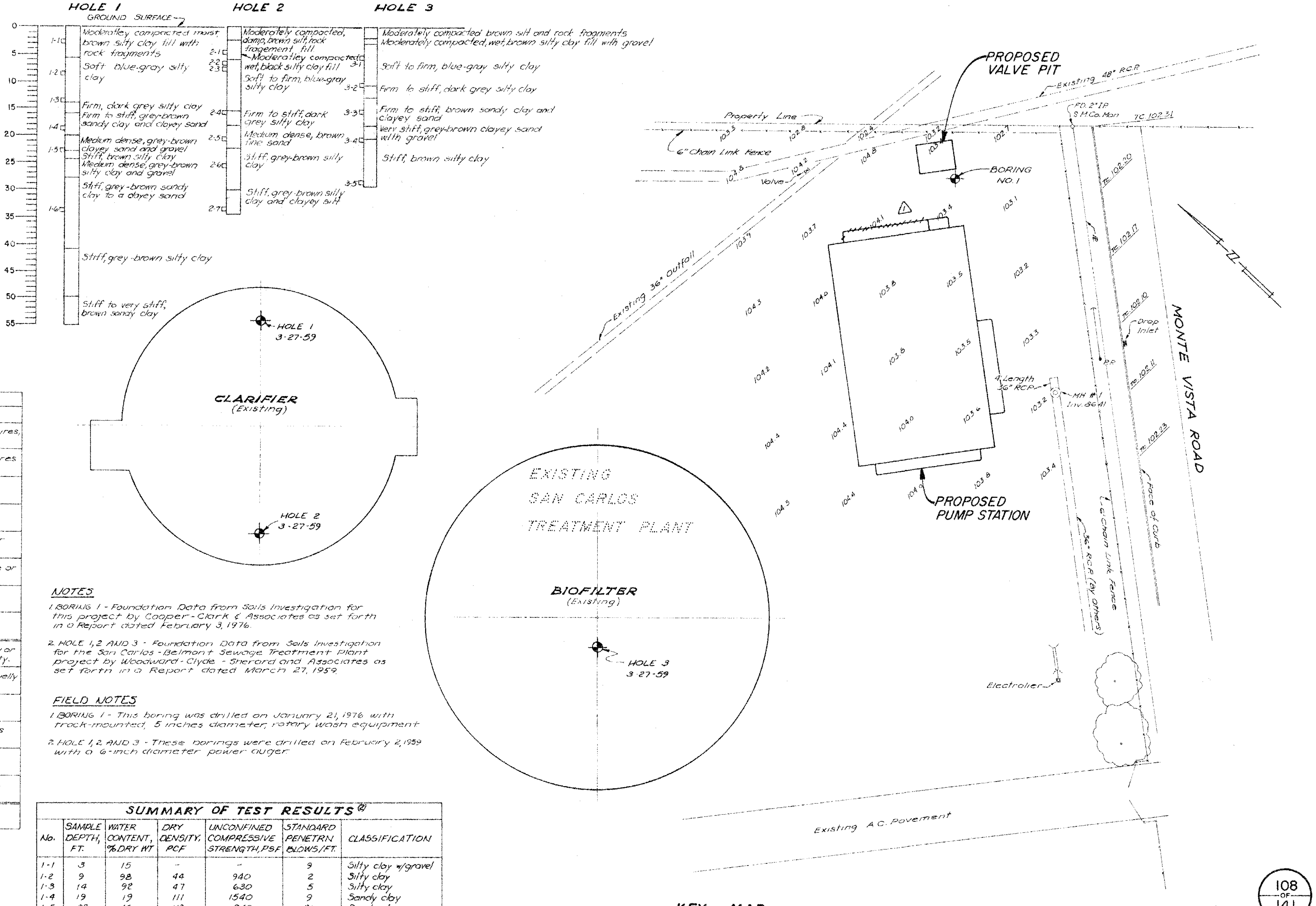
DS · Strain controlled direct shear test at natural moisture content

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS		SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS (More than 1/2 of soil > No. 200 sieve size)	GRAVELS (More than 1/2 of coarse fraction > No. 4 sieve size)	GW	Well graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly graded gravels or gravel-sand mixtures little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS (More than 1/2 of coarse fraction < No. 4 sieve size)	SW	Well graded sands or gravelly sands, little or no fines.
		SP	Poorly graded sand or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE GRAINED SOILS (More than 1/2 of soil < No. 200 sieve size)	SILTS & CLAYS LL < 50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		OL	Organic silts and organic silty clays of low plasticity.
	SILTS & CLAYS LL > 50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silty clays, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.

GRAIN SIZE - CHART

CLASSIFICATION	RANGE OF GRAIN SIZES	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS	Above 12"	Above 305
COBBLES	12" to 3"	305 to 76.2
GRAVEL coarse fine	3" to No. 4 3" to 3/4" 3/4" to No. 4	76.2 to 4.76 76.2 to 19.1 19.1 to 4.76
SAND coarse medium fine	No. 4 to No. 200 No. 4 to No. 10 No. 10 to No. 40 No. 40 to No. 200	4.76 to 0.074 4.76 to 2.00 2.00 to 0.420 0.420 to 0.074
SILT & CLAY	Below No. 200	Below 0.074



KEY MAP

Scale 1"=20'

NOTES

1. BORING 1 - Foundation Data from Soils Investigation for this project by Cooper-Clark & Associates as set forth in a Report dated February 3, 1976.

2. HOLE 1, 2 AND 3 - Foundation Data from Soils Investigation for the San Carlos-Belmont Sewage Treatment Plant project by Woodward-Clyde - Sherard and Associates as set forth in a Report dated March 27, 1959.

FIELD NOTES

1. BORING 1 - This boring was drilled on January 21, 1976 with track-mounted, 5 inches diameter, rotary wash equipment

2. HOLE 1, 2 AND 3 - These borings were drilled on February 2, 1959 with a 6-inch diameter power auger.

SUMMARY OF TEST RESULTS(2)

No.	SAMPLE DEPTH, FT.	WATER CONTENT, %DRY WT	DRY DENSITY, PCF	UNCONFINED COMPRESSIVE STRENGTH, PSF	STANDARD PENETRN BLOWS/FT.	CLASSIFICATION
1-1	3	15	-	-	9	Silty clay w/gravel
1-2	9	98	44	940	2	Silty clay
1-3	14	92	47	630	5	Silty clay
1-4	19	19	111	1540	9	Sandy clay
1-5	23	16	119	940	21	Sandy clay
1-6	34	20	-	-	16	Clayey sand
2-1	5	41	88	760	10	Silty Clay
2-2	7	-	-	-	5	Silty Sand
2-3	8	92	46	460	5	Silty clay
2-4	16	22	105	2100	7	Silty clay
2-5	21	18	118	880	18	Sand
2-6	26	31	89	3460	10	Silty clay
2-7	34	25	101	2930	10	Silty clay
3-1	6	72	55	780	3	Silty clay
3-2	11	26	96	2070	7	Silty clay
3-3	16	17	117	3270	10	Sandy clay
3-4	21	17	116	2240	12	Clayey sand
3-5	29	30	94	2640	9	Silty clay

(2) REFERS TO BORING LOGS TITLED "HOLE 1", "HOLE 2", AND "HOLE 3"

Record Drawing

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(REVISED SET JUNE 2006)

△1 RECORD DRAWING, JUNE 1982.

SUBMITTED	
JENKS & HARRISON	DATE
APPROVED	
REDWOOD CITY	DATE
APPROVED	
SAN CARLOS	DATE
APPROVED	
BELMONT	DATE
APPROVED	
MENLO PARK S.D.	DATE

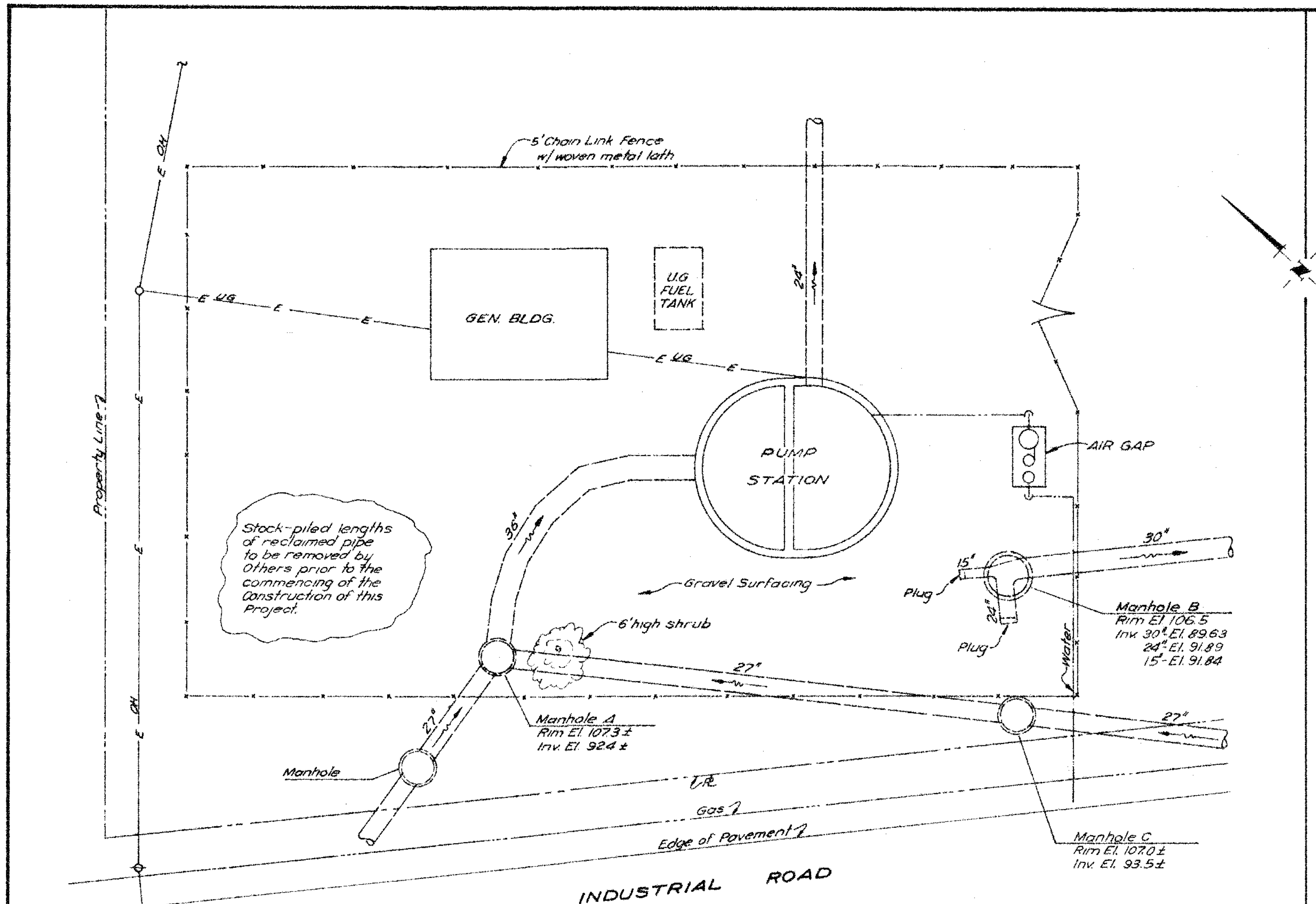
SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
LOG OF BORINGS
KEY MAP AND SAMPLE DATA

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by:	MB	Scale:	AS NOTED
Des/Chkd by:	DAB	Date:	8-77 / 9-79



EXISTING CONDITION

SITE PLAN

SCALE 1"=10'

Record Drawing

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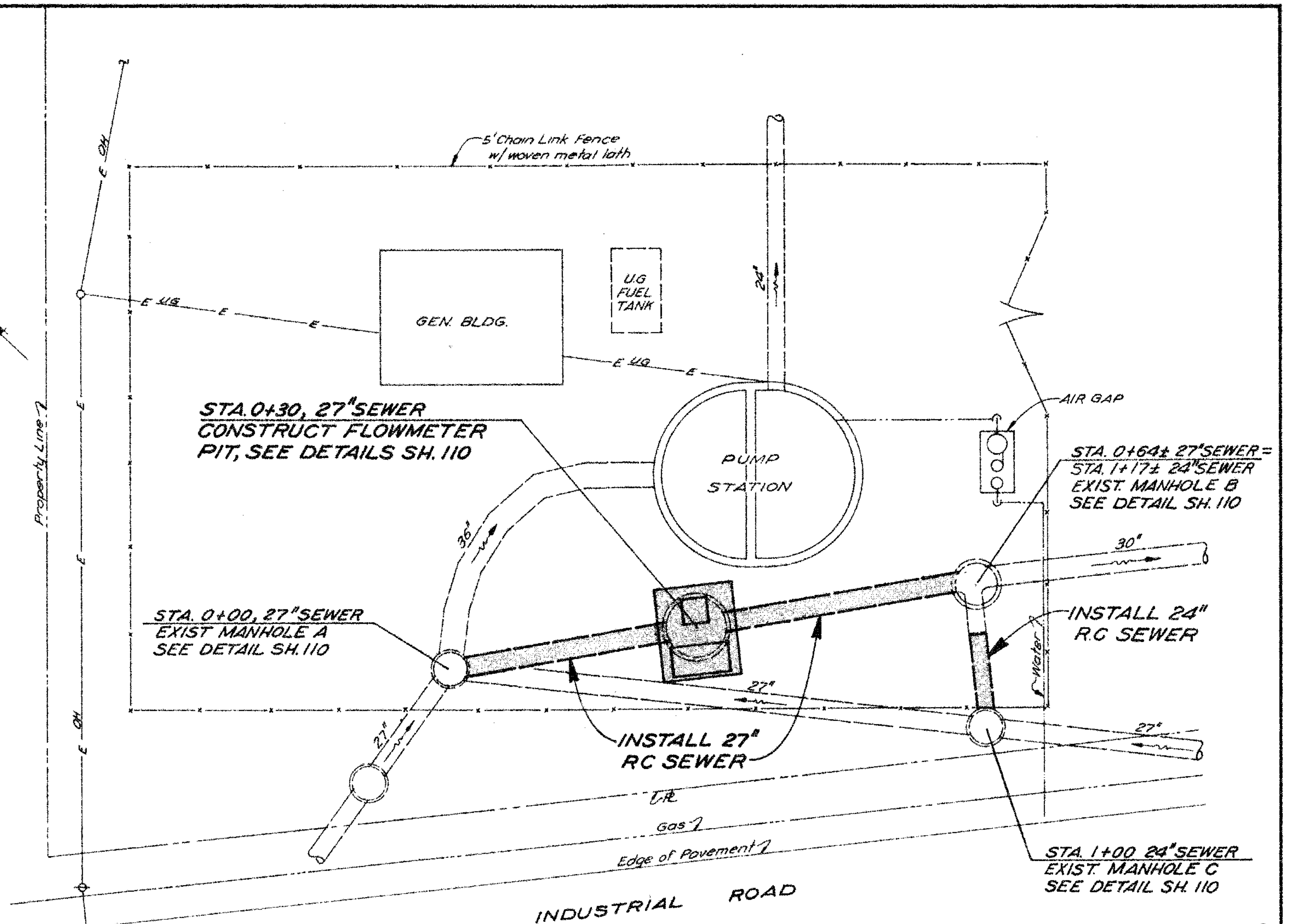
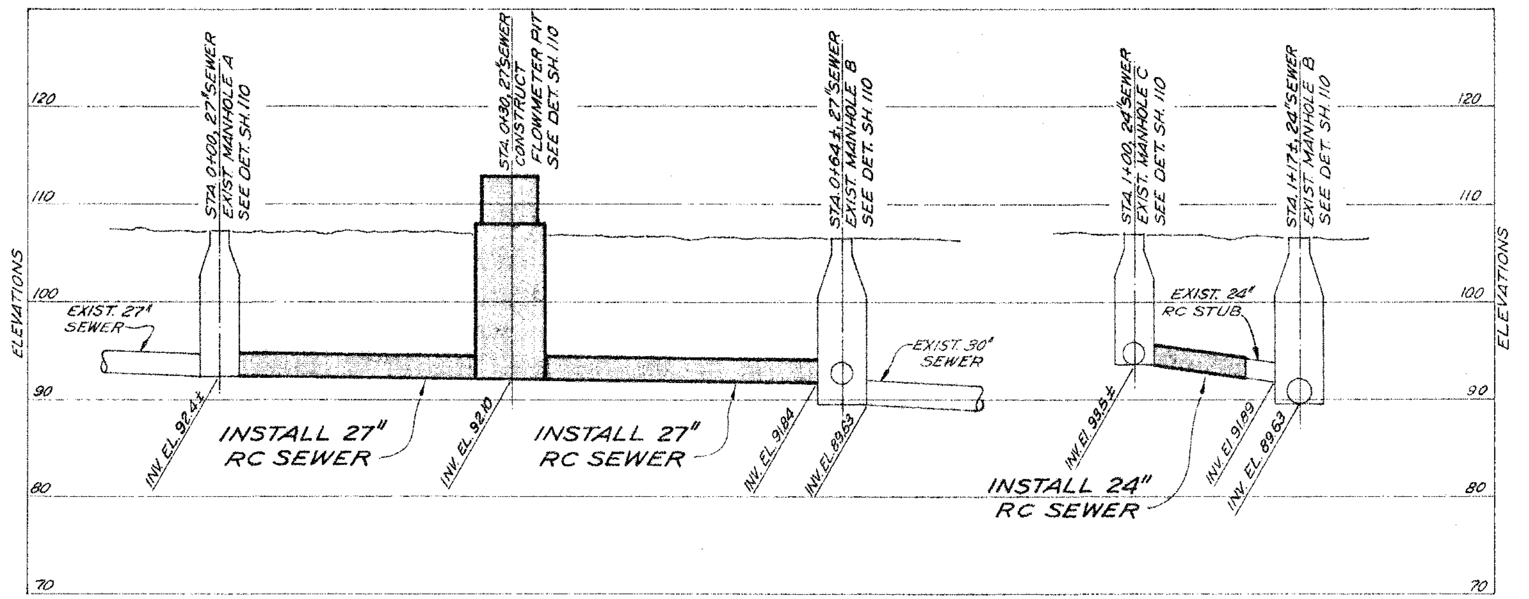


SITE PLAN

SCALE 1"=10'

CONSTRUCTION NOTES

1. THE CONTRACTOR SHALL COMMENCE THE NEW HOLLY STREET PUMP STATION SEWER AND FLOWMETER TIE-IN FOLLOWING THE MAKING OF THE NECESSARY PROVISIONS FOR HANDLING THE INCOMING FLOW AND DEWATERING THE STRUCTURE AND PIPES AS REQUIRED TO CONFORM TO NORMAL OPERATIONS AND TO MINIMIZE INTERRUPTIONS OF NORMAL OPERATIONS, AS APPROVED BY THE ENGINEER. THE CONTRACTOR SHALL PROVIDE TEMPORARY PUMPING AND PIPING AS REQUIRED BY THE CONSTRUCTION OF THESE IMPROVEMENTS. THE CONSTRUCTION SCHEDULE SHALL BE AS DESCRIBED IN SECTION B OF THE SPECIFICATIONS.
2. THE CONTRACTOR SHALL VERIFY ALL FEATURES (INCLUDING DIMENSIONS) OF THE EXISTING FACILITIES IN THE FIELD PRIOR TO THE FABRICATION OR CONSTRUCTION REQUIRED BY THE ALTERATIONS AND ADDITIONS INDICATED.
3. THE CONTRACTOR SHALL REMOVE EXCAVATION, PIPEWORK, CONCRETE AND PAVEMENT AS REQUIRED IN THE LOCATIONS INDICATED AND TO THE DIMENSIONS SHOWN. THIS WORK SHALL BE DONE IN SUCH A MANNER THAT THE REMAINING IMPROVEMENTS SHALL NOT BE DAMAGED AND SHALL BE TO THE SATISFACTION OF THE ENGINEER.
4. THE CONTRACTOR SHALL PATCH AND REPAIR THE EXISTING PIPEWORK STRUCTURES AS REQUIRED BY THESE IMPROVEMENTS BY THE USE OF SUITABLE AND APPROPRIATE BUILDING MATERIALS TO MATCH THE EXISTING STRUCTURE TO THE SATISFACTION OF THE ENGINEER.
5. THE CONTRACTOR SHALL RELOCATE EXISTING CONDUITS AND EXISTING SMALL LINES (NOT SHOWN) AS REQUIRED BY THESE IMPROVEMENTS
6. THE CONTRACTOR SHALL COMPILE, AND TRANSMIT TO THE ENGINEER, ACCURATE RECORDS OF THE "AS BUILT" LOCATIONS OF ALL PIPEWORK WHICH HE INSTALLS AS PART OF THIS PROJECT.
7. THE ITEMS SHOWN THUS ▨ ON THIS SHEET SHALL BE FURNISHED, INSTALLED AND/OR CONSTRUCTED AS A PART OF THIS PROJECT.



27" SEWER

24" SEWER

PROFILES

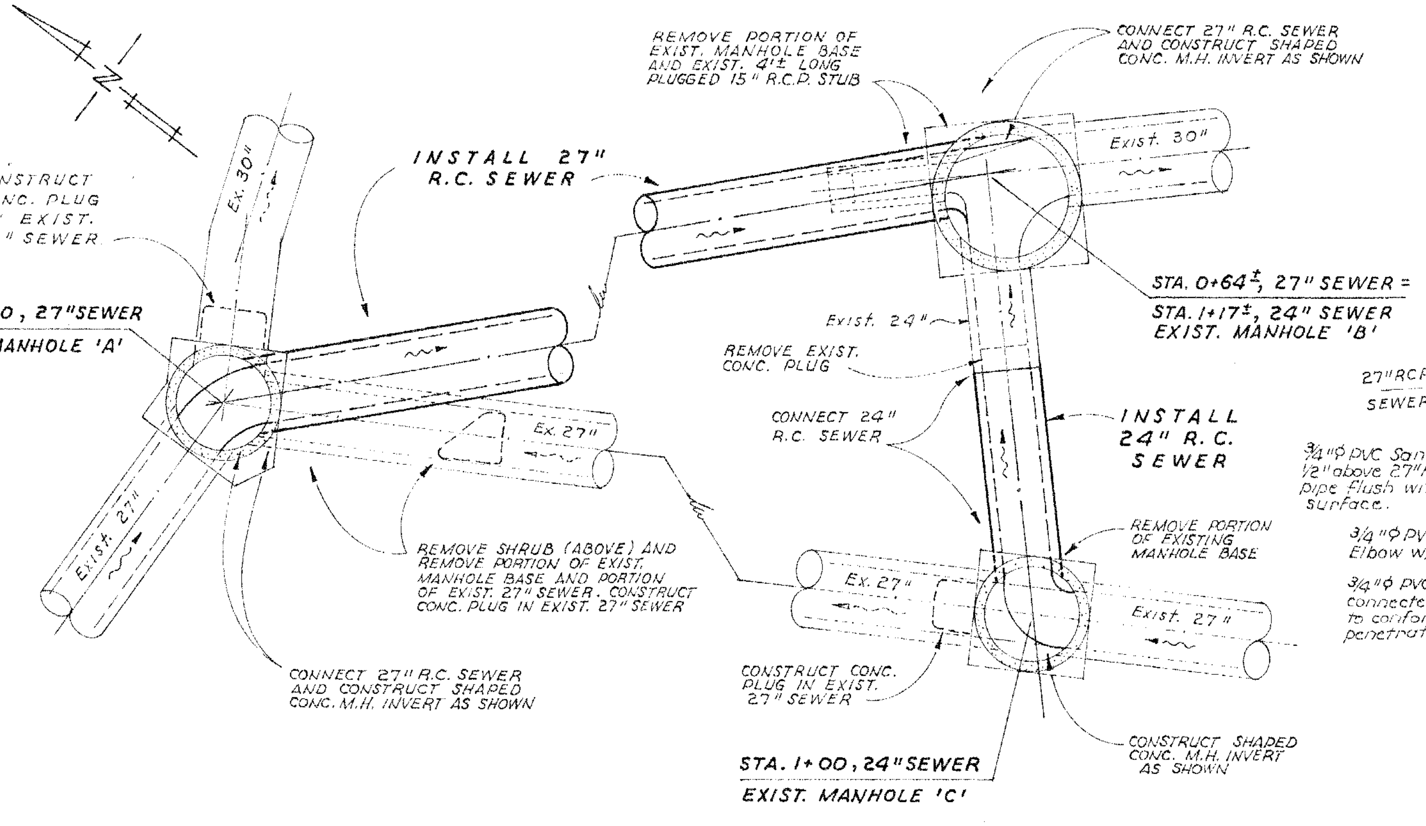
SCALE 1"=10'

109 OF 141

RECORD DRAWING, JUNE 1982

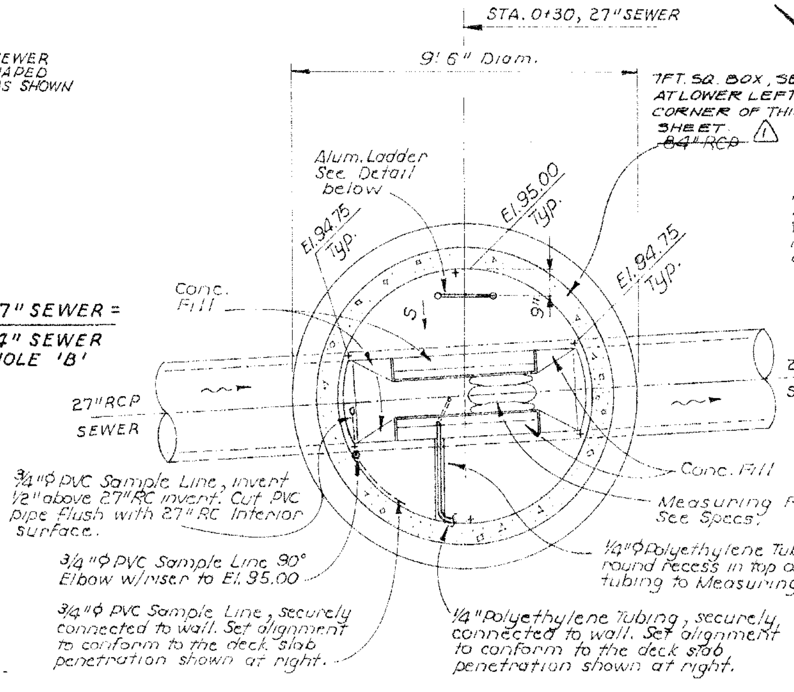
SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION HOLLY STREET PUMP STATION SITE PLANS AND PROFILES
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: SLH — Scale: AS NOTED Des./Chkd by: DAB — Date: 8-77/9-79

(REVISED SET JUNE 2006)

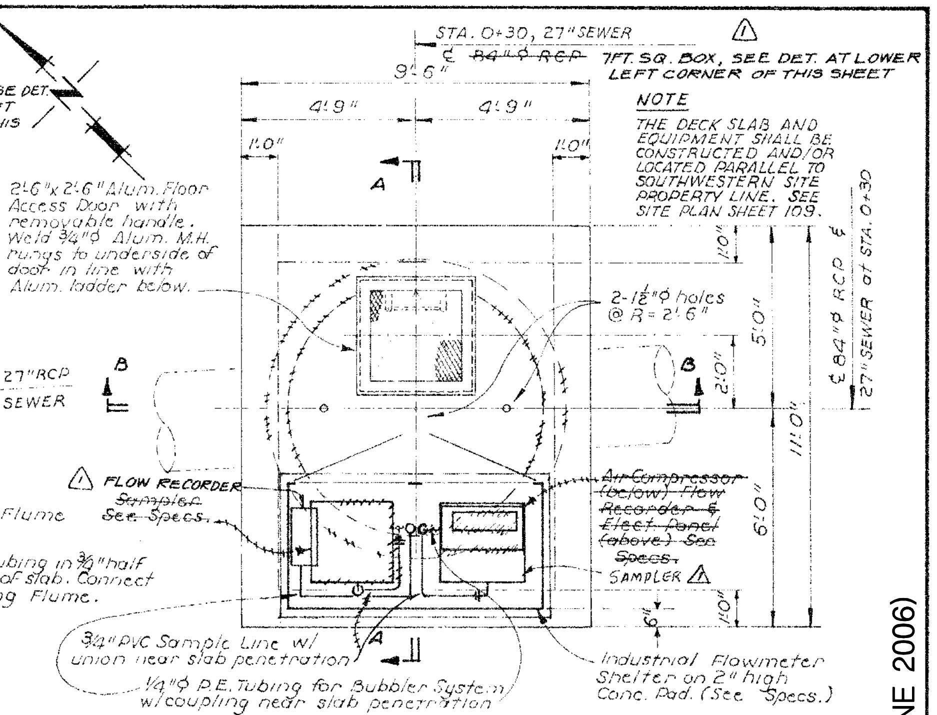


EXISTING MANHOLE LAYOUT DETAILS

Scale: 1/4" = 1'0"



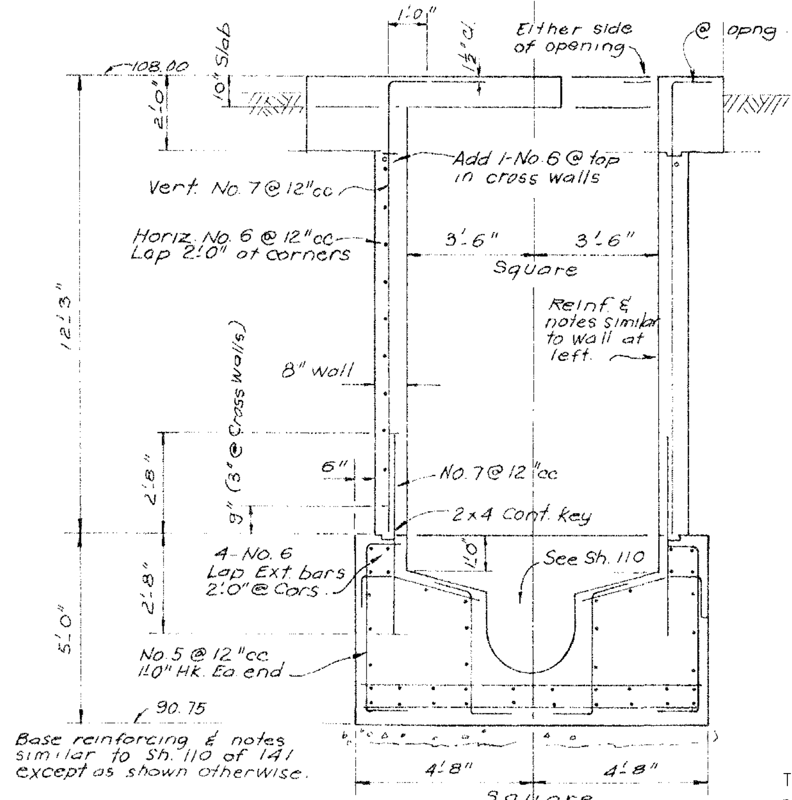
SECTIONAL PLAN



NOTE

THE DECK SLAB AND EQUIPMENT SHALL BE CONSTRUCTED AND/OR LOCATED PARALLEL TO SOUTHWESTERN SITE PROPERTY LINE. SEE SITE PLAN SHEET 109.

DECK PLAN



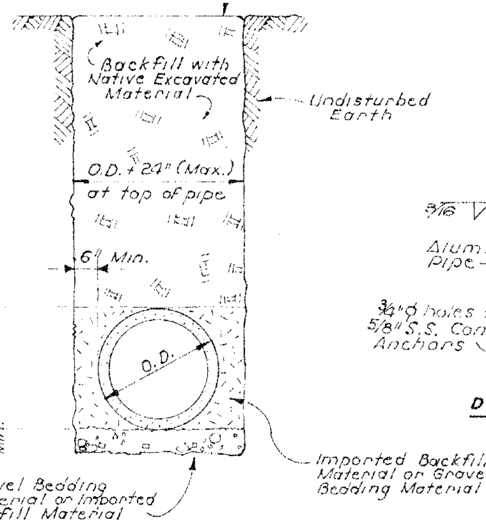
Base reinforcing & notes similar to Sh. 110 of 141 except as shown otherwise.

SCALE: 3/8" = 1'-0"

FLOWMETER PIT MODIFICATION △

NOTE

Finish Trench Surfacing shall match existing surfacing.



TYP. TRENCH SECT.

No Scale

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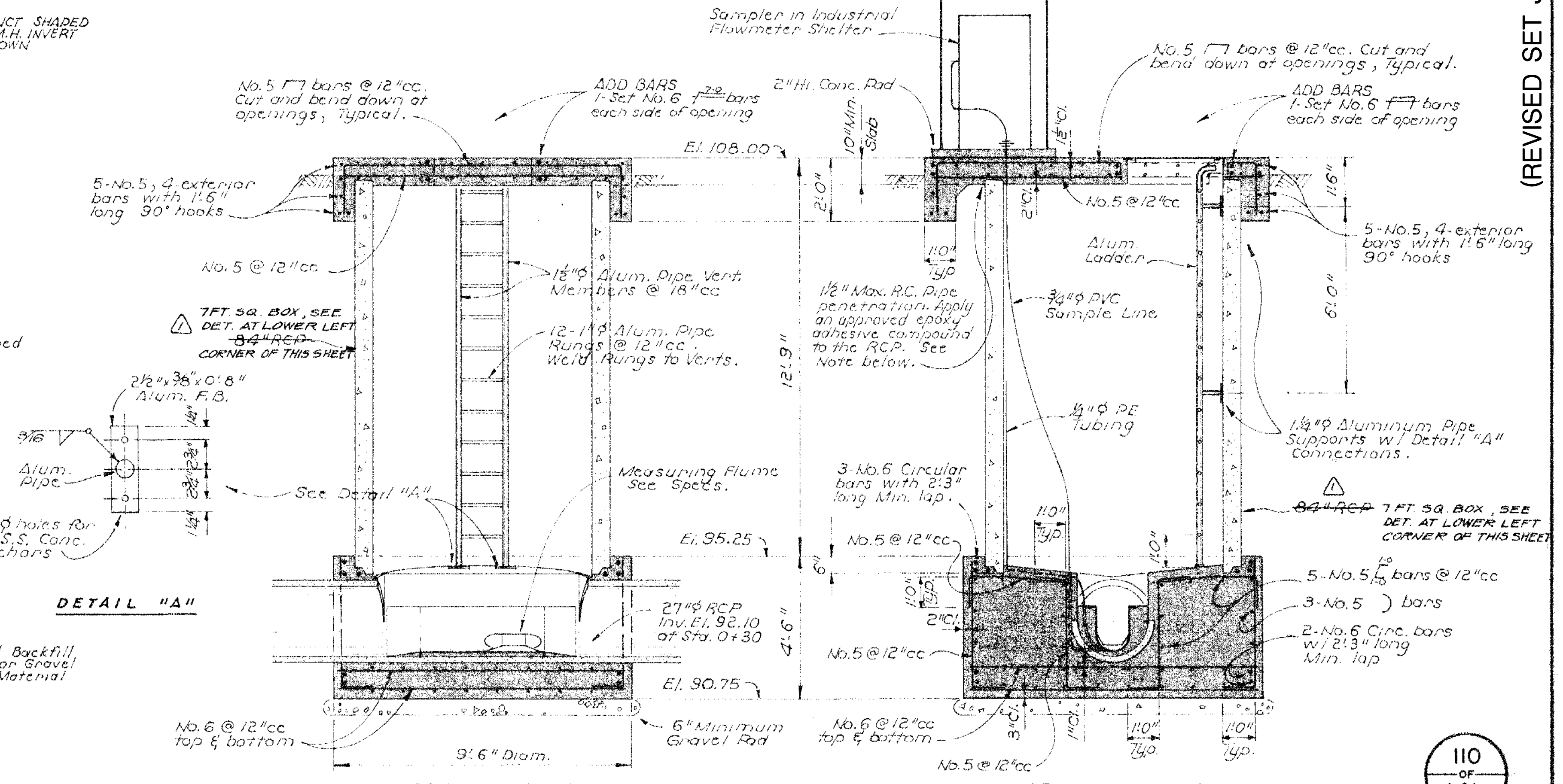

DETAIL "A"

SECTION B - B

SECTION A - A

FLOWMETER PIT DETAILS

Scale: 3/8" = 1'0"

110
OF
141

NOTE

The surface of the reinforced concrete pipe at all junctions of new concrete and the reinforced concrete pipe shall be thoroughly cleaned and free from surface contamination, dust and/or loose particles. Coat these surfaces of the reinforced concrete pipe with an approved epoxy adhesive compound: "Concresive 1001-LPL" (Adhesive Engineering Co.) "Sikadur Hi-Mod" (Sika Chemical Corp.), or approved equal, in accordance with the manufacturers recommendations. New concrete shall be placed against this coating before the coating sets. If the coating should set, apply a second coating before pouring concrete.

△ RECORD DRAWING , JUNE 1982

SUBMITTED	
JENKS & HARRISON	DATE
APPROVED	
REDWOOD CITY	DATE
APPROVED	
SAN CARLOS	DATE
APPROVED	
BELMONT	DATE
APPROVED	
MENLO PARK S.D.	DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
HOLLY STREET PUMP STATION
FLOWMETER PIT DETAILS

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by:	LLK MR	Scale:	3/8" = 1'-0"
Des/Chkd by:	DAB	Date:	8-77 / 9-79

(REVISED SET JUNE 2006)

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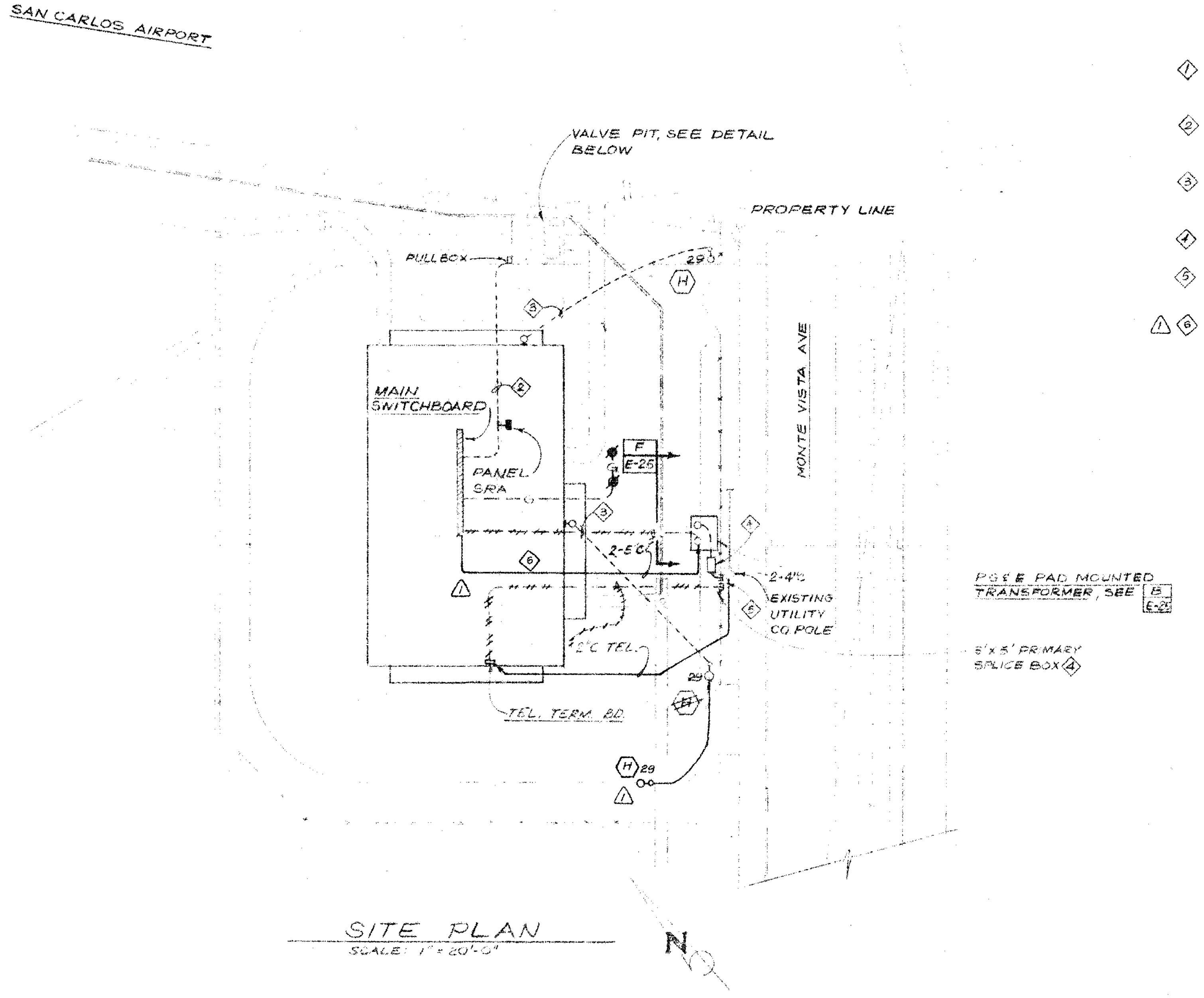
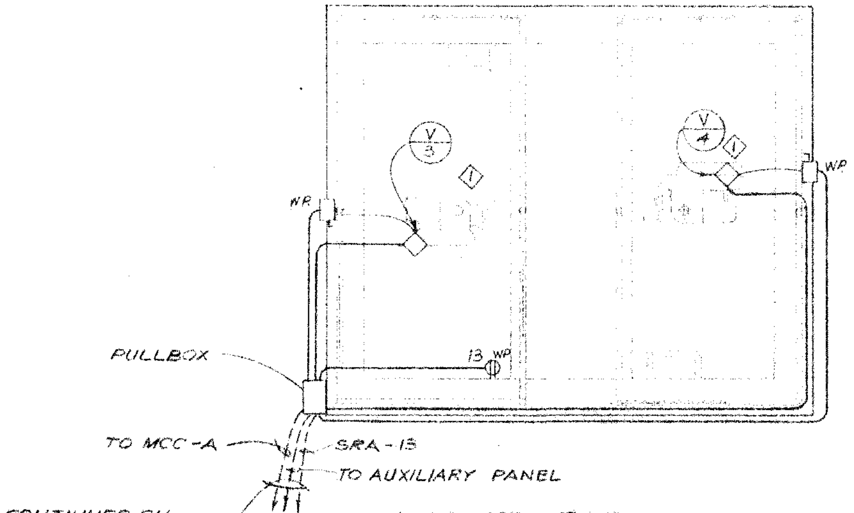


SITE PLAN
SCALE: 1"=20'-0"



VALVE PIT
SCALE: 3/8"=1'-0"

SHEET NOTES

◇1 VALVE ASSEMBLY IS A PACKAGE UNIT. CONNECT PER MANUFACTURER'S INSTRUCTIONS. SEE 1 / E-24

◇2 ROUTE CONDUITS EXPOSED ON CEILING OF INTERMEDIATE FLOOR.

◇3 TO SRA-29 VIA PHOTO CELL & WALL MOUNTED FIXTURE, CONTINUED ON E-16.

◇4 SPLICE BOX PER P.G.&E STANDARD #052676 SHEET 4.

◇5 STUB OUT AT PROPERTY LINE IN ACCORDANCE WITH PG&E AND PT&T REQUIREMENTS.

△1 ◇6 ROUTED PG&E SERVICE CONDUITS THROUGH BARMINUTOR CHAMBER

LEGEND

▭	FLUORESCENT FIXTURE AND OUTLET ~ SURFACE
⬡	LIGHTING FIXTURE IDENTIFICATION TAG
S	SINGLE POLE WALL SWITCH +54"
S^T	MANUAL MOTOR STARTER
⊖	RECEPTACLE, DUPLEX, 15A, 3PG, 120 V.
▶	WALL MOUNTED TELEPHONE, PER SPECIFICATIONS, +50
Ⓙ	JUNCTION BOX
Ⓜ	MOTOR OUTLET AND CONNECTION
☐	DISCONNECT SWITCH
■	PANELBOARD
——	CONDUIT RUN EXPOSED
◇	SHEET NOTE IDENTIFICATION TAG
⊟	SECTION OR DETAIL IDENTIFICATION TAG
⊖	MECHANICAL EQUIPMENT IDENTIFICATION TAG
- - - -	CONDUIT RUN CONCEALED BELOW FLOOR OR GRADE
LS	LEVEL SWITCH
—▶—	CONDUIT SEAL
	TRANSFORMER
	MOLDED CASE CIRCUIT BREAKER
	CURRENT TRANSFORMER
FS	FLOAT SWITCH
Ⓐ	AMMETER
MCP	COMBINATION MOTOR STARTER WITH MOTOR CIRCUIT PROTECTOR SINGLE SPEED
—B—	BUBBLER AIR PIPING
●●	CONTROL STATION
L	LOCK-OUT STOP PUSHBUTTON
PS	PRESSURE SWITCH
	EQUIPMENT CONNECTION
●	GROUND ROD, TOP 6" BELOW GRADE, OR AS NOTED.
—G—	GROUND CABLE, #4/0, 12" BELOW GRADE.
Ⓢ	SOLENOID VALVE.
LS	LIMIT SWITCH.
Ⓕ	AIR FLOW SWITCH.
U.O.N	UNLESS OTHERWISE NOTED
⊸	BUBBLER TUBE
WP	WEATHERPROOF

(REVISED SET JUNE 2006)

Record Drawing

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OF
141

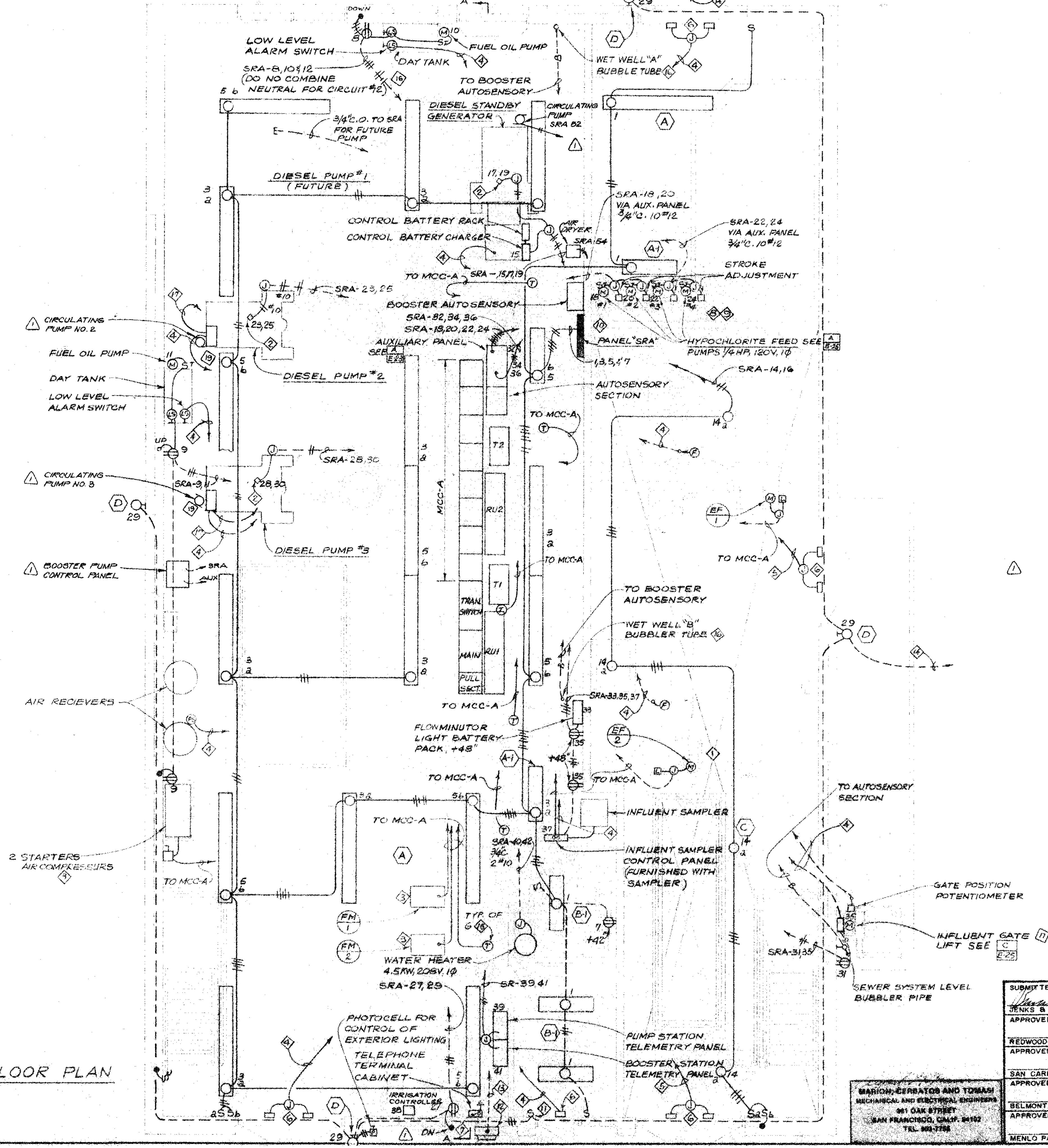
△1 RECORD DRAWING, JUNE 1982

E-15

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA
SUBREGIONAL WASTEWATER WORKS
SAN CARLOS PUMP STATION
ELECTRICAL
SITE PLAN - LEGEND
JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: JW RB
Scale: AS NOTED
Des/Chkd by: AMM
Date: 8-77/9-79



GROUND FLOOR PLAN

SCALE 1/4"=1'-0"

SHEET NOTES

1. INSTALLATION IN THIS AREA SHALL BE IN ACCORDANCE WITH N.E.C. ARTICLE #500 FOR CLASS I, DIVISION I, HAZARDOUS LOCATIONS.
2. ENGINE HEATERS, 2KW, 208V-1Φ, VERIFY ACTUAL LOCATION FROM SHOP DRAWINGS.
3. PACKAGE UNIT, REFER TO MANUFACTURER'S SHOP DRAWINGS.
4. TO AUXILIARY PANEL, SEE A/E-22 & C/E-22
5. TO INTRINSICALLY SAFE RELAY IN AUXILIARY PANEL
6. FURNISH AND INSTALL MAGNETIC DOOR SWITCHES, WITH MAGNET FOR EACH DOOR, EDWARDS #61, WITH NORMALLY OPEN (DOOR CLOSED) CONTACTS IN PARALLEL, SEE C/E-22
7. 1/2"C. 1#12 TO NEAREST WATER PIPE (GROUND) PER TELEPHONE COMPANY REQUIREMENTS.
8. CONNECT PER MANUFACTURER'S INSTRUCTIONS
9. EXPOSED CONDUIT IN HYPOCHLORITE AREA SHALL BE P.V.C.
10. MOUNT TRANSFORMER "T3" ON WALL ABOVE PANEL
11. PHOTO-CELL BY-PASS SWITCH. PROVIDE LABEL.
12. REMOTE P.G.&E METERING
13. TO METERING SECTION IN MAIN SWITCHBOARD
14. OUT TO POLE MOUNTED FIXTURE, CONTINUED ON E-15
15. REFER TO MECHANICAL DRAWING SH-72 FOR LOCATION OF THERMOSTATS.

REFER TO MECHANICAL DRAWING SH-74 FOR BUBBLER TUBE PIPING DETAIL.

TO BOOSTER AUTOSENSORY, WIRE & CONDUIT AS REQUIRED BY EQUIPMENT SUPPLIER.

16. FUEL PUMP & FUEL LEVEL SWITCH FOR DIESEL GENERATOR DAY TANK ON CIRCUIT #47, FOR BOOSTER PUMP ENGINE DAY TANK ON CIRCUIT #48.
17. 480V, 3Φ W/W.P. DISCONNECT HOME RUN TO MCC W/15A 3POLE BREAKER.
18. ⚠1 IRRIGATION CONTROLLER ON CIRCUIT #38
19. CIRCULATING PUMPS WITH MANUAL AND ROOF-MOUNTED THERMOSTATIC STARTERS. CIRCUIT #50 FOR PUMP NO. 2, CIRCUIT #52 FOR PUMP AT GENERATOR. CIRCUIT #49 FOR PUMP NO. 3.

(REVISED SET JUNE 2006)

Record Drawing

⚠1 RECORD DRAWING, JUNE 1982

E-16

MARION, CERBATOS AND TOMASI
MECHANICAL AND ELECTRICAL ENGINEERS
961 OAK STREET
SAN FRANCISCO, CALIF. 94102
TEL. 863-7788

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

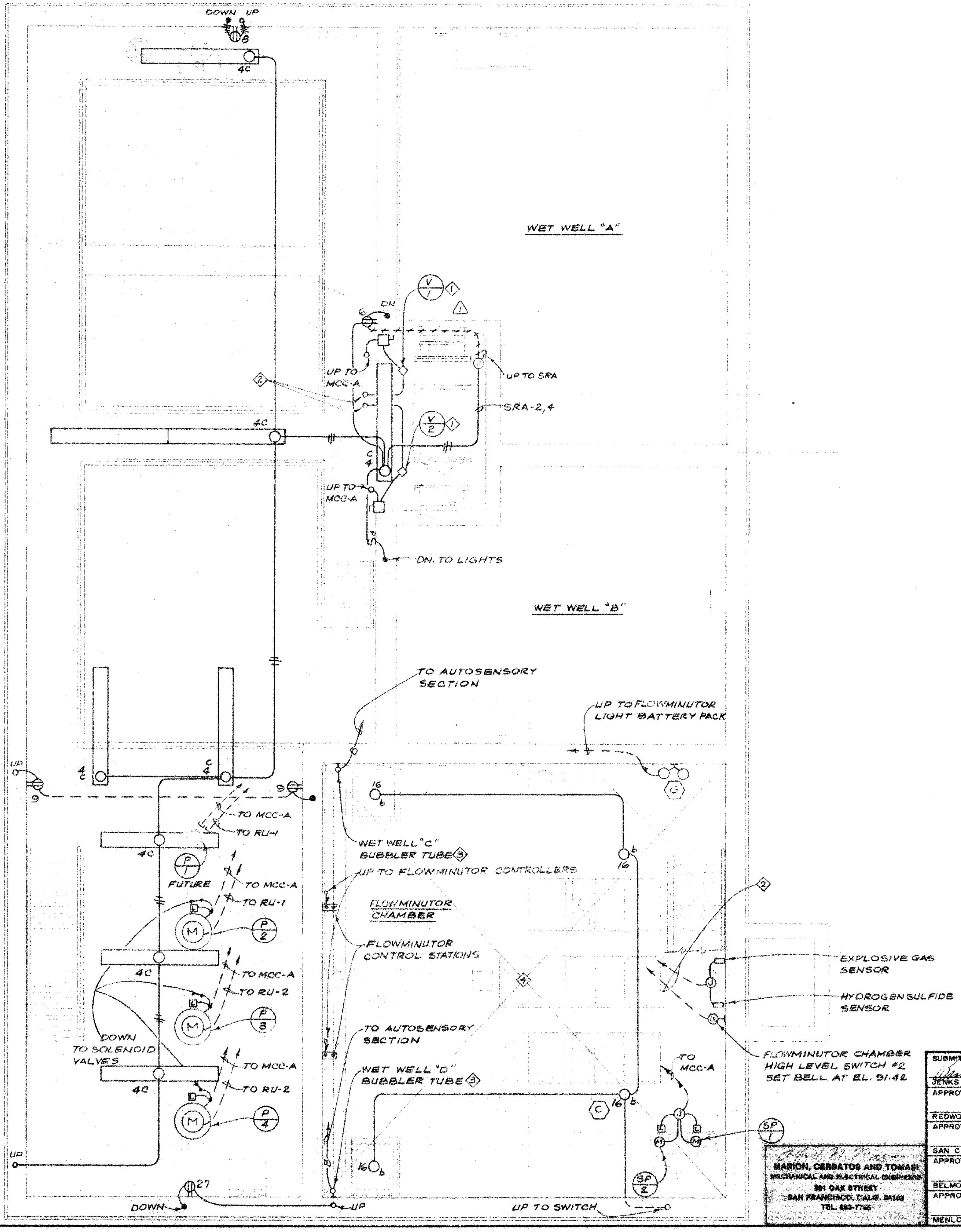
SAN CARLOS PUMP STATION
ELECTRICAL
GROUND FLOOR PLAN

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: JW RB	Scale: AS NOTED
Des/Chkd by: AMM	Date: 8-77/9-77

SHEET NOTES

1. PACKAGE UNIT REFER TO MANUFACTURER'S DRAWINGS.
2. TO AUXILIARY PANEL, SEE A/E-22 & C/E-22
3. REFER TO MECHANICAL DRAWING SH-74, FOR BUBBLER PIPING DETAIL.
4. INSTALLATION THIS AREA SHALL BE IN ACCORDANCE WITH NEC ARTICLE 500 FOR CLASS. I, DIVISION I HAZARDOUS LOCATIONS



INTERMEDIATE FLOOR PLAN
SCALE: 1/4" = 1'-0"

Record Drawing

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113 OF 141

1 RECORD DRAWING, JUNE 1982

E-17

SUBMITTED
JENKS & HARRISON DATE
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MARION, CERBATOS AND TOMASI
MECHANICAL AND ELECTRICAL ENGINEERS
301 OAK STREET
SAN FRANCISCO, CALIF. 94102
TEL. 863-7765

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
ELECTRICAL
INTERMEDIATE FLOOR PLAN

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

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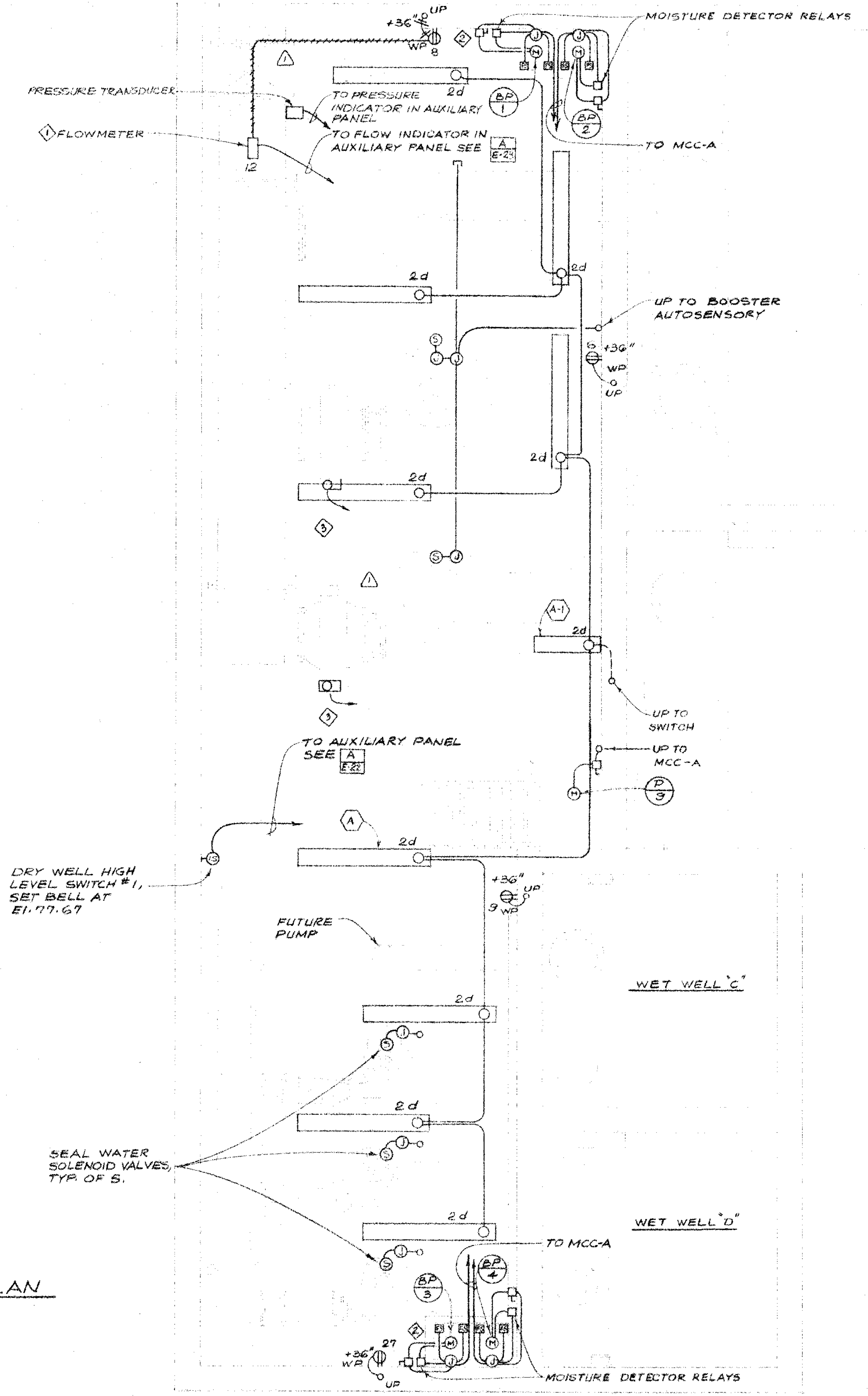

PUMP ROOM PLAN
SCALE: 1/4"=1'-0"

SHEET NOTES

◇1 REQUIREMENTS FOR INSTALLATION VARY ACCORDING TO TYPE OF FLOWMETER FURNISHED. INSTALL PER MANUFACTURER'S INSTRUCTIONS. WALL MOUNTED FLOWMETER, IF FURNISHED SHALL BE MOUNTED AS DIRECTED BY ENGINEER.

◇2 FLOAT SWITCHES & MOISTURE DETECTOR RELAYS ARE FURNISHED WITH BILGE PUMPS. SET FLOAT SWITCHES AS DIRECTED BY ENGINEER. MOUNT MOISTURE DETECTOR RELAYS AT +60" AND CONNECT PER MANUFACTURER'S INSTRUCTIONS. SEE G/E-25.

△1 ◇3 30" BALL VALVE MOTOR OPERATORS. POWER FROM MCC-A, CONTROLS AT BOOSTER PUMP ENGINES CONTROL PANEL.

(REVISED SET JUNE 2006)

Record Drawing

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114 OF 141

△1 RECORD DRAWING, JUNE 1982

E-18

MARION, CERBATOS AND TOMASI
MECHANICAL AND ELECTRICAL ENGINEERS
361 OAK STREET
SAN FRANCISCO, CALIF. 94102
TEL. 863-7756

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SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
ELECTRICAL
PUMP ROOM PLAN

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

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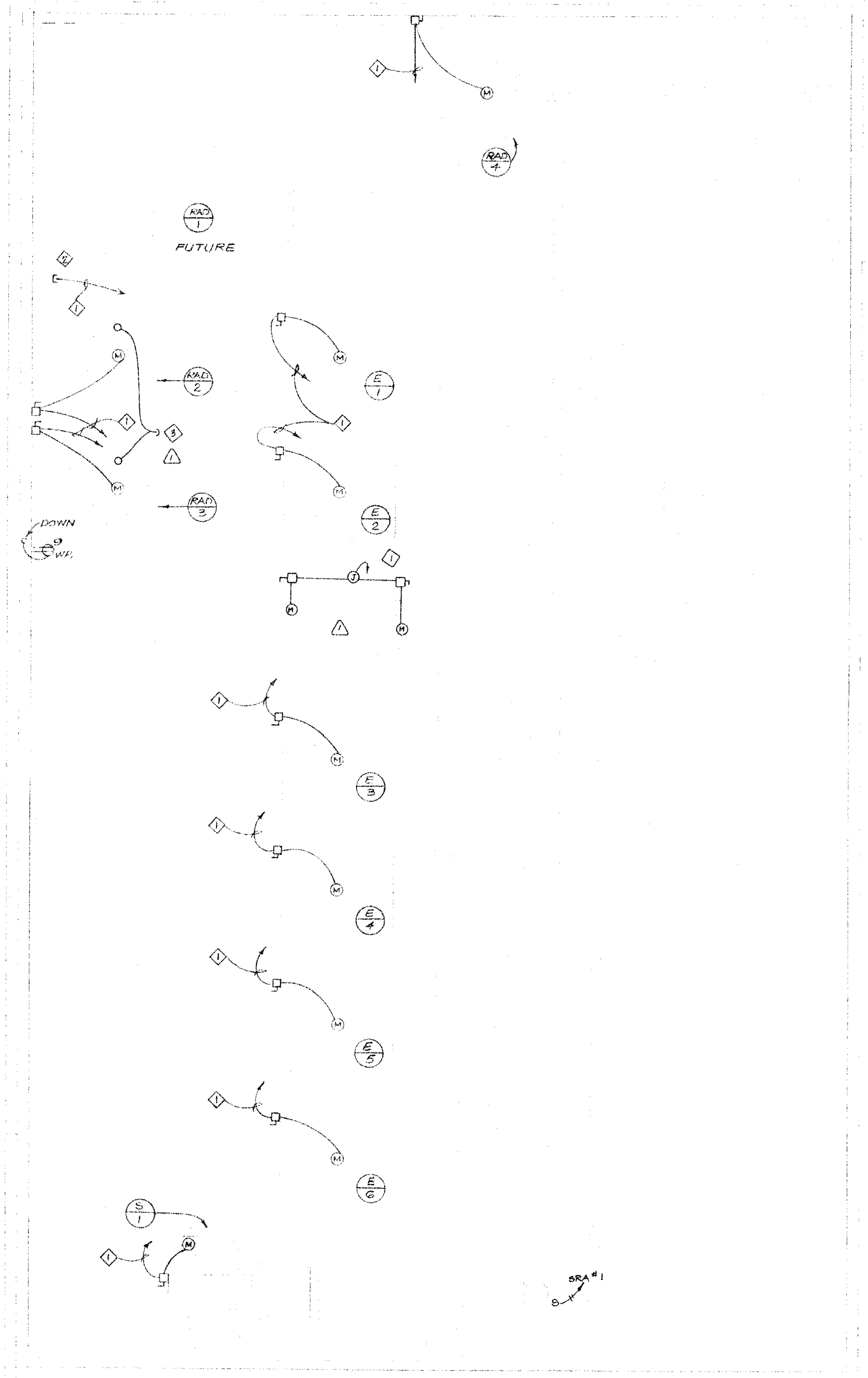

ROOF PLAN

SCALE: 1/4"=1'-0"

SHEET NOTES

1. DOWN TO MCC-A
2. STUB OUT AND CAP FOR FUTURE RADIATOR
3. RADIATOR LOW WATER CUT OFF SWITCHES CIRCUIT TO BOOSTER PUMP ENGINES CONTROL PANEL

(REVISED SET JUNE 2006)

Record Drawing

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115 OF 141

1 RECORD DRAWING, JUNE 1982

E-19

MARION, CERBATOS AND TOMASI
MECHANICAL AND ELECTRICAL ENGINEERS
351 OAK STREET
SAN FRANCISCO, CALIF. 94102
TEL. [illegible]-7755

SUBMITTED JENKS & HARRISON	DATE
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SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
ELECTRICAL
ROOF PLAN

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

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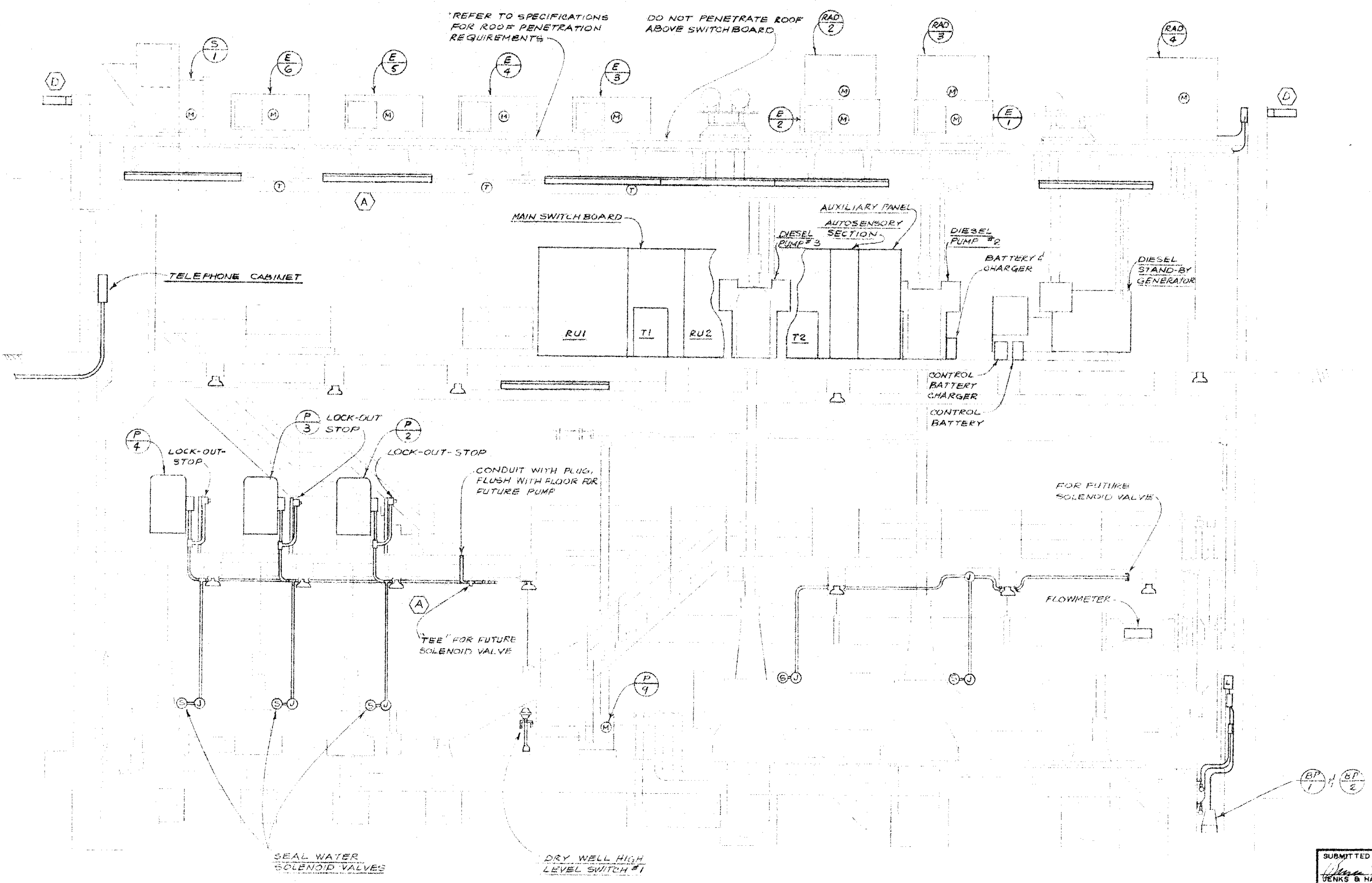
NOTES

① SEE SH-72 FOR MOUNTING OF THERMOSTATS



SECTION A-A
SCALE: 1/4"=1'-0"

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116 OF 141

RECORD DRAWING, JUNE 1982

E-20

MARION, CERBATOS AND TOMASI
MECHANICAL AND ELECTRICAL ENGINEERS
361 OAK STREET
SAN FRANCISCO, CALIF. 94102
TEL. 863-7758

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JENKS & HARRISON DATE
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BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
ELECTRICAL
BUILDING SECTION

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

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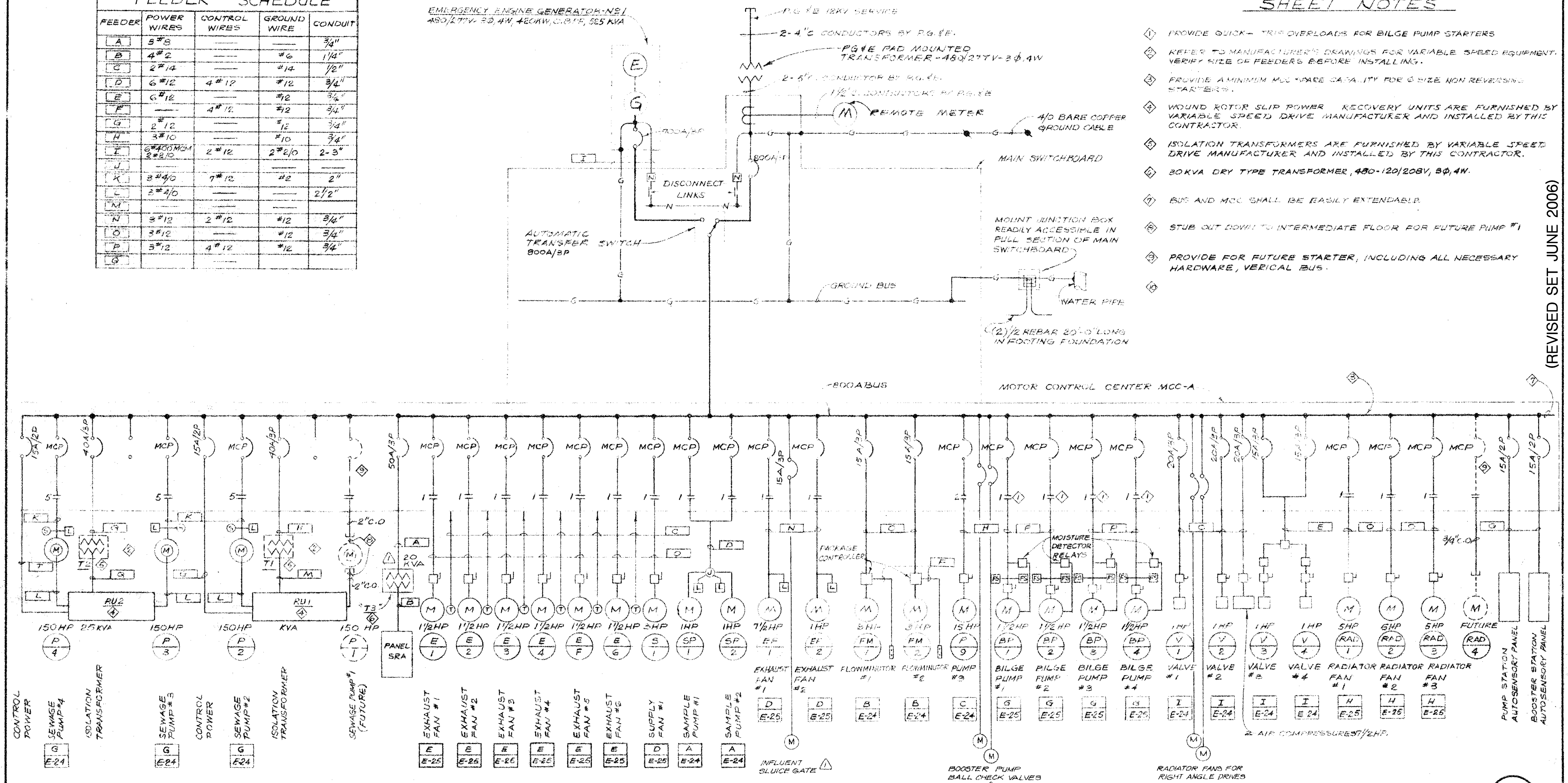
Date: 8-77/9-79



MAIN PUMP STATION SINGLE LINE DIAGRAM

FEEDER SCHEDULE

FEEDER	POWER WIRES	CONTROL WIRES	GROUND WIRE	CONDUIT
A	3#8	—	—	¾"
B	4#2	—	#6	1¼"
C	2#14	—	#14	½"
D	6#12	4#12	#12	¾"
E	6#12	—	#12	¾"
F	—	4#12	#12	¾"
G	2#12	—	#12	¾"
H	3#10	—	#10	¾"
I	6#400MCM 2#2/0	2#12	2#2/0	2-3"
J	—		—	—
K	3#4/0	7#12	#2	2"
L	3#4/0	—	—	2½"
M	—	—	—	
N	3#12	2#12	#12	¾"
O	3#12	—	#12	¾"
P	3#12	4#12	#12	¾"
Q		—		

SHEET NOTES

1. PROVIDE QUICK- TRIP OVERLOADS FOR BILGE PUMP STARTERS
2. REFER TO MANUFACTURER'S DRAWINGS FOR VARIABLE SPEED EQUIPMENT. VERIFY SIZE OF FEEDERS BEFORE INSTALLING.
3. PROVIDE A MINIMUM MCC SPARE CAPACITY FOR 6 SIZE NON REVERSING STARTERS.
4. WOUND ROTOR SLIP POWER RECOVERY UNITS ARE FURNISHED BY VARIABLE SPEED DRIVE MANUFACTURER AND INSTALLED BY THIS CONTRACTOR.
5. ISOLATION TRANSFORMERS ARE FURNISHED BY VARIABLE SPEED DRIVE MANUFACTURER AND INSTALLED BY THIS CONTRACTOR.
6. 30 KVA DRY TYPE TRANSFORMER, 480-120/208V, 3Ø, 4W.
7. BUS AND MCC SHALL BE EASILY EXTENDABLE
8. STUB OUT DOWN TO INTERMEDIATE FLOOR FOR FUTURE PUMP #1
9. PROVIDE FOR FUTURE STARTER, INCLUDING ALL NECESSARY HARDWARE, VERICAL BUS.
10.

(REVISED SET JUNE 2006)

Record Drawing

117 OF 141

E-21

⚠ RECORD DRAWING, JUNE 1982

SUBMITTED
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SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
ELECTRICAL
SINGLE LINE DIAGRAM

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

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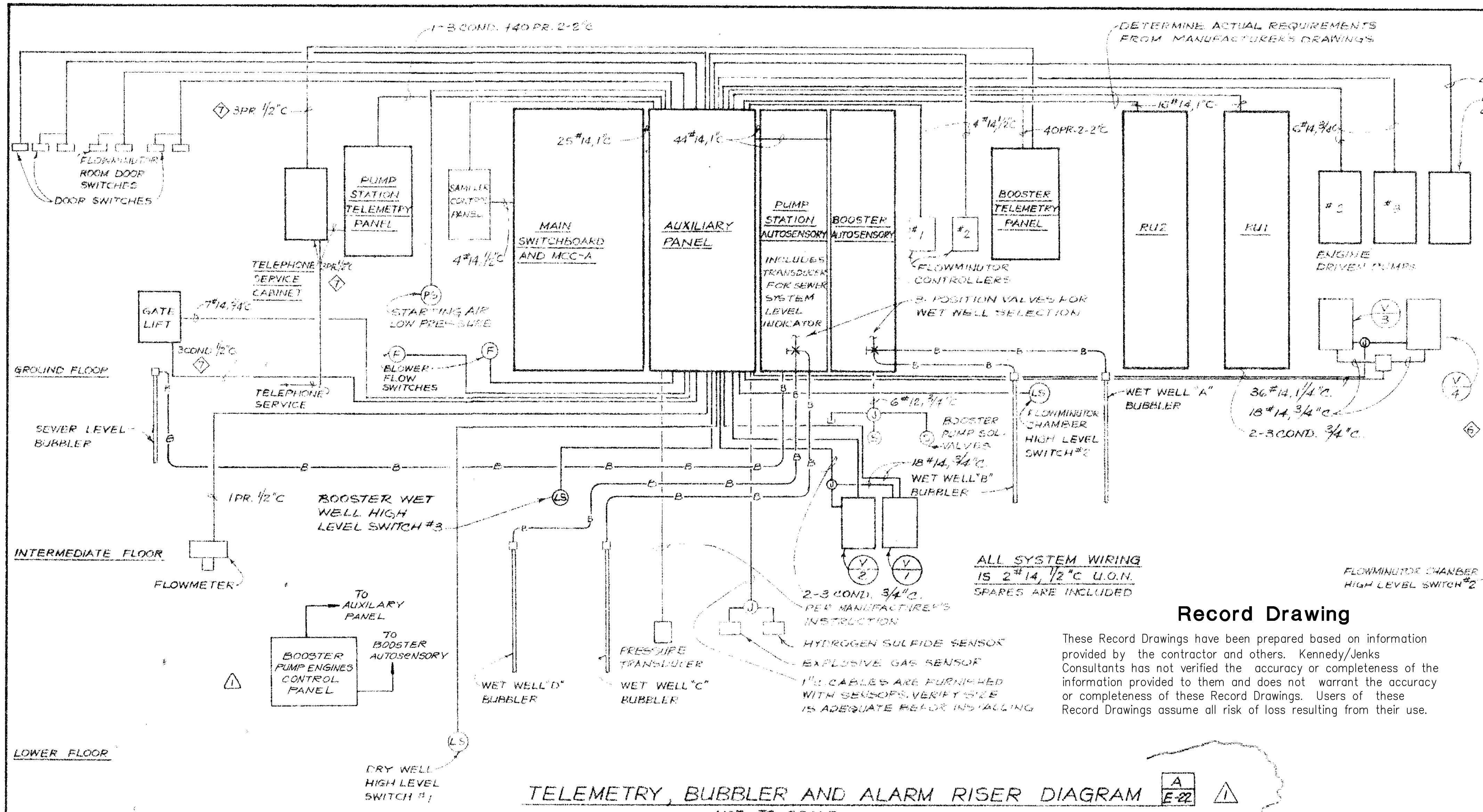
Des/Chkd by:	AMM	Date:	8-77 / 9-79



TELEMETRY, BUBBLER AND ALARM RISER DIAGRAM A/E-22

NOT TO SCALE

Record Drawing

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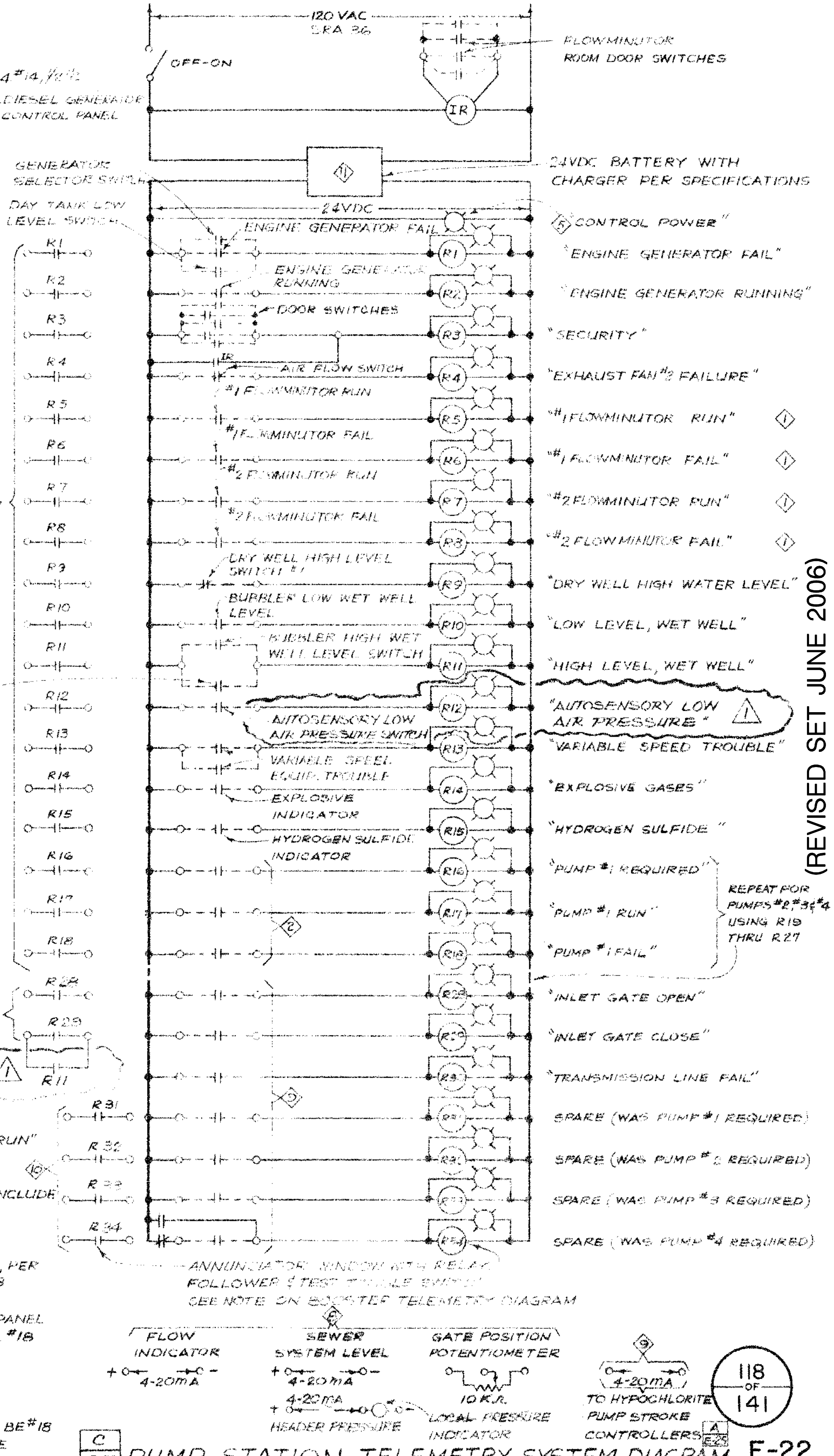
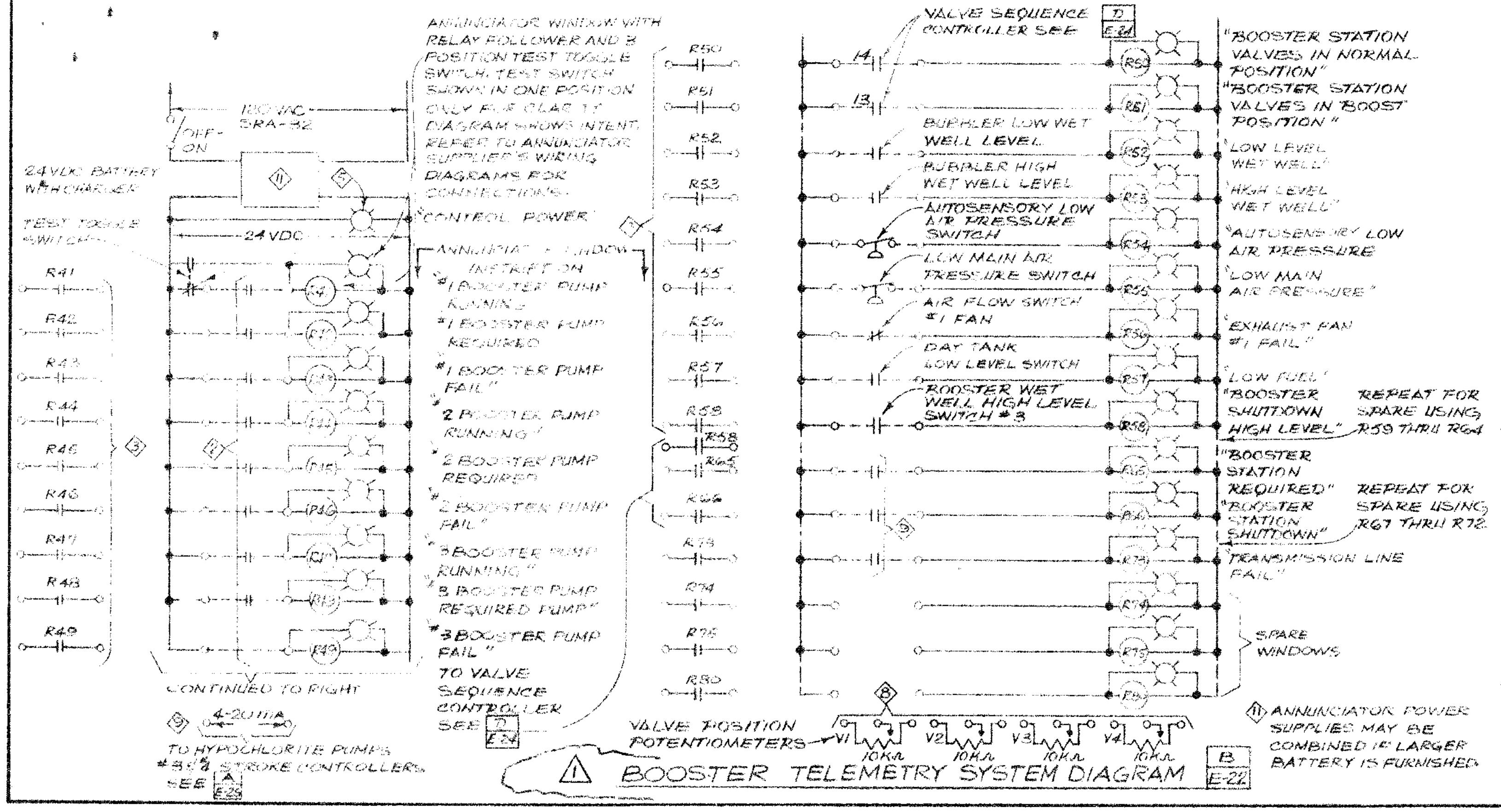


C/E-22 PUMP STATION TELEMETRY SYSTEM DIAGRAM



BOOSTER TELEMETRY SYSTEM DIAGRAM B/E-22

SHEET NOTES

1. FLOWMINUTOR CONTROLS SHALL INCLUDE "RUN" AND "FAIL" CONTACTS PER B/E-24.
2. PUMP & AUTOSENSORY CONTROLS SHALL INCLUDE CONTACTS TO GIVE REQUIRED SIGNAL.
3. CONNECT TO BOOSTER TELEMETRY PANEL, PER MANUFACTURER'S INSTRUCTIONS, USING #18 SHIELDED TWISTED PAIR.
4. CONNECT TO PUMP STATION TELEMETRY PANEL PER MANUFACTURER'S INSTRUCTIONS USING #18 SHIELDED TWISTED PAIR.
5. INSTALL PILOT LIGHTS, WITH ENGRAVED NAMEPLATES, IN RELAY PANEL DOORS.
6. ALL INPUTS TO TELEMETRY PANEL SHALL BE #18 SHIELDED CABLE, TWISTED PAIR OR THREE CONDUCTOR, AS SHOWN
7. USE SAME SHIELDED CABLE AS FOR ⑥.
8. CONNECT ANALOG INPUTS DIRECTLY TO TELEMETRY PANEL PER MANUFACTURER'S INSTRUCTIONS.
9. OUTPUTS FROM TELEMETRY PANEL. REFER TO AUTOCON DRAWINGS.
10. NOT USED, SPARE, PROVIDED IN TELEMETRY EQUIPMENT FURNISHED BY OWNER

REV.	DATE	DESCRIPTION
1	7/94	GENERAL REVISION

MARION, CERRATOS AND TOMASI
MECHANICAL AND ELECTRICAL ENGINEERS
461 OAK STREET
SAN FRANCISCO, CALIF. 94102
TEL. [illegible]

SUBMITTED
JENKS & HARRISON DATE
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REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
ELECTRICAL
TELEMETRY DIAGRAMS

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

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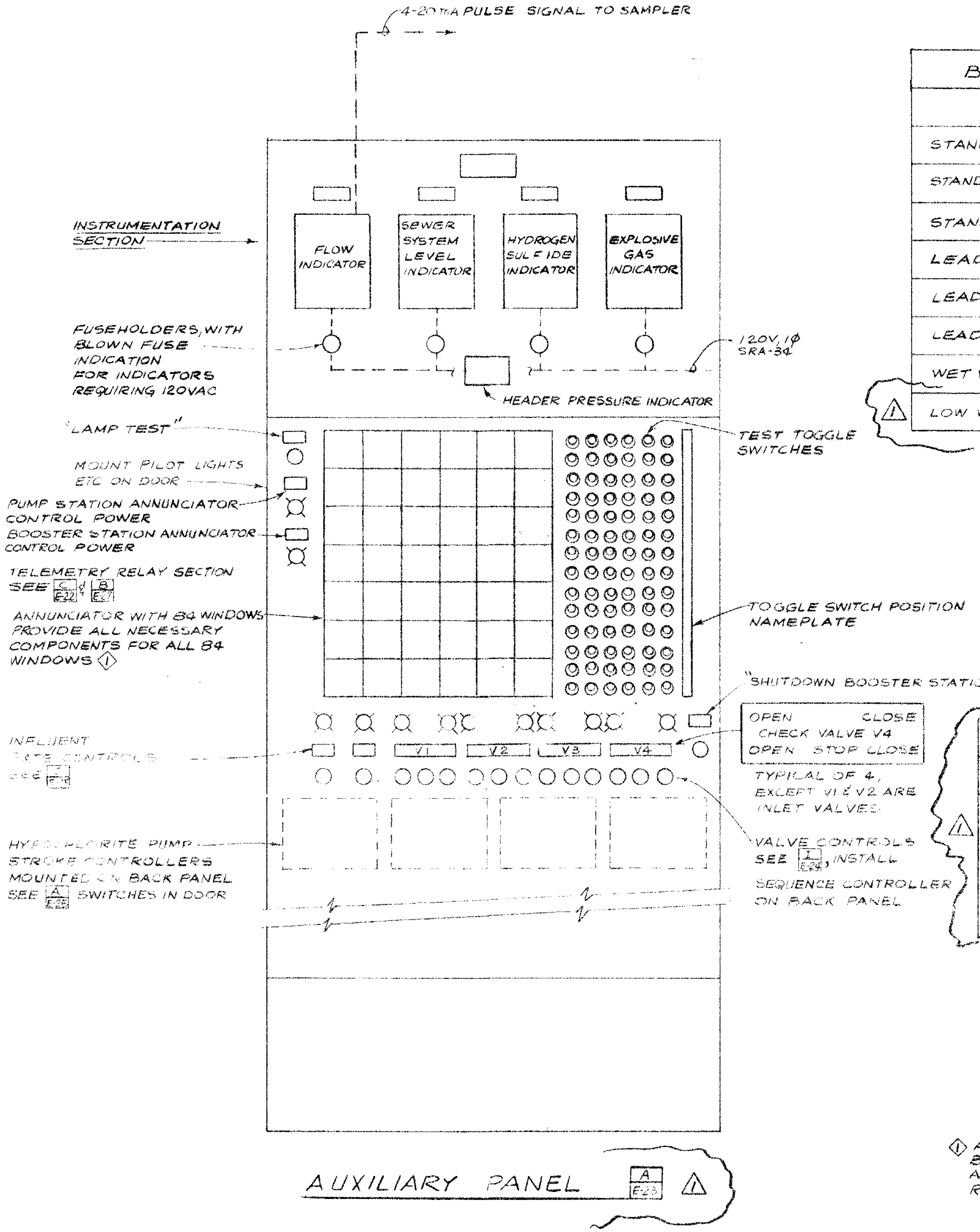
E-22

118 OF 141

(REVISED SET JUNE 2006)



AUXILIARY PANEL A/E-23 ⚠1

BOOSTER PUMP AND ALARM PROGRAM		
PUMP OPERATION	ELEVATION	
	RISING	FALLING
STANDBY PUMP - HIGH SPEED	96.5	
STANDBY PUMP - LOW SPEED, HIGH WET WELL LEVEL ALARM	95.5	
STANDBY PUMP - OFF		95.0
LEAD PUMP - HIGH SPEED	95.0	
LEAD PUMP - LOW SPEED	90.5	
LEAD PUMP - OFF, WET WELL EMPTYING PUMP ON		87.0
WET WELL EMPTYING PUMP OFF		78.5
⚠1 LOW WET WELL LEVEL ALARM		91.0

PUMP STATION PUMP AND ALARM PROGRAM		
PUMP OPERATION	ELEVATION	
	RISING	FALLING
— HIGH WET WELL LEVEL SWITCH	89.0	
STANDBY PUMP — HIGH SPEED	88.5	
STANDBY PUMP — LOW SPEED, HIGH WET WELL LEVEL ALARM.	87.5	
LAG PUMP — HIGH SPEED	87	
STANDBY PUMP — OFF		87
LAG PUMP — LOW SPEED	85.5	
LEAD PUMP — HIGH SPEED	85.0	
LAG PUMP — OFF		85.0
LEAD PUMP — LOW SPEED	83.5	
LEAD PUMP — OFF		82.0
— LOW WET WELL LEVEL ALARM.		81.0

PANELBOARD SCHEDULE

⚠1

PANEL	CIRCUIT DATA		MOUNT	TYPE	BUS
	CIRCUIT Nº	BREAKER			
SRA	1-9, 14-16, 26, 27, 28, 29, 32-39, 41, 49-50	20A/1P	SURFACE	NLAB DOUBLE TUB	225A, 120/208V, 3Ø, 4W.
	10-13, 18, 20-22, 24, 31, 34-36, 47, 48	15A/1P			
	40-42	30A/2P			
	17-19, 23-25, 28-30	20A/2P			
	51-60	SPACE			
	MAIN	100A/3P			

FIXTURE SCHEDULE

TAG	MANUFACTURER'S CAT. Nº	LAMP	VOLTS	MOUNTING
A	DAY BRITE #8N4R	4F40/CW	120V	SURFACE
A1	DAY BRITE #4N2R	2F40/CW		
B				
B-1	DAY BRITE #14 WA2RA	2F40/CW		
C	CROUSE-HINDS #EVC×2021	1-300W, PS-30		
D	GARDCO #BE14FS-120-160 HPS-BRA	1-150WHPS		WALL SURFACE
F	PRESCOLITE #9300 WITH GUARD	1-100W-A	120V	WALL SURFACE
G	CHLORIDE #HZ-2-12-44	2-44 W	12V	WALL SURFACE
H	GARDCO #H141FM-120-150 HPS-BRA WITH #C49-20L POLE	1-150W, HPS	120V	POLE I/E-25

SHEET NOTES

① ARRANGE WINDOWS SO THAT BEZEL COLOR SHALL BE BLACK FOR NORMAL INPUTS, AND RED FOR ALARM INPUTS. PROVIDE 4 SPARE RED BEZEL REMAINDER TO BE BLACK.

⚠1 SEE SHEET 119 A FOR BOOSTER PUMP ENGINES CONTROL PANEL MODIFICATIONS, BALL CHECK VALVE CONTROLLER PANEL DIAGRAM AND AUXILIARY PANEL MODIFICATION.

Record Drawing

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119 OF 141

⚠1 RECORD DRAWING, JUNE 1982

E-23

REV.	DATE	DESCRIPTION
⚠1	7/14/82	GENERAL REVISION

MARION, CERBATOS AND TOMASI
MECHANICAL AND ELECTRICAL ENGINEERS
381 OAK STREET
SAN FRANCISCO, CALIF. 94102
TEL. 863-7755

SUBMITTED
JENKS & HARRISON DATE
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REDWOOD CITY DATE
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SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA
SUBREGIONAL WASTEWATER WORKS
SAN CARLOS PUMP STATION
ELECTRICAL
SCHEDULES AND DETAILS
JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS
Drawn by: JW RB
Scale: NONE
Des/Chkd by: AMM
Date: 8-77 / 9-79

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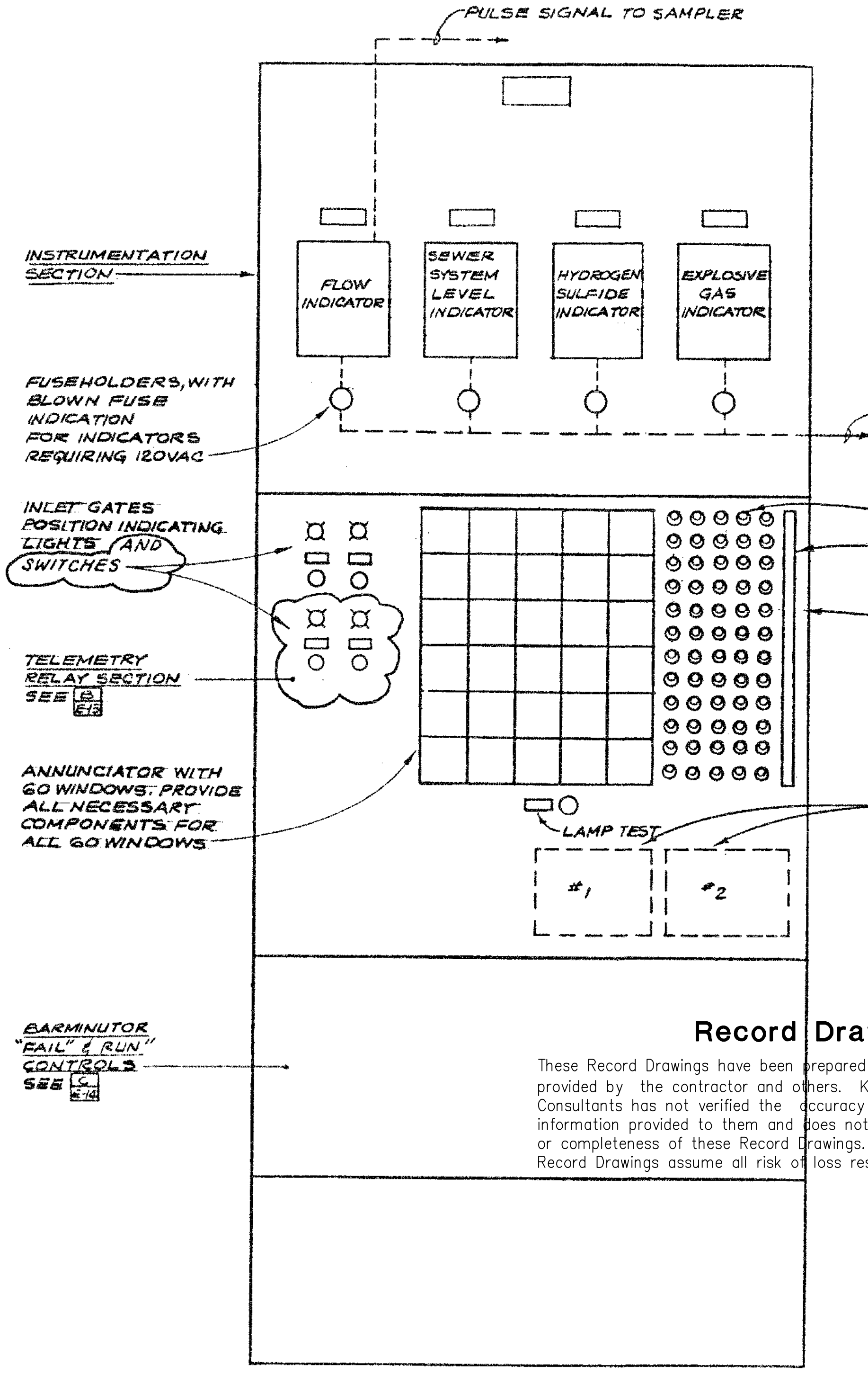
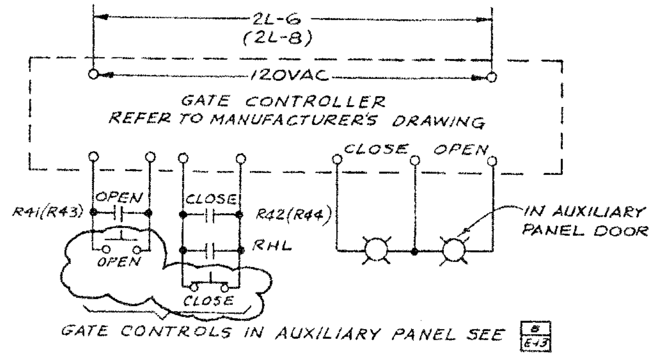
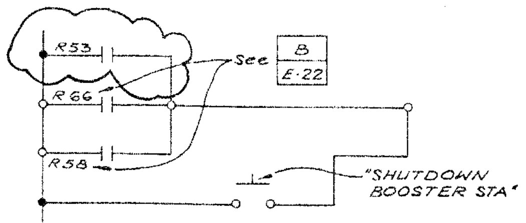


AUXILIARY PANEL A E-14
REDWOOD CITY PUMP STATION

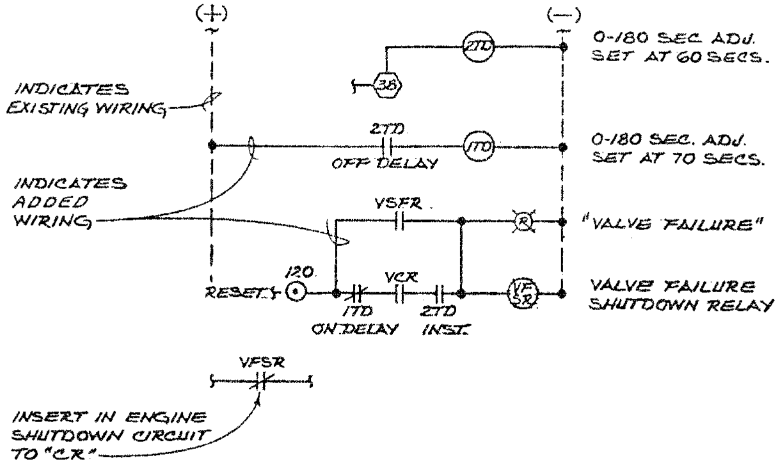


GATE CONTROLS IN AUXILIARY PANEL SEE B E-13

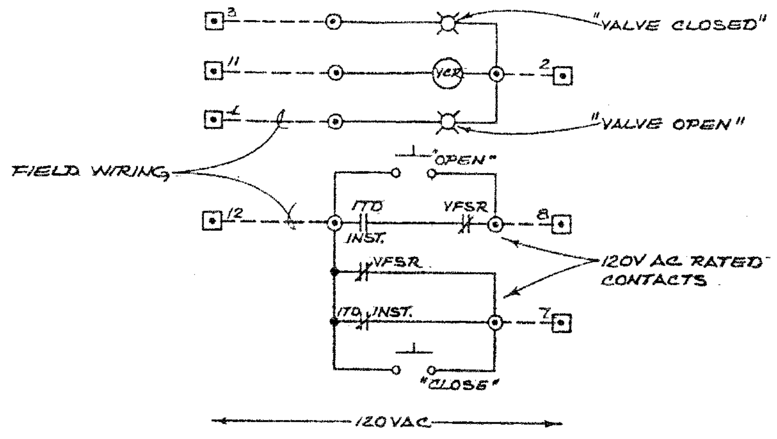
GATE CONTROL DIAGRAM E E-14
REDWOOD CITY PUMP STATION



AUXILIARY PANEL
SAN CARLOS PUMP STATION



EXISTING ENGINE CONTROLS



BALL CHECK VALVE CONTROL

SAN CARLOS PUMP STATION MODIFICATIONS TO LLOYD ENGINE CONTROL PANELS

SEE LLOYD DWG, OL1531D-2
TYPICAL FOR TWO BOOSTER PUMPS

LEGEND

⬡ TERMINAL ON ENGINE CONTROL MODULE
▣ TERMINAL IN VALVE CONTROLLER.
⊙ TERMINAL IN CONTROL PANEL.

CHANGE ORDERS

SAN CARLOS PUMP STATION

A. Ball Valve Controls: Provide power and control wiring for two electric ball valves on the engine driven booster pumps as follows:
  1. Install two additional 15A/3P circuit breakers in motor control center MCC-A.
  2. Provide power feeder, for each valve, from MCC-A, sized 3/4" conduit with 3 #12 power and 1 #12 ground.
  3. Provide control wiring from each valve to their respective booster engine control panel each sized 3/4" with 8 #14 (one is spare).
  4. Modify the Lloyd engine control panels per the detail above.

B. Auxiliary Panel: Refer to detail "B" on sheet E-22, and detail "D" on sheet E-24. Add a contact on annunciator relay R53. See detail at left.

C. Booster Pumps-Autocon Autosensory: Jumper out the interlocking which prevents the standby pump from running if the lead pump is running. Indicate purpose of jumper on drawings for future reference.

D. Main Treatment Plant-Autocon Main Telemetry Panel: Add a normally open pushbutton on the door of this panel and connect to the telemetry system. Connect pushbutton so as to activate "Booster Station Shutdown" at San Carlos Pump Station. Provide engraved phenolic nameplate "San Carlos Booster Station Shutdown".

REDWOOD CITY PUMP STATION

Auxiliary Panel: Add "open" and "close" pushbuttons. See detail above.

BELMONT PUMP STATION

A. Auxiliary Panel: Refer to Telemetry System Diagram on sheet E-29 and detail "C" on sheet E-30. Add a contact on annunciator relay R12. Contacts shall be parallel with the R26 and R13 contacts which are connected to the Inlet Gate Controls.

B. Existing Autocon Equipment: Certain changes to this equipment are already required by note #20 on sheet E-28 and notes #1 and #2 on sheet E-29. In addition to these changes, add the following:

Modify the pump operation so that as the demand for pumping capacity increases, the first variable speed pump shall automatically start at minimum speed and be increased in speed to precisely match system demand. If the demand exceeds the capacity of the first pump running at maximum speed, the first pump shall be automatically transferred to the line at full speed and the second pump shall automatically start at minimum speed. The second pump shall then increase in speed to match the pump requirements.

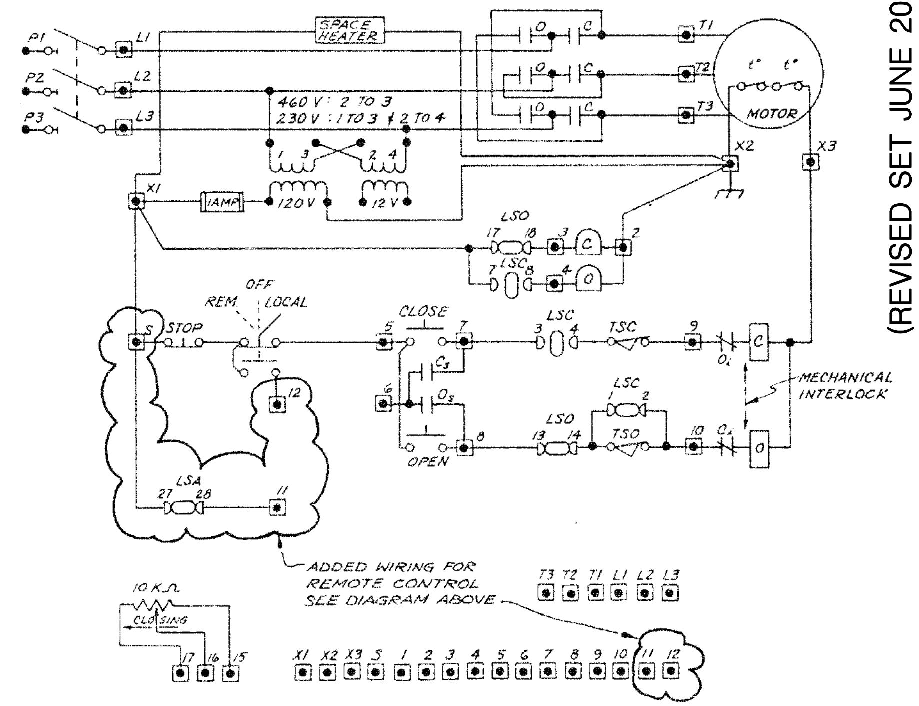
On decreasing demand for pumping capacity, the second pump shall automatically reduce its speed to match demand until dropping to minimum speed. If the demand continues to decrease, the first pump shall be automatically shut off and the second pump shall be ramped to maximum speed. As demand for pumping capacity continues to decrease, the second pump speed shall automatically be reduced proportional to the demand. Under a minimum system demand condition, the second pump speed shall be reduced to minimum speed and held until the level falls to the preset "STOP" level. The speed of each variable speed pump shall be infinitely variable from minimum to maximum speed.

Closed transition circuit shall be provided to minimize electrical surges during transfer of the variable speed motor to constant speed operation. In the event of VFD "fail", the system will automatically run the pumps in constant line speed mode.

In addition to the change required by note #20 on sheet E-28, provide for power failure recycling after a power failure so as to minimize inrush currents. Provide interlocking so that standby pump will run on its program only if one of the other two pumps is in the "Fail" mode. Make additional changes that will bring this equipment and its operation up to Autocon's modern practice and make its operation similar to the new equipment being furnished at the other pump stations, as follows:

1. Add a new B+ delay card.
2. Convert unit from 6 fuses to 2 fuses.
3. Modify capacitor bank timer circuit.
4. Add louvers and 2 exhaust fan assemblies.
5. Install new percentage RPM meter (old one not working).

Changes shall be designed, performed and acceptance tested by authorized Autocon representatives, and shall comply with the project specifications. Submit drawings and description of proposed changes for approval. Provide "as-built" drawings at completion of project.



BALL CHECK VALVE
CONTROLLER PANEL DIAGRAM

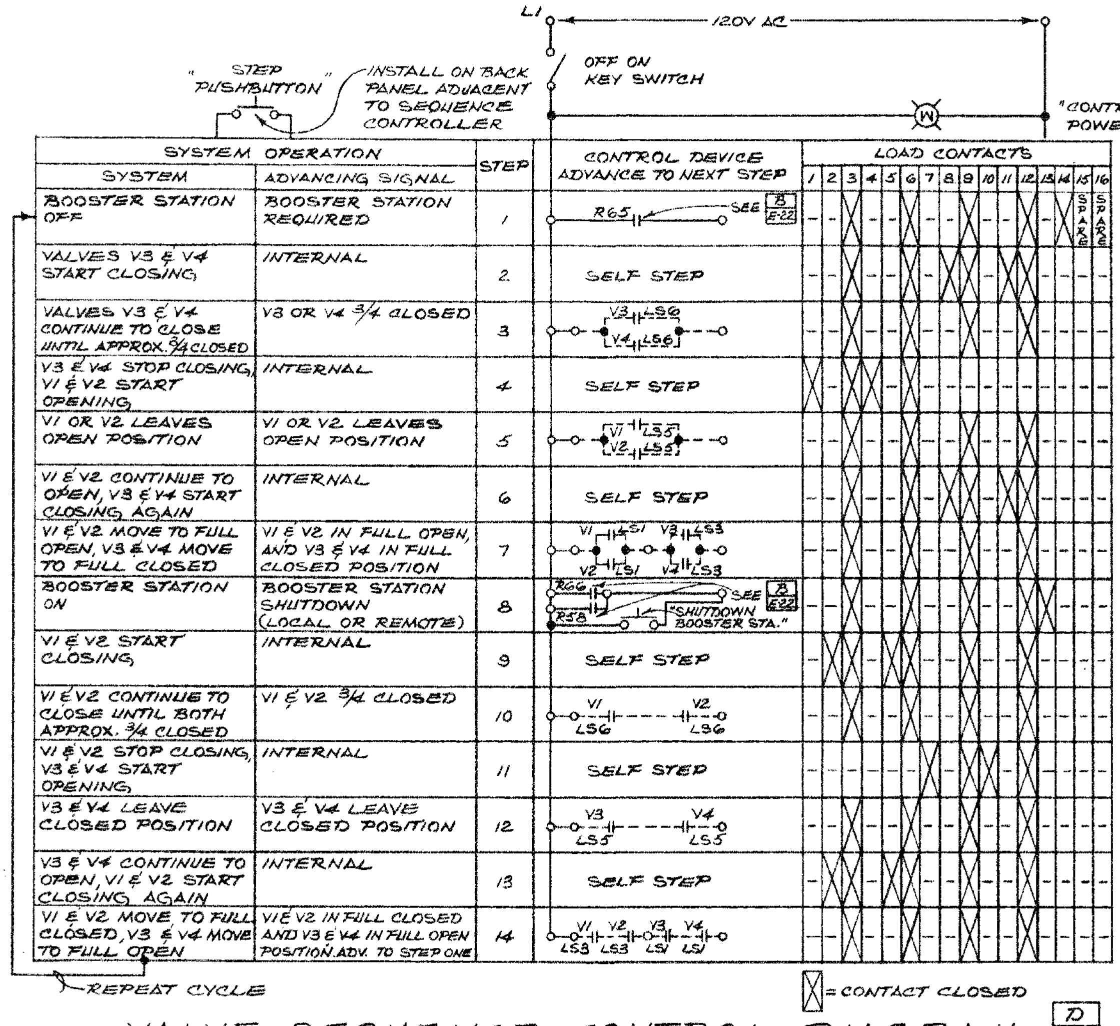
(REVISED SET JUNE 2006)

119A OF 141

CHANGE ORDER NO. 4

SUBMITTED KENNEDY/JENKS DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	PUMP STATIONS ELECTRICAL DETAILS AND DIAGRAMS
APPROVED BELMONT DATE	KENNEDY / JENKS ENGINEERS CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: JC — Scale: NONE Des/Chkd by: AMM DAB — Date: MAY 1981

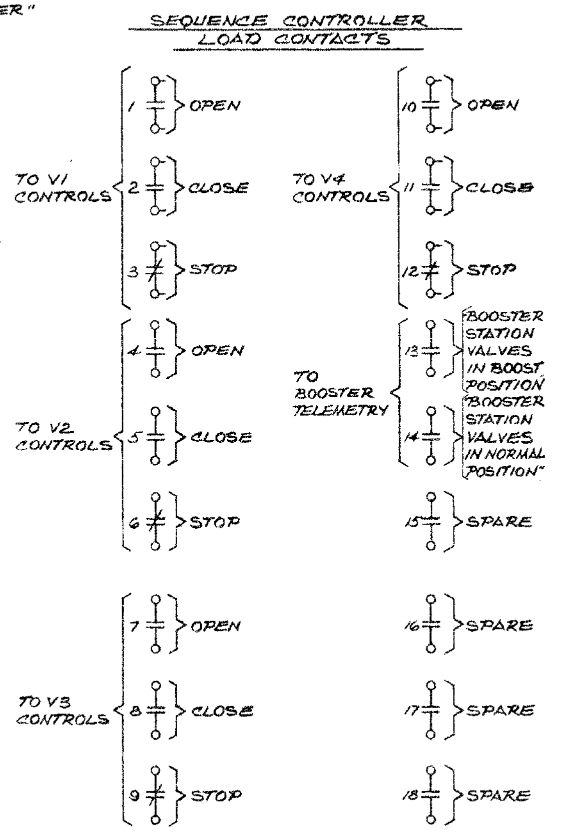
MARION, CERBATOS AND TOMASI
MECHANICAL AND ELECTRICAL ENGINEERS
361 OAK STREET
SAN FRANCISCO, CALIF. 94102
TEL. 863-7755

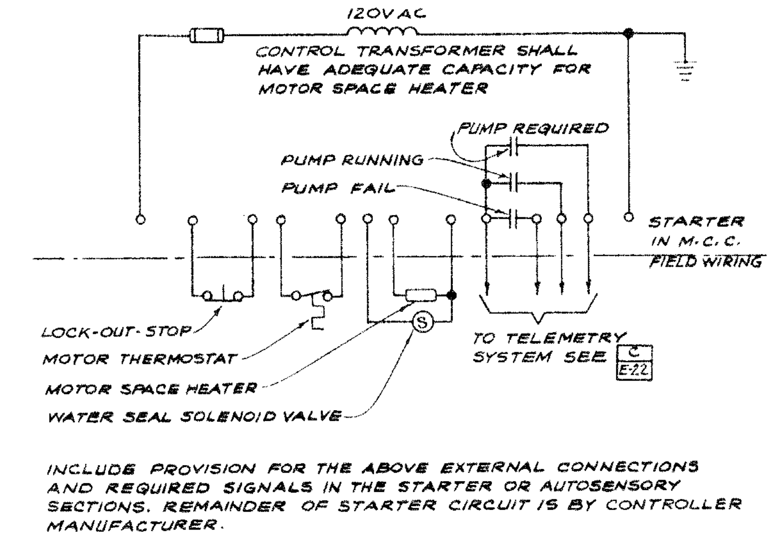


SYSTEM OPERATION		STEP	CONTROL DEVICE ADVANCE TO NEXT STEP	LOAD CONTACTS															
SYSTEM	ADVANCING SIGNAL			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
BOOSTER STATION OFF	BOOSTER STATION REQUIRED	1	R65 SEE B/E-22	-	-	X	-	-	X	-	-	X	-	-	X	-	X	SPARE	SPARE
VALVES V3 & V4 START CLOSING	INTERNAL	2	SELF STEP	-	-	X	-	-	X	-	X	X	-	X	X	-	-	-	-
VALVES V3 & V4 CONTINUE TO CLOSE UNTIL APPROX. 3/4 CLOSED	V3 OR V4 3/4 CLOSED	3	V3 LS6 V4 LS6	-	-	X	-	-	X	-	-	X	-	-	X	-	-	-	-
V3 & V4 STOP CLOSING, V1 & V2 START OPENING	INTERNAL	4	SELF STEP	X	-	X	X	-	X	-	-	-	-	-	-	-	-	-	-
V1 OR V2 LEAVES OPEN POSITION	V1 OR V2 LEAVES OPEN POSITION	5	V1 LS5 V2 LS5	-	-	X	-	-	X	-	-	X	-	-	X	-	-	-	-
V1 & V2 CONTINUE TO OPEN, V3 & V4 START CLOSING AGAIN	INTERNAL	6	SELF STEP	-	-	X	-	-	X	-	X	X	-	X	X	-	-	-	-
V1 & V2 MOVE TO FULL OPEN, V3 & V4 MOVE TO FULL CLOSED	V1 & V2 IN FULL OPEN, AND V3 & V4 IN FULL CLOSED POSITION	7	V1 LS1 V3 LS3 V2 LS1 V4 LS3	-	-	X	-	-	X	-	-	X	-	-	X	-	-	-	-
BOOSTER STATION ON	BOOSTER STATION SHUTDOWN (LOCAL OR REMOTE)	8	R66 SEE B/E-22 R58 "SHUTDOWN BOOSTER STA."	-	-	X	-	-	X	-	-	X	-	-	X	X	-	-	-
V1 & V2 START CLOSING	INTERNAL	9	SELF STEP	-	X	X	-	X	X	-	-	X	-	-	X	-	-	-	-
V1 & V2 CONTINUE TO CLOSE UNTIL BOTH APPROX. 3/4 CLOSED	V1 & V2 3/4 CLOSED	10	V1 LS6 V2 LS6	-	-	X	-	-	X	-	-	X	-	-	X	-	-	-	-
V1 & V2 STOP CLOSING, V3 & V4 START OPENING	INTERNAL	11	SELF STEP	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-
V3 & V4 LEAVE CLOSED POSITION	V3 & V4 LEAVE CLOSED POSITION	12	V3 LS5 V4 LS5	-	-	X	-	-	X	-	-	X	-	-	X	-	-	-	-
V3 & V4 CONTINUE TO OPEN, V1 & V2 START CLOSING AGAIN	INTERNAL	13	SELF STEP	-	X	X	-	X	X	-	-	X	-	-	X	-	-	-	-
V1 & V2 MOVE TO FULL CLOSED, V3 & V4 MOVE TO FULL OPEN	V1 & V2 IN FULL CLOSED AND V3 & V4 IN FULL OPEN POSITION. ADV. TO STEP ONE	14	V1 LS3 V2 LS3 V3 LS1 V4 LS1	-	-	X	-	-	X	-	-	X	-	-	X	-	-	-	-

☒ = CONTACT CLOSED

VALVE SEQUENCE CONTROL DIAGRAM D/E-24





INCLUDE PROVISION FOR THE ABOVE EXTERNAL CONNECTIONS AND REQUIRED SIGNALS IN THE STARTER OR AUTOSENSORY SECTIONS. REMAINDER OF STARTER CIRCUIT IS BY CONTROLLER MANUFACTURER.

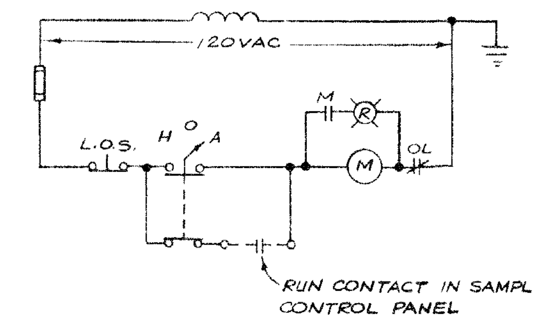
VARIABLE SPEED PUMP CONTROL DIAGRAM G/E-24

VALVE LIMIT SWITCH CONTACT DEVELOPMENT

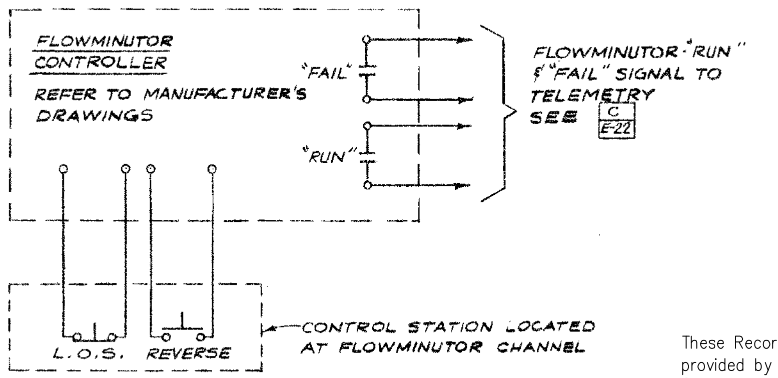
LIMIT SWITCH	VALVE POSITION		
	FULL OPEN	INTERMEDIATE	FULL CLOSED
LS1	━━━	- - - - - -	- - -
LS2	━━━	- - - - - -	- - -
LS3	- - -	- - - - - -	━━━
LS4	- - -	- - - - - -	━━━
LS5	━━━	━━━━━━	- - -
LS6	- - -	- - - - ━━ ←ADJUSTABLE→	━━━

LEGEND
━━ CONTACT CLOSED
- - - CONTACT OPEN

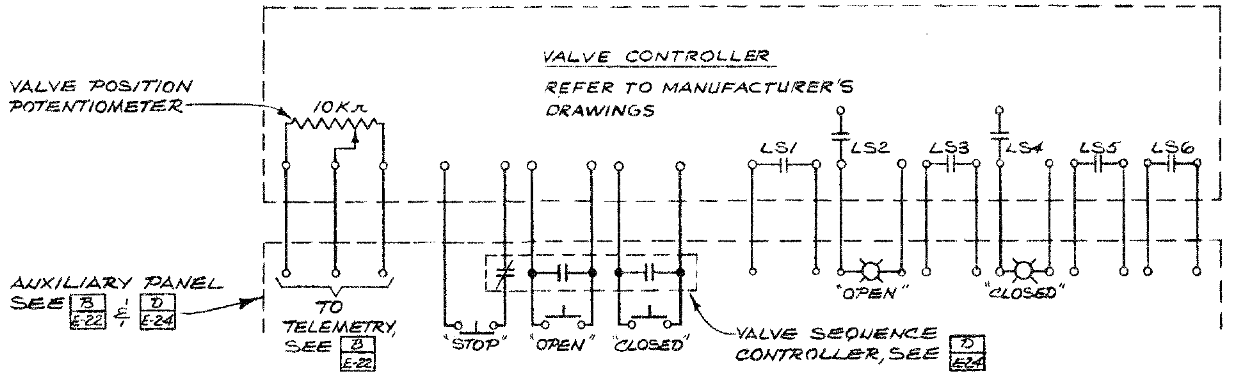
(REVISED SET JUNE 2006)



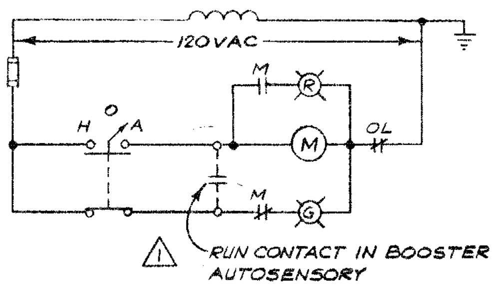
SAMPLE PUMP CONTROL DIAGRAM A/E-24



FLOWMINUTOR CONTROL DIAGRAM B/E-24



VALVE CONTROL DIAGRAM I/E-24 ⚠1



WET WELL EMPTYING PUMP CONTROL DIAGRAM C/E-24

Record Drawing

These Record Drawings have been prepared based on information provided by the contractor and others. Kennedy/Jenks Consultants has not verified the accuracy or completeness of the information provided to them and does not warrant the accuracy or completeness of these Record Drawings. Users of these Record Drawings assume all risk of loss resulting from their use.

120 OF 141

RECORD DRAWING, JUNE 1982 E-24

REV.	DATE	DESCRIPTION
⚠1	7/14/80	GENERAL REVISION

Michael M. Marion
MARION, CERBATOS AND TOMASI
MECHANICAL AND ELECTRICAL ENGINEERS
361 OAK STREET
SAN FRANCISCO, CALIF. 94102
TEL. 863-7755

SUBMITTED
JENKS & HARRISON DATE
APPROVED
REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA
SUBREGIONAL WASTEWATER WORKS
SAN CARLOS PUMP STATION
ELECTRICAL
DIAGRAMS
JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS
Drawn by: JW RB
Scale: NONE
Des/Chkd by: AMM
Date: 8-77/9-79

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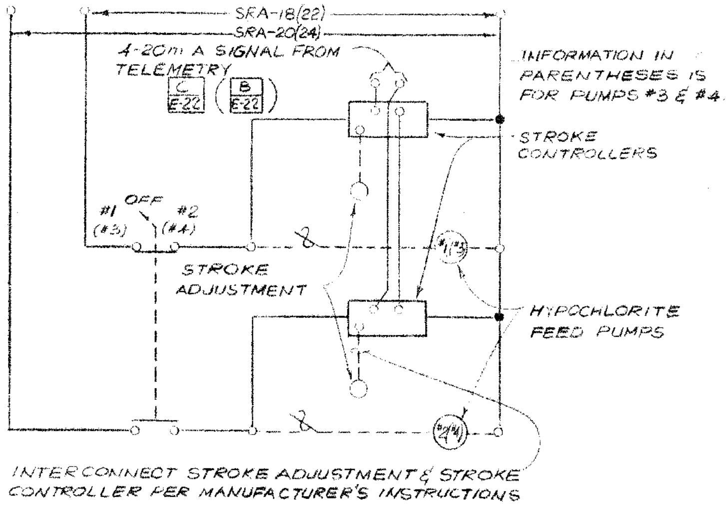
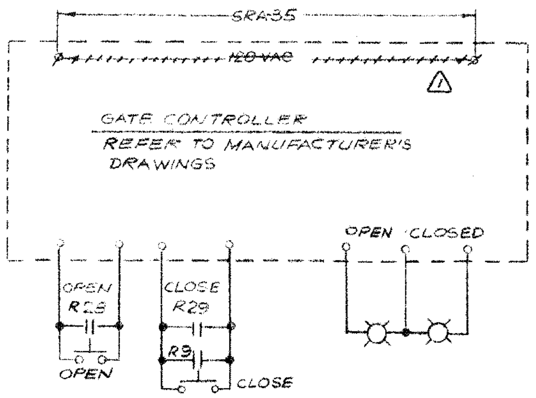
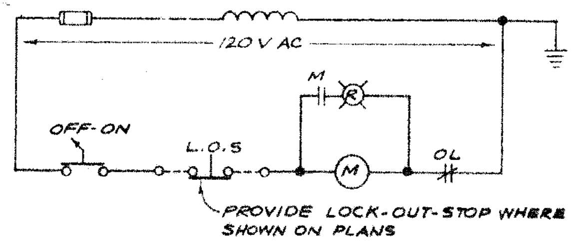


HYPOCHLORITE FEED PUMP CONTROL DIAGRAM A/E-25

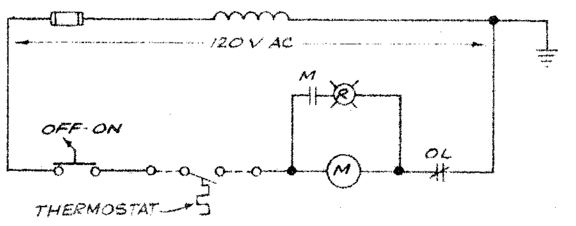


GATE CONTROLS IN AUXILIARY PANEL, SEE C/E-22

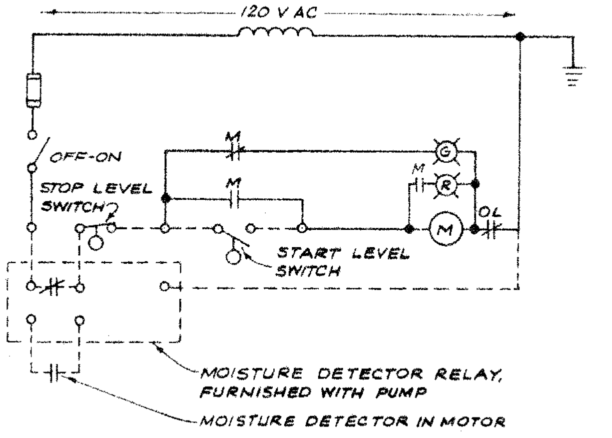
GATE CONTROL DIAGRAM C/E-25



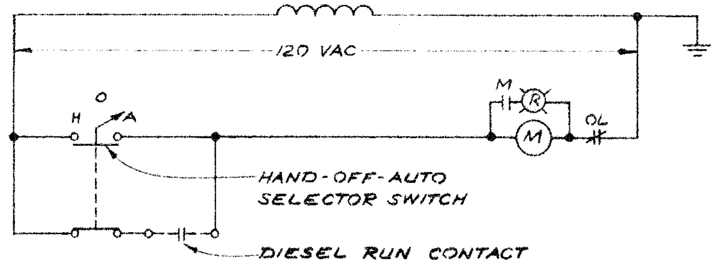
FAN CONTROL DIAGRAM D/E-25



FAN CONTROL DIAGRAM E/E-25

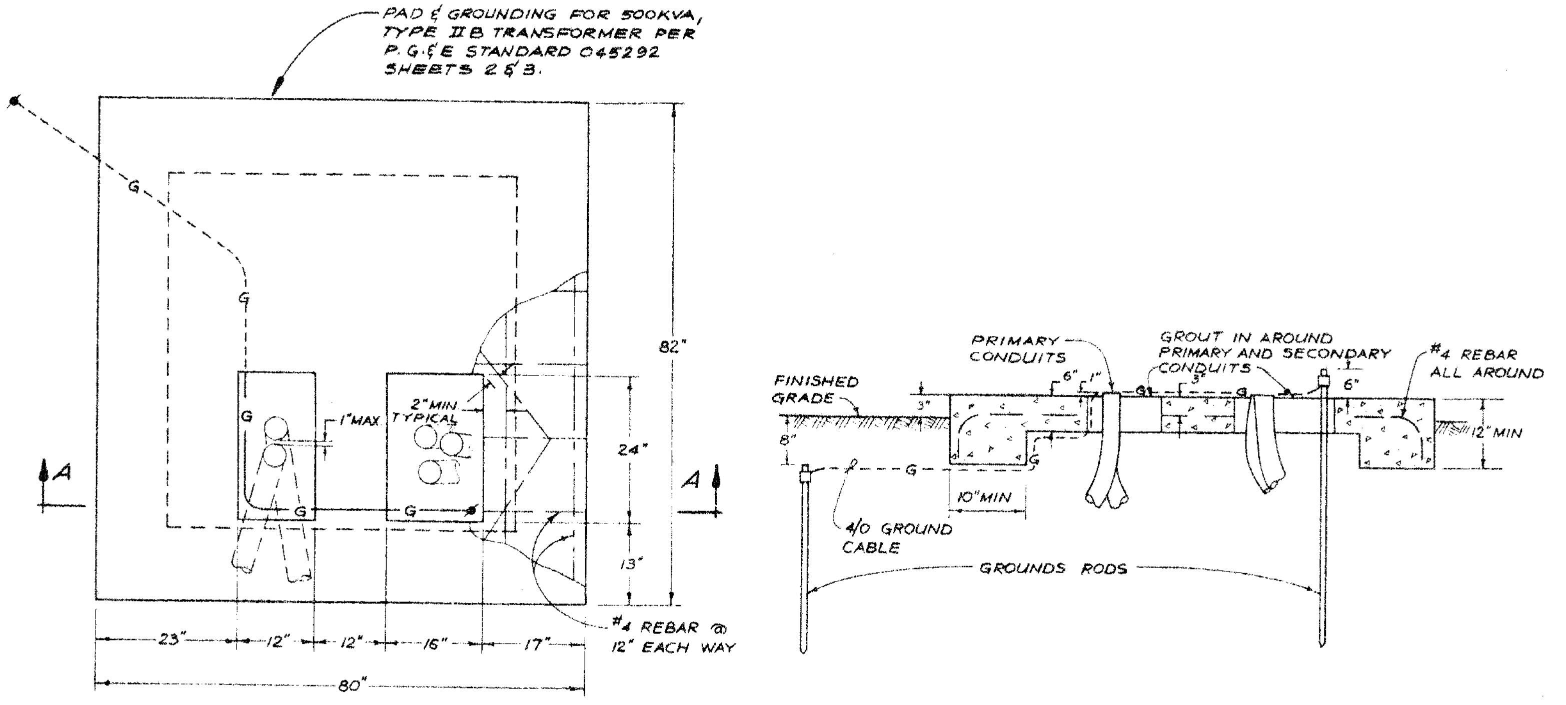


TYPE "A" BILGE PUMP CONTROL DIAGRAM G/E-25



RADIATOR FAN CONTROL DIAGRAM H/E-25

(REVISED SET JUNE 2006)



PLAN

SECTION A-A

TRANSFORMER PAD DETAIL B/E-25
SCALE 3/4"=1'-0"

Alfred M. Marion

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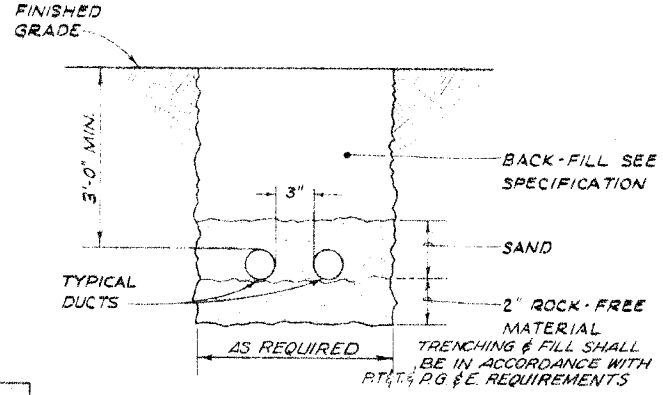
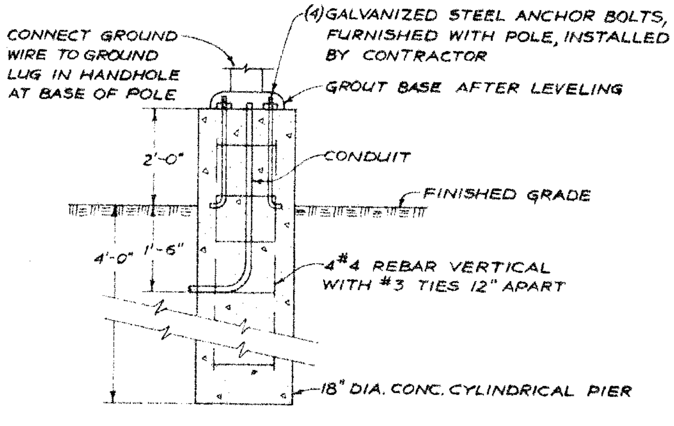


TYPICAL DUCT DETAIL F/E-25
NOT TO SCALE



FIXTURE MOUNTING DETAIL I/E-25
NOT TO SCALE

121 OF 141

1 RECORD DRAWING, JUNE 1982

E-25

SUBMITTED JENKS & HARRISON DATE	**SOUTH BAYSIDE SYSTEM AUTHORITY** SAN MATEO COUNTY, CALIFORNIA
APPROVED REDWOOD CITY DATE	SUBREGIONAL WASTEWATER WORKS
APPROVED SAN CARLOS DATE	SAN CARLOS PUMP STATION ELECTRICAL DETAILS AND DIAGRAMS
APPROVED BELMONT DATE	**JENKS & HARRISON** CONSULTING SANITARY & CIVIL ENGINEERS
APPROVED MENLO PARK S.D. DATE	Drawn by: JW RB · Scale: AS NOTED Des/Chkd by: AMM · Date: 8-77/9-79

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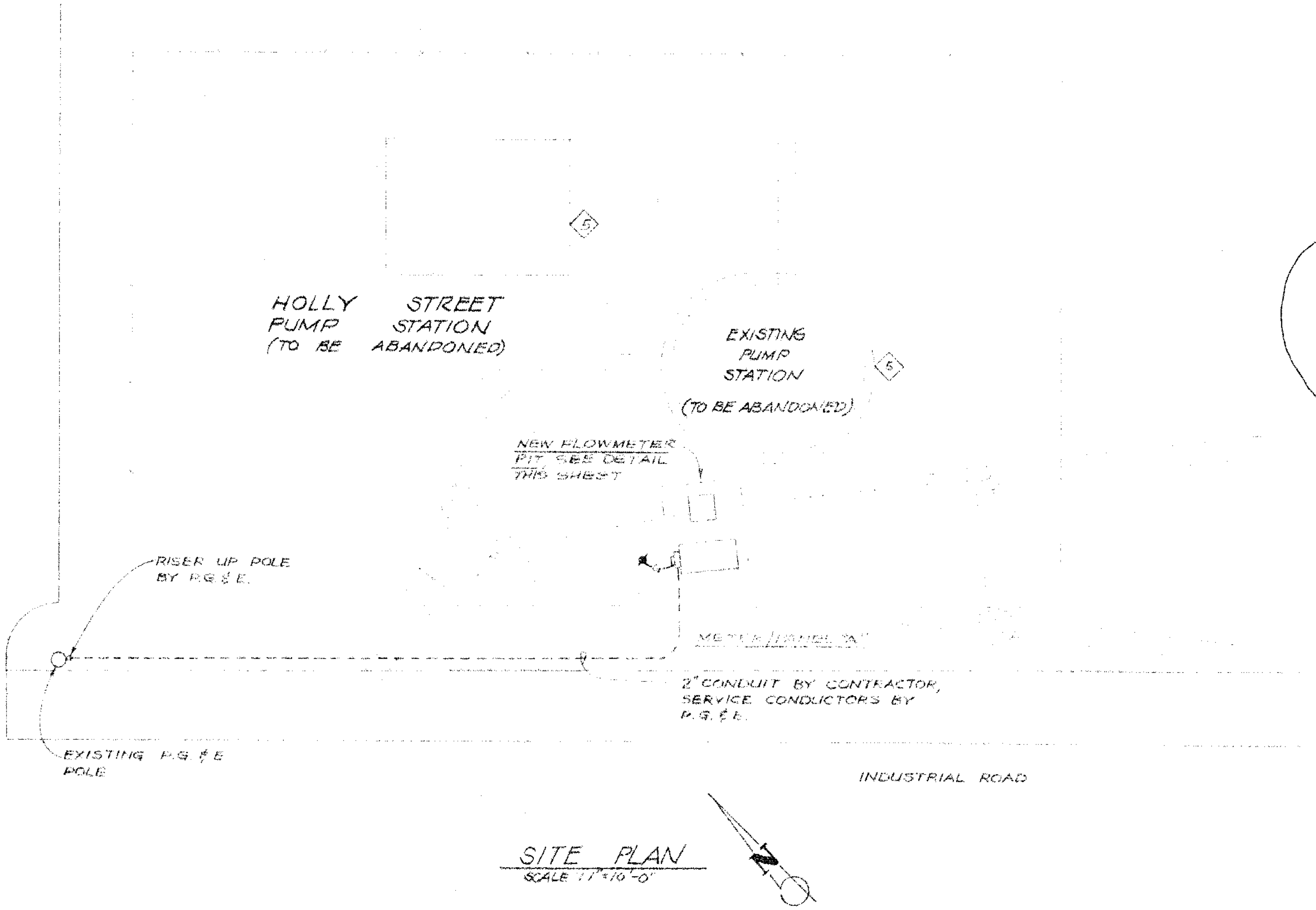
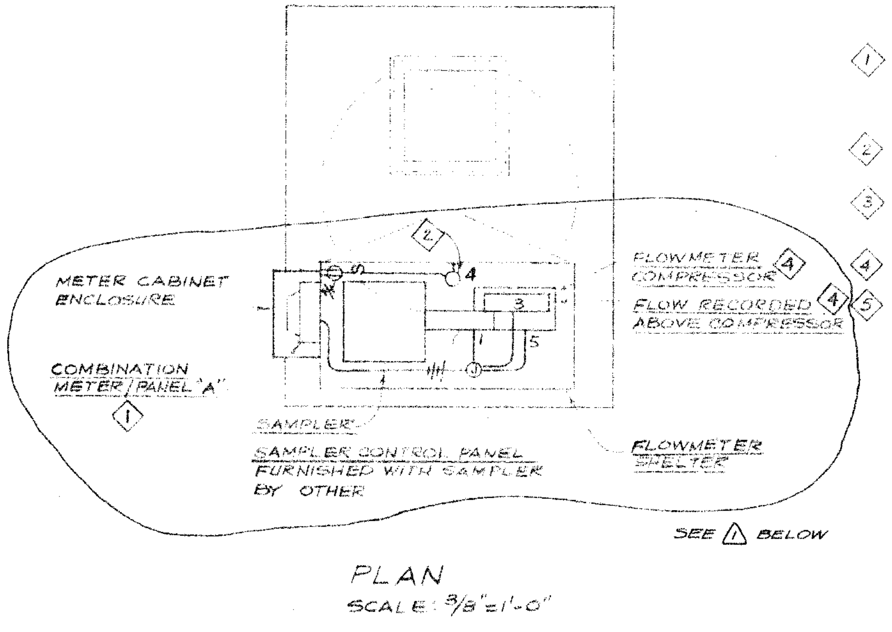


SITE PLAN
SCALE 1"=10'-0"



PLAN
SCALE: 3/8"=1'-0"

SHEET NOTES

1. COMBINATION METER/PANEL FOR UG SERVICE, WEATHERPROOF, NEMA 3R. INSTALL IN HEAVY DUTY, VANDALPROOF METER CABINET ENCLOSURE, WITH WINDOW, IN ACCORDANCE WITH P.G.&E. RULES & REGULATIONS.
2. PRESCOLITE #9800 WITH GUARD ACCESSORY, 120V, 100W LAMP.
3. CONNECT TO GROUND ROD AND 2-REBARS IN STRUCTURE. GROUND ROD 3/4"×10', PER P.G.&E STANDARD #013109 SHEET 1.
4. REFER TO MANUFACTURER'S INSTRUCTIONS.
5. DEMOLITION OF EXISTING FACILITIES IS NOT IN THIS CONTRACT.

Record Drawing

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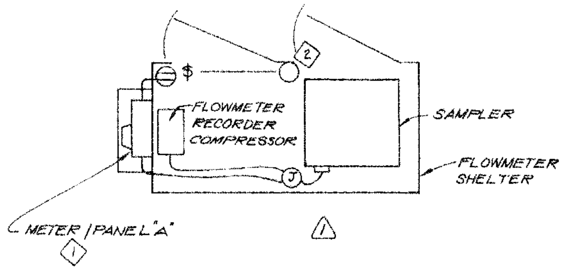
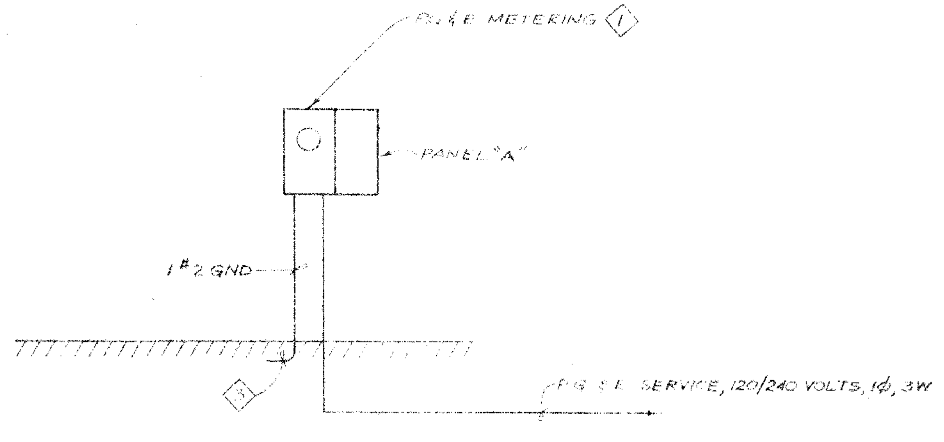


(REVISED SET JUNE 2006)

PANELBOARD "A" SCHEDULE				
CIRCUIT Nº	BREAKER	TYPE	BUS	MOUNT
1-6	15A/1P	NLTQ	120/240V, 1Ø, 3W, 100A	SURFACE
7-10 SPACE ONLY	/1P			
MAIN	100A/2P			



POWER-RISER DIAGRAM
NOT TO SCALE

1 RECORD DRAWING, JUNE 1982

E-26

Alfred W. Marion

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SUBMITTED
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REDWOOD CITY DATE
APPROVED
SAN CARLOS DATE
APPROVED
BELMONT DATE
APPROVED
MENLO PARK S.D. DATE

SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

SUBREGIONAL WASTEWATER WORKS

SAN CARLOS PUMP STATION
ELECTRICAL
HOLLY STREET PUMP STATION

JENKS & HARRISON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by: JW RB
Scale: AS NOTED
Des/Chkd by: AMM
Date: 8-77/9-79

Appendix H: Belmont Conveyance System, San Carlos Site Improvements

Brown and Caldwell, July 27, 2016

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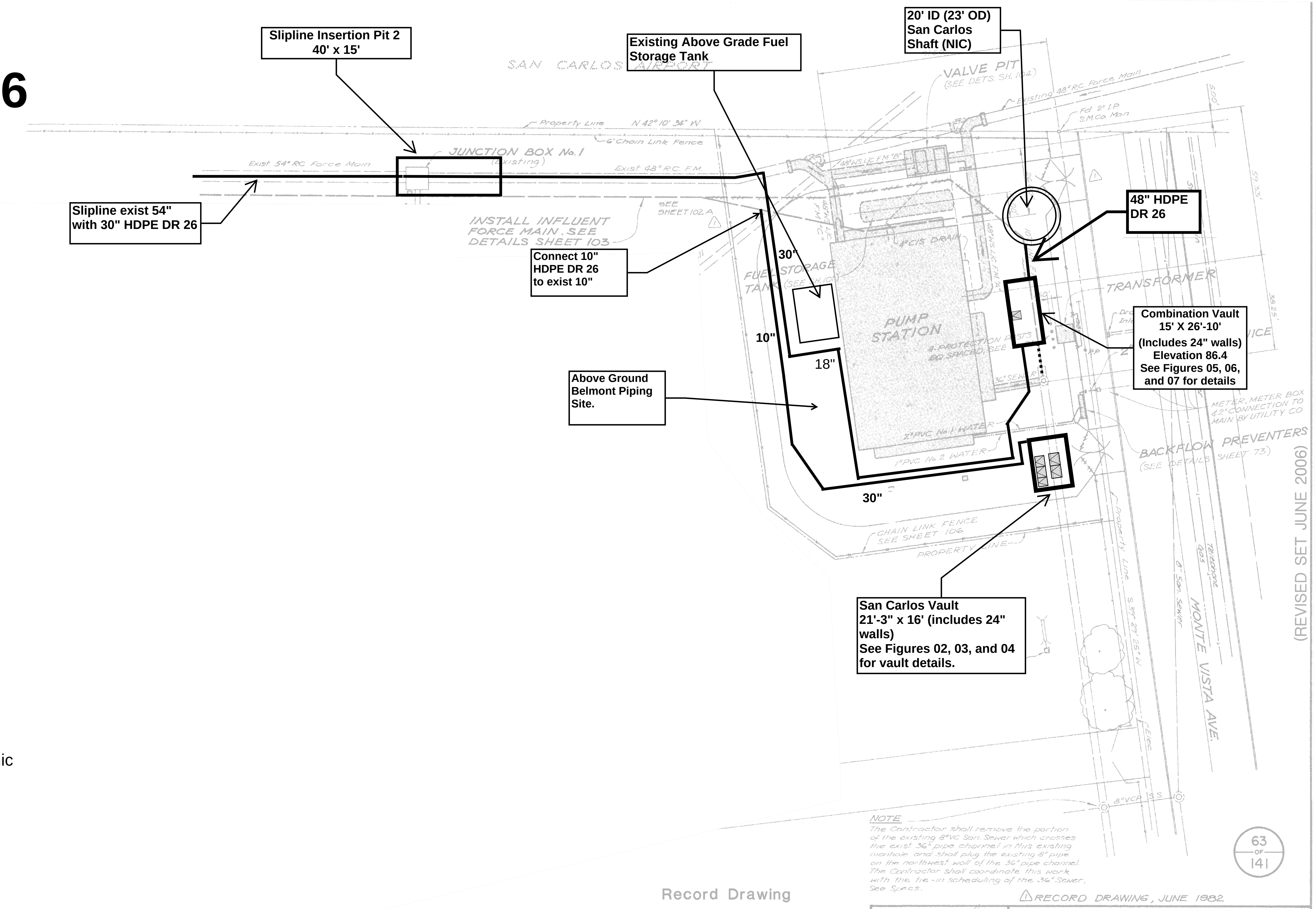
Draft
07-27-2016



Notes:

1. Above Ground Belmont Piping site Contains:
 -Composite Sampler Teledyne ISCO 5800
- 18" Endress and Hauser Proline Prosonic Flow 93W Flowmeter
2. San Carlos Vault Contains:
- Trash Rack
3. Combo Vault Contains:
-Khrone Magmeter
 -Composite Sampler Teledyne ISCO 5800
 -Leachate disposal connection

Record Drawing

SUBMITTED
JENKS & HARRISON DATE

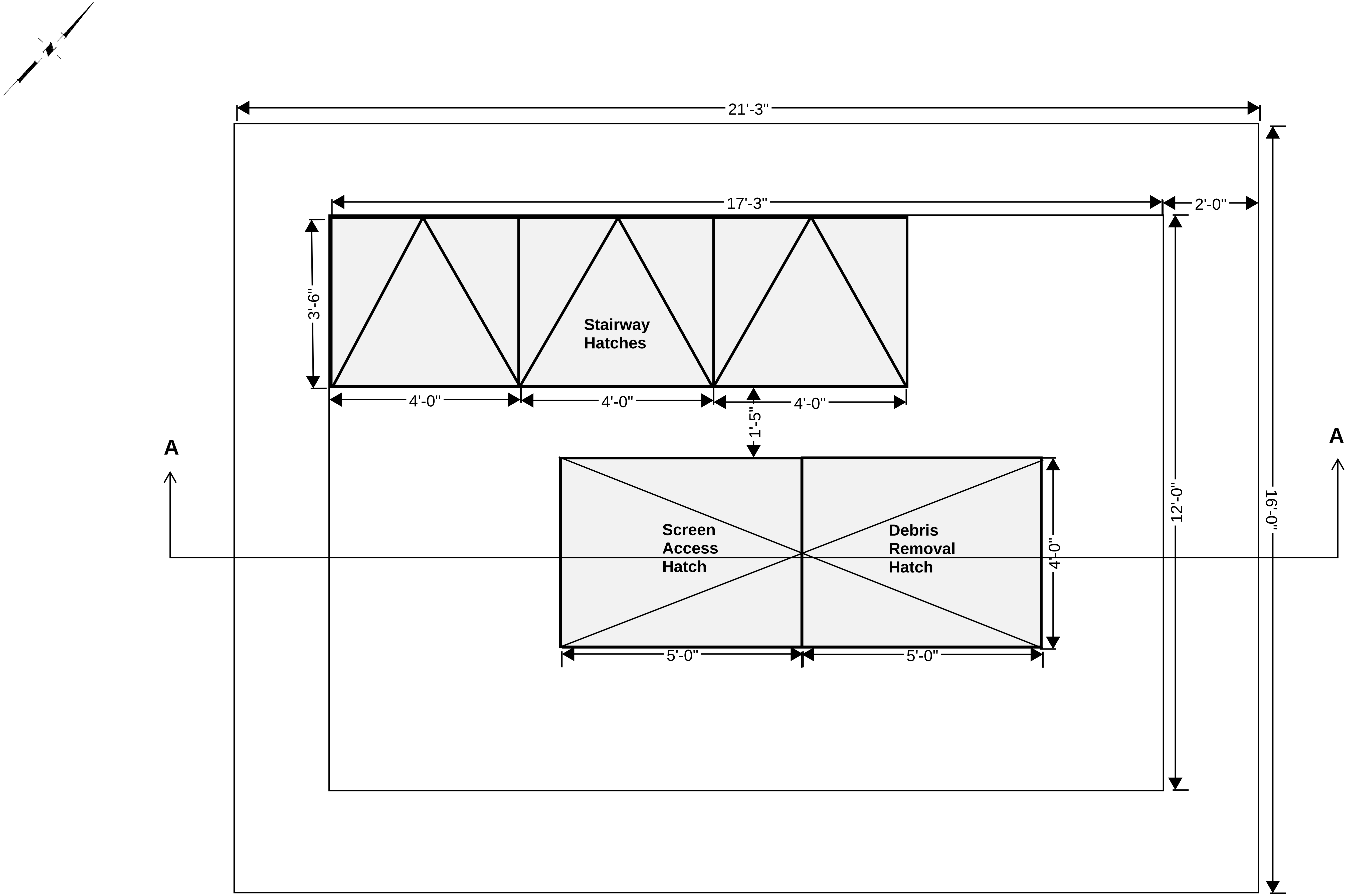
SOUTH BAYSIDE SYSTEM AUTHORITY
SAN MATEO COUNTY, CALIFORNIA

BELMONT CONVEYANCE SYSTEM FIGURE 1

San Carlos Site Improvements

SITE PLAN

Brown AND Caldwell



Scale: 1/2" = 1'-0"

Line is 1 inch

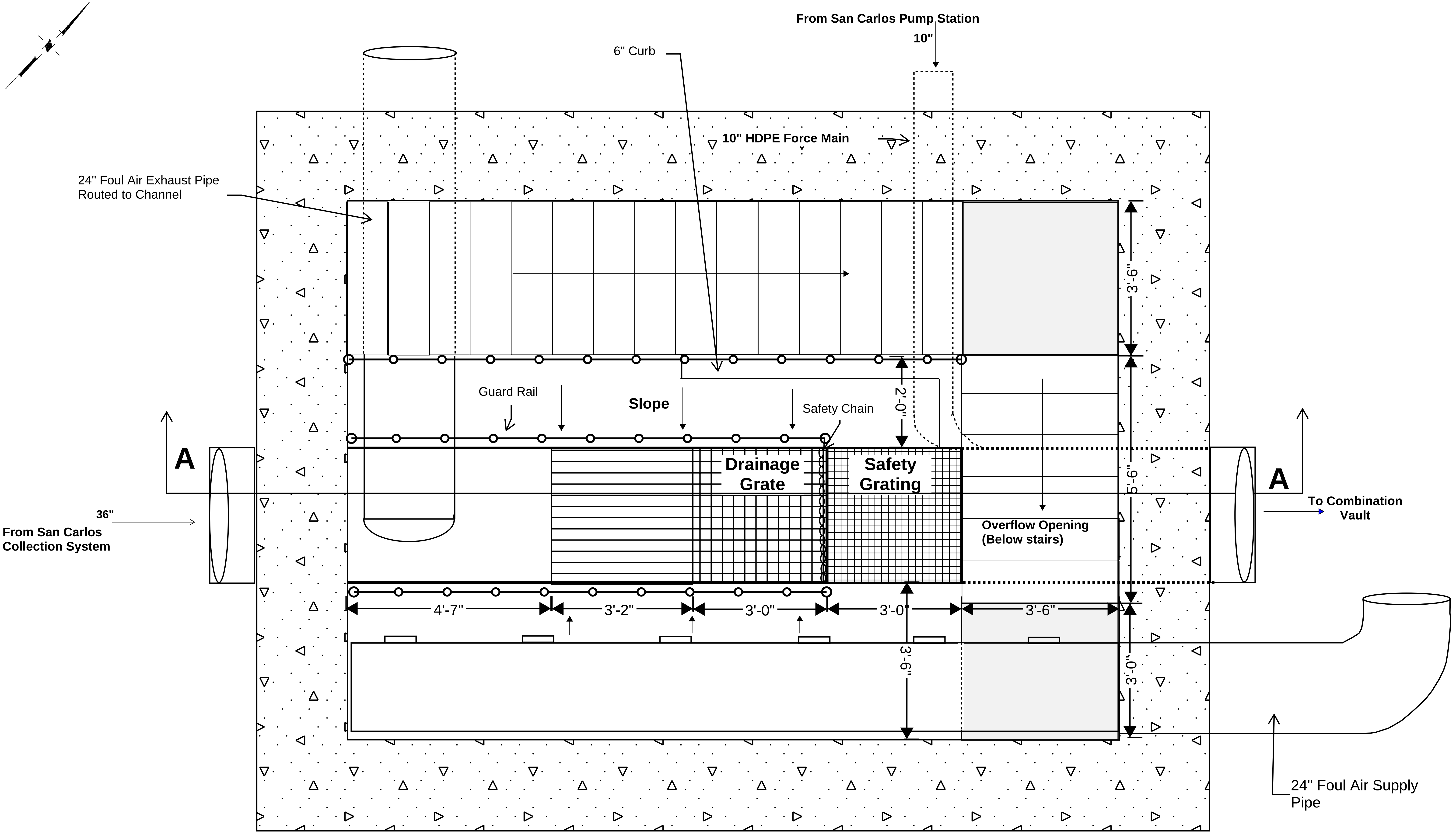
BELMONT CONVEYANCE SYSTEM

FIGURE 2

San Carlos Site Improvements

SAN CARLOS VAULT TOP PLAN VIEW

Brown AND Caldwell



Scale: 1/2" = 1'-0"

Line is 1 inch

BELMONT CONVEYANCE SYSTEM

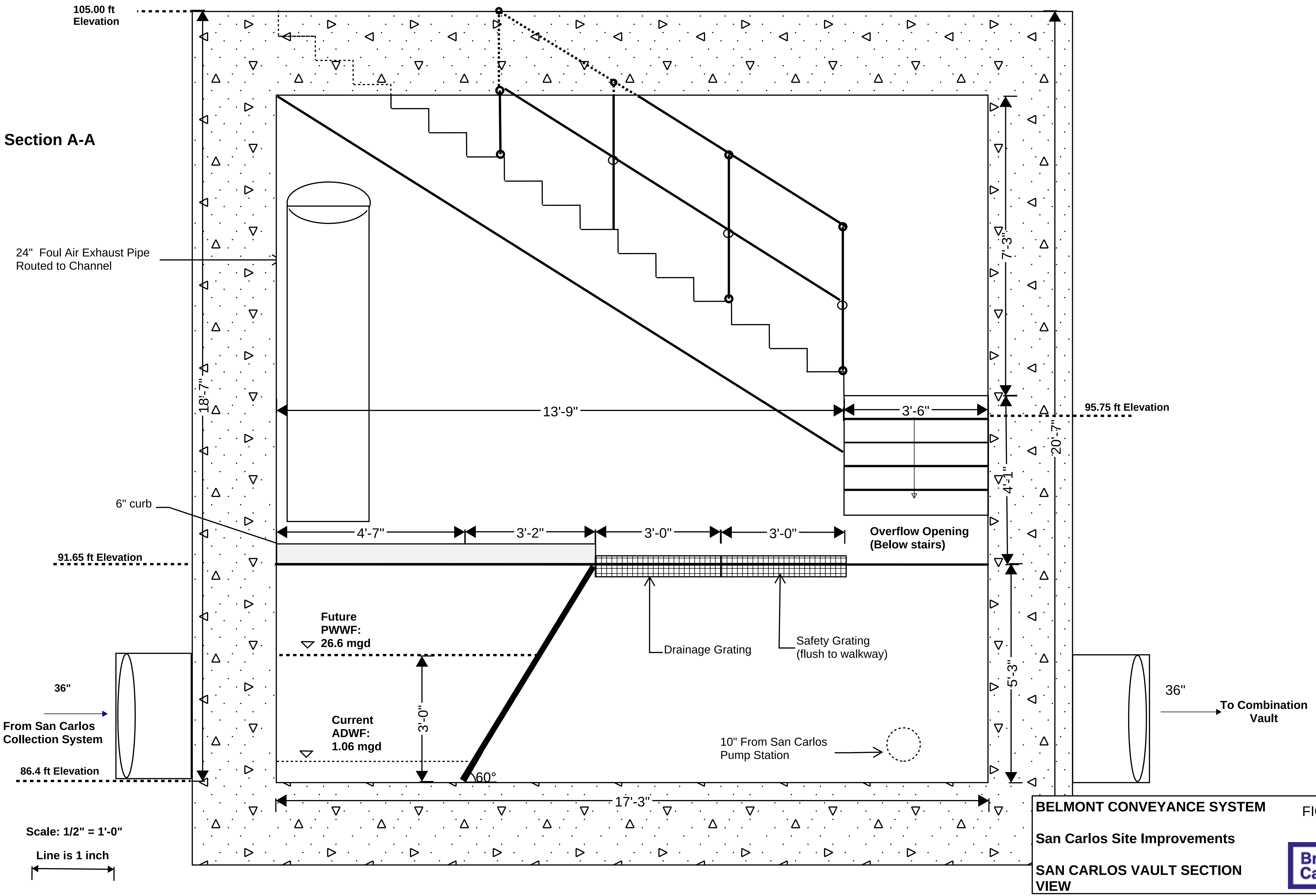
FIGURE 3

San Carlos Site Improvements

SAN CARLOS VAULT PLAN VIEW

Brown AND Caldwell

Section A-A



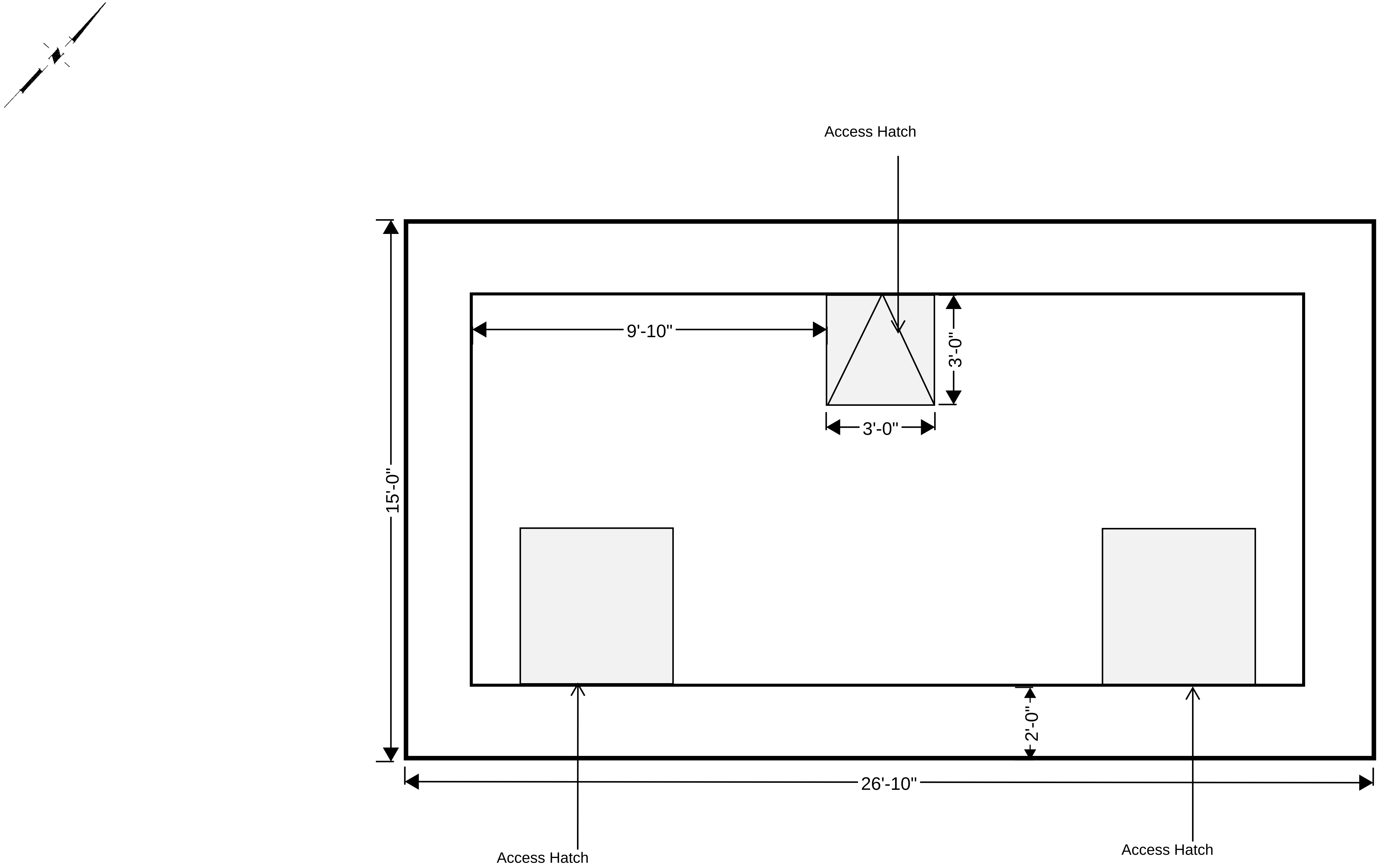
BELMONT CONVEYANCE SYSTEM

FIGURE 4

San Carlos Site Improvements

SAN CARLOS VAULT SECTION VIEW

Brown AND Caldwell



Scale: 1" = 3'-0"

Line is 1 inch

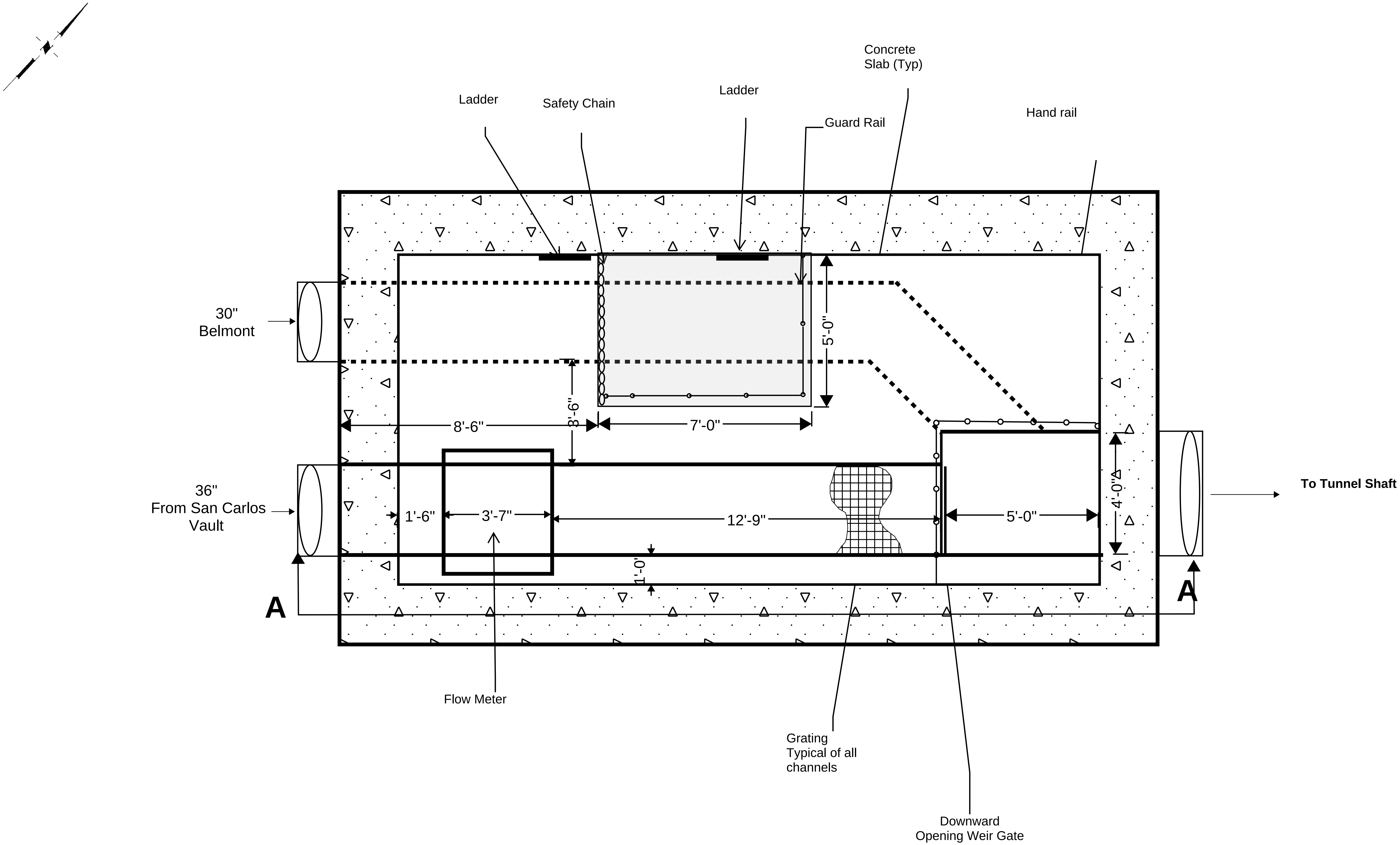
BELMONT CONVEYANCE SYSTEM

FIGURE 5

San Carlos Site Improvements

COMBO VAULT TOP PLAN VIEW

Brown AND Caldwell



Scale: 1" = 3'-0"

Line is 1 inch

BELMONT CONVEYANCE SYSTEM

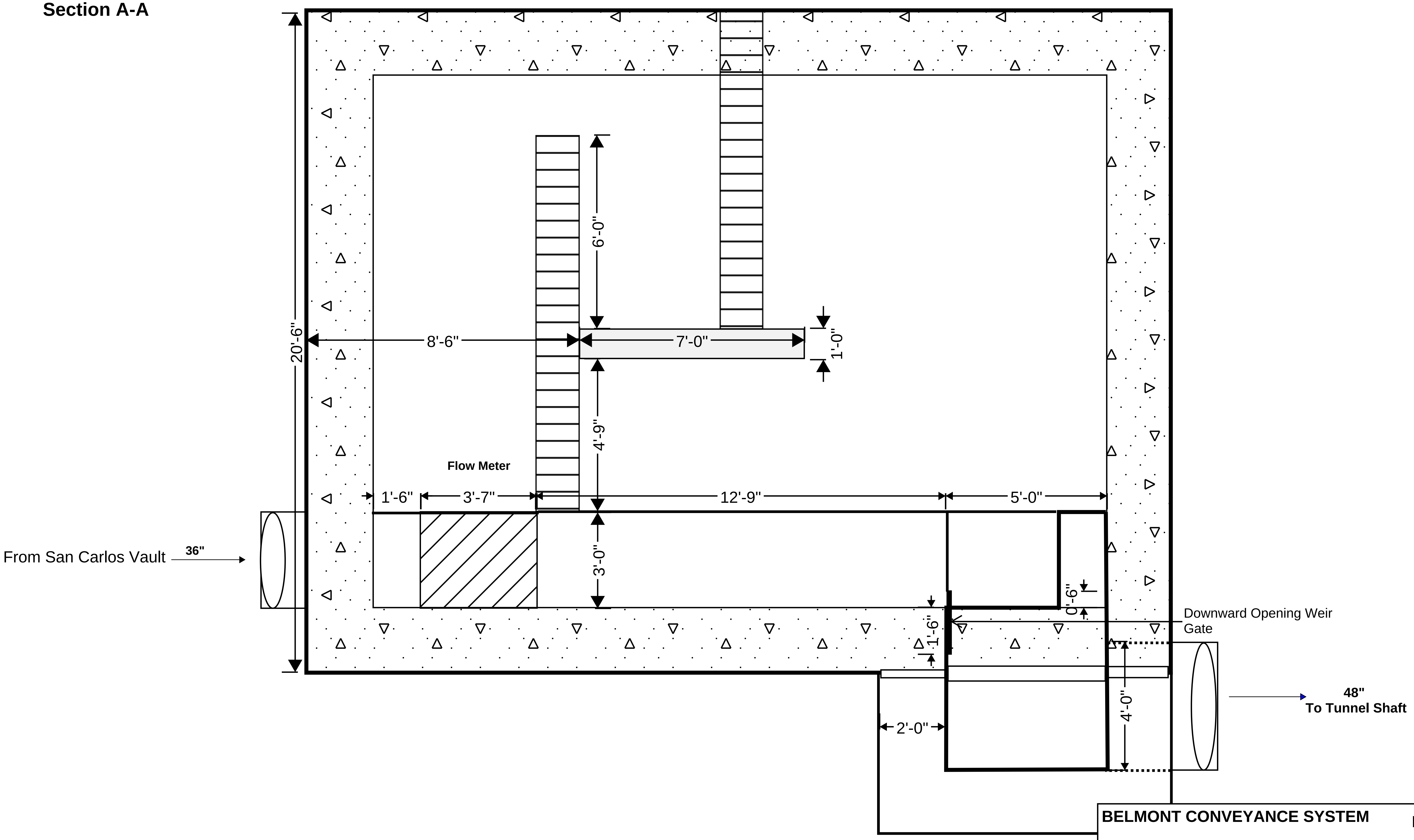
San Carlos Site Improvements

COMBO VAULT PLAN VIEW

FIGURE 6

Brown AND Caldwell

Section A-A



BELMONT CONVEYANCE SYSTEM

FIGURE 7

San Carlos Site Improvements

COMBO VAULT SECTION VIEW

Brown AND Caldwell

Appendix I: Belmont Conveyance Project Detailed Cost Estimate

Brown and Caldwell, April 11, 2016

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Project Number:	**142399**
Estimate Issue:	**4**
Due Date:	**5/5/2016**
Estimator:	**Ian Kruljac**

SILICON VALLEY CLEAN WATER
BELMONT PUMP STATION
CONCEPTUAL LEVEL CLASS 3 ESTIMATE

Engineer	BROWN AND CALDWELL
Estimator	Ian Kruljac
BC Project Manager	CHARLIE JOYCE
BC Office	WALNUT CREEK
Estimate Issue No.	4
QA/QC Reviewer	DESIGN TEAM
QA/QC Review Date	4/11/2016

BELMONT PUMP STATION

Phase	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
01 BELMONT PUMP STATION DEMOLITION									
02221 Site Demolition		1.0 LSUM	6,758.87	1,293.12		5,553.64		13,605.63 /LSUM	13,606
02221 Site Demolition - Asphalt		13,000.0 SQFT	1.26	0.18		0.73		2.17 /SQFT	28,246
02999 Pump Room -Equipment and Misc Metals Demolition		1.0 LSUM	86,864.90			17,112.26		103,977.16 /LSUM	103,977
02999 Electrical Demolition - Disposal		1.0 LS			23,043.29			23,043.29 /LS	23,043
26012 Electrical, Demolition		1.0 LSUM	54,351.71					54,351.71 /LSUM	54,352
	01 BELMONT PUMP STATION DEMOLITION	1.0 LSUM	164,353.29	3,629.22	23,043.29	32,198.12		223,223.92 /LSUM	223,224

Phase	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
02 BELMONT PUMP STATION MODIFICATIONS									
03900	Patching Concrete - Allowance	300.0 SQFT	24.01	37.68		4.55		66.24 /SQFT	19,873
11999	Pumps Station - Pumps and Instr..	4.0 Each	16,315.19	137,493.91		728.78		154,537.88 /Each	618,152
11999	Grinder Installation	1.0 Each	6,884.54	75,564.40		1,041.11		83,490.05 /Each	83,490
11999	New Proccess Valves	15.0 Each	1,476.77	14,783.94		85.47		16,346.18 /Each	245,193
14999	Electric Hoist and Monorail	1.0 Each	4,682.02	38,281.60		196.31		43,159.93 /Each	43,160
22999	Tie Ins Work Allownace	1.0 LS			138,815.01			138,815.01 /LS	138,815
23999	Foul Air Fans and Ducting	1.0 LSUM	59,115.25	101,280.92		20,822.25		181,218.42 /LSUM	181,218
26321	Emergency Generator Set and Tank	1.0 Each	33,040.26	299,042.56		9,357.23		341,440.05 /Each	341,440
26999	Electrical Allowance	1.0 LS			2,082,225.24			2,082,225.24 /LS	2,082,225
27999	Combination Vault W/San Carlos Flowmeter	1.0 Each	5,433.83	76,201.48	13,881.52	859.47		96,376.30 /Each	96,376
27999	San Carlos Vault	1.0 Each	29,885.36	165,221.34		2,259.77		197,366.47 /Each	197,366
31240	Dewatering Systems - 4 Pumps 60 Days	1.0 SET	82,988.61	16,806.23	694.05	11,152.02		111,640.91 /SET	111,641
31250	Shoring Systems - Combination Vault	3,150.0 SQFT	22.18	17.37		9.58		49.12 /SQFT	154,739
31315	Excavation and Backfill - Comb. Vault	768.9 cy	17.56	11.26		22.75		51.57 /cy	39,653
31315	Excavation and Backfill - SC - Vault	96.3 cy	30.00	22.46		58.77		111.22 /cy	10,710
40120	Ductile Iron Piping and Valves Spools	180.0 lf	323.11	1,951.71				2,274.82 /lf	409,468
46999	New Stop and Slide Gates	3.0 Each	5,445.70	17,223.60		1,188.99		23,858.29 /Each	71,575
	02 BELMONT PUMP STATION MODIFICATIONS	1.0 LSUM	477,389.95	2,023,936.59	2,235,615.82	108,150.45		4,845,092.81 /LSUM	4,845,093

Phase	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
03 YARD AND CONVEYANCE PIPING									
	22999 30" Above Ground Belmont Pipe and Sampler	40.0 LFT	484.95	2,725.77		32.76		3,243.48 /LFT	129,739
	31240 Dewatering Systems	5.0 SET	43,245.81	7,923.09	694.08	5,962.76		57,825.73 /SET	289,129
	31315 SLIPLINE INSERTION PITS	2.0 Each	41,234.97	26,128.12		22,620.93		89,984.01 /Each	179,968
	31315 SLIPLINE PULL PIT	1.0 Each	38,416.70	22,056.45		19,579.16		80,052.31 /Each	80,052
	31315 CIPP ACCESS PITS	2.0 Each	31,632.86	15,987.48		14,997.55		62,617.88 /Each	125,236
	33500 30" HDPE TRENCH - OPEN CUT (SCPS)	420.0 LFT	680.03	297.81	0.52	300.71		1,279.07 /LFT	537,208
	33500 42" HDPE TRENCH - OPEN CUT (SPCS)	20.0 LFT	688.09	302.60		306.69		1,297.38 /LFT	25,948
	33500 10" HDPE TRENCH - OPEN CUT	225.0 LFT	684.17	301.08	0.97	302.77		1,288.97 /LFT	290,019
	33999 30" HPDE LINING	3,100.0 LFT	104.99	620.21	12.49	25.62		763.31 /LFT	2,366,252
	33999 CIPP LINING	1,200.0 LFT			425.07			425.07 /LFT	510,079
	40530 HDPE Butt Fusion Field Run	665.0 LFT	172.19	336.24		4.38		512.81 /LFT	341,022
	03 YARD AND CONVEYANCE PIPING	4,965.0 LFT	264.46	523.68	111.32	82.34		981.80 /LFT	4,874,651

Phase	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
04 BELMONT SITE CIVIL ALLOWANCES									
01999 Traffic Control Allowance		1.0 LSUM			138,815.01			138,815.01 /LSUM	138,815
02999 Potholing Allowance		1.0 LSUM			27,763.01			27,763.01 /LSUM	27,763
22999 Potable Water Allowance		1.0 LSUM	14,381.49	15,071.53		6,940.74		36,393.76 /LSUM	36,394
32740 Asphalt Paving And Grading		13,000.0 SQFT	9.31	5.79		0.59		15.69 /SQFT	203,974
32740 Sidewalk Allowance		500.0 SQFT	6.41	5.55		0.10		12.06 /SQFT	6,027
32999 New Gate Allowance		25.0 LFT	121.74	241.14				362.89 /LFT	9,072
33630 Storm Drainage Piping - Allowance		200.0 LFT	49.21	28.41		3.88		81.50 /LFT	16,300
33635 Manholes Allowance - 6' DIA Assumes 10 VLF		3.0 ea	6,630.72	9,165.48	2,766.86	1,623.12		20,186.18 /ea	60,559
33635 Catch Basin - Allowance		2.0 ea	9,557.84	3,437.81	2,766.87	942.55		16,705.06 /ea	33,410
	04 BELMONT SITE CIVIL ALLOWANCES	1.0 LSUM	190,560.97	139,142.15	180,412.34	22,198.66		532,314.12 /LSUM	532,314
	01 SVCW BELMONT PUMPSTATION	1.0 LSUM	2,145,367.59	4,766,752.04	2,991,785.13	571,377.53		10,475,282.29 /LSUM	10,475,282

Estimate Totals

Description	Rate	Hours	Amount	Totals
Labor		17,670 hrs	2,145,368	
Material			4,766,752	
Subcontract			2,991,785	
Equipment		10,863 hrs	571,378	
Gross Markups			**10,475,283**	**10,475,283**
Total				**10,475,283**

SILICON VALLEY CLEAN WATER
BELMONT PUMP STATION
CONCEPTUAL LEVEL CLASS 3 ESTIMATE

Engineer	BROWN AND CALDWELL
Estimator	Ian Kruljac
BC Project Manager	CHARLIE JOYCE
BC Office	WALNUT CREEK
Estimate Issue No.	4
QA/QC Reviewer	DESIGN TEAM
QA/QC Review Date	4/11/2016

Phase	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
01 BELMONT PUMP STATION DEMOLITION									
02221 Site Demolition									
02-41-13.33	Minor site demolition, pipe, sewer/water, 21" to 24" diameter, remove,	40.0 lf	51.21	-	-	48.79	-	100.00 /lf	4,000
02-41-13.33	Minor site demolition, pipe, sewer/water, 27" to 54" diameter, remove,	40.0 lf	53.77	-	-	51.23	-	105.00 /lf	4,200
01-56-26.50	Temporary fencing, chain link, rented up to 12 months, 6' high, 11 ga, to 1000'	200.0 lf	2.50	4.29	-	-	-	6.79 /lf	1,358
	Site Demolition	**1.0 LSUM**	**4,699.70**	**858.00**		**4,000.75**		**9,558.45 /LSUM**	**9,558**
02221 Site Demolition - Asphalt									
02-41-13.17	Demolish, remove pavement & curb, remove bituminous pavement, 4" to 6" thick, excludes hauling and disposal fees	1,444.4 sy	6.69	-	-	3.10	-	9.79 /sy	14,141
02-41-13.33	Site demo, for disposal off site, add	240.7 cy	7.14	-	-	9.95	-	17.09 /cy	4,114
02-41-19.23	Rubbish handling, dumpster, 40 C.Y., 13 ton capacity, weekly rental, includes one dump per week, cost to be added to demolition cost.	2.0 week	-	775.00	-	-	-	775.00 /week	1,550
	Site Demolition - Asphalt	**13,000.0 SQFT**	**0.88**	**0.12**		**0.53**		**1.52 /SQFT**	**19,805**
02999 Pump Room -Equipment and Misc Metals Demolition									
11-05-05.10	Hydraulic gate, canal, flap, knife, slide or sluice, 19" to 36" diameter, selective demolition	3.0 ea	450.47	-	-	101.90	-	552.37 /ea	1,657
22-05-05.10	Pump, 75 H.P. thru 100 H.P., selective demolition	3.0 ea	4,362.12	-	-	-	-	4,362.12 /ea	13,086
02-41-13.36	Selective demolition, utility valves, pump spools, fitttings & accessories 14"-24", excludes excavation	15.0 ea	468.96	-	-	35.11	-	504.07 /ea	7,561
02-41-13.36	Selective demolition, utility valves, pump spools, fitttings & accessories 4"-12", excludes excavation	3.0 ea	379.23	-	-	-	-	379.23 /ea	1,138
05-05-05.10	Selective metals demolition, structural steel platform, interior, excl shoring, bracing, cutting, loading, hauling, dumping	500.0 sf	34.27	-	-	1.97	-	36.24 /sf	18,118
02-41-19.21	Selective demolition, gutting, building interior, commercial building, includes disposal, excludes dumpster fees	500.0 sffl	8.24	-	-	2.82	-	11.06 /sffl	5,529
23-05-05.10	Grinder - selective demolition	1.0 ea	2,630.71	-	-	-	-	2,630.71 /ea	2,631
23-05-05.10	Exhaust system, components, selective demolition	1.0 syst	113.16	-	-	-	-	113.16 /syst	113
22-05-05.10	Pipe, metal pipe, 30" thru 36" diameter, selective demolition	60.0 lf	65.40	-	-	1.47	-	66.87 /lf	4,012
05-05-05.10	Selective metals demolition, structural steel, Over Head Crane	1.0 LSUM	9,869.04	-	-	9,013.20	-	18,882.24 /LSUM	18,882

Phase	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
	Pump Room -Equipment and Misc Metals Demolition	**1.0 LSUM**	**60,400.45**			**12,327.38**		**72,727.83 /LSUM**	**72,728**
02999 Electrical Demolition - Disposal									
02-42-10.10	Copper wire disposal costs	5,000.0 lb	-	-	3.20	-		3.20 /lb	16,000
02-42-10.10	Steel disposal costs	5,000.0 lb	-	-	0.12	-		0.12 /lb	600
	Electrical Demolition - Disposal	**1.0 LS**			**16,600.00**			**16,600.00 /LS**	**16,600**
26012 Electrical, Demolition									
26-05-05.10	Electrical demo, remove devices, switches or disconnects, to 60A	4.0 ea	38.70	-	-	-	-	38.70 /ea	155
26-05-05.10	Electrical demo, disconnect power to exhaust Blowers	1.0 ea	697.28	-	-	-	-	697.28 /ea	697
26-05-05.10	Electrical demo, remove panelboards/loadcenters, to 225A	4.0 ea	1,045.92	-	-	-	-	1,045.92 /ea	4,184
26-05-05.10	Electrical demo, remove misc. electrical equipment, transformers, etc.	1.0 ea	871.60	-	-	-	-	871.60 /ea	872
02-22-04.52	Equipment dismantling/demolition, generator set, complete incl all anciliory devices	1.0 ea	31,885.44	-	-	-	-	31,885.44 /ea	31,885
	Electrical, Demolition	**1.0 LSUM**	**37,792.79**					**37,792.79 /LSUM**	**37,793**
	01 BELMONT PUMP STATION DEMOLITION	**1.0 LSUM**	**114,281.04**	**2,408.00**	**16,600.00**	**23,194.98**		**156,484.02 /LSUM**	**156,484**

Phase	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
02 BELMONT PUMP STATION MODIFICATIONS									
03900 Patching Concrete - Allowance									
03-01-30.62	infill walls; dowels, resteel, soffit form, place/finish	300.0 sf	16.70	25.00	-	3.28	-	44.98 /sf	13,492
	Patching Concrete - Allowance	**300.0 SQFT**	**16.70**	**25.00**		**3.28**		**44.98 /SQFT**	**13,492**
11999 Pumps Station - Pumps and Instr..									
46-06-22.00	Submersible pump - FLYGT-Model-NP3301 complete	3.0 ea	5,493.74	69,500.00	-	700.00		75,693.74 /ea	227,081
46-06-22.00	Submersible pump Local Control Panel - FLYGT-Model-NP3301	3.0 ea	2,746.87	23,490.00	-		0.00	26,236.87 /ea	78,711
27-20-57.00	LIT - Level Indicating Ultrasonic or Std - Install, Calibrate, Test, Loop Check	2.0 ea	1,464.29	2,500.00	-	-	-	3,964.29 /ea	7,929
27-20-07.00	Ultrasonic Level Transmitters	2.0 ea	464.85	2,798.00	-	-	-	3,262.85 /ea	6,526
27-20-10.00	AI - Comb. Gas Analyzers	3.0 ea	464.85	3,715.00	-	-	-	4,179.85 /ea	12,540
27-20-53.00	AI - Analyzer Indicator - Install, Calibrate, Test, Loop Check	5.0 ea	883.22		-	-	-	883.22 /ea	4,416
46-06-22.00	Submersible pump - FLYGT 250 gpm	2.0 ea	5,493.75	32,100.00	-			37,593.75 /ea	75,187
	Pumps Station - Pumps and Instr..	**4.0 Each**	**11,344.57**	**91,227.75**		**525.00**		**103,097.32 /Each**	**412,389**
11999 Grinder Installation									
22-13-29.13	Pump,grinder system, 120 V 15 HP GRD 7001 trls,alrm/ds panel with wire,	1.0 ea	4,500.00	50,000.00	-	750.00	-	55,250.00 /ea	55,250
03-63-05.10	Chemical anchoring, for fastener 1-1/4" diam x 10" embedment, incl epoxy cartridge, excl layout, drilling & fastener	8.0 ea	16.68	16.90	-	-	-	33.58 /ea	269
03-82-16.10	Concrete impact drilling, for anchors, 8" d, 1-1/4" dia, in concrete or brick walls and floors, includes bit cost, layout and set up time, excl anchor	8.0 ea	19.21	0.26	-	-	-	19.47 /ea	156
	Grinder Installation	**1.0 Each**	**4,787.07**	**50,137.28**		**750.00**		**55,674.35 /Each**	**55,674**
11999 New Proccess Valves									
22-20-02.80	Valves, Swing Check 150 psi, Dezurik AWA style, 16" diameter	3.0 ea	872.42	19,734.00	-	300.00	-	20,906.42 /ea	62,719
22-20-02.80	Valves, semi-steel, lubricated plug valve, flanged, 200 psi, 18" pipe	3.0 ea	1,962.95	15,000.00				16,962.95 /ea	50,889
22-20-02.80	Valves, semi-steel, lubricated plug valve, flanged, 200 psi, 16" pipe	3.0 ea	2,072.01	14,000.00	-		-	16,072.01 /ea	48,216
22-05-23.80	Valves, steel, forged, ball, socket weld, 800 lb., 1"	6.0 ea	113.44	156.00	-	3.92	-	273.37 /ea	1,640
	New Proccess Valves	**15.0 Each**	**1,026.85**	**9,809.20**		**61.57**		**10,897.62 /Each**	**163,464**
14999 Electric Hoist and Monorail									

Phase	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
14999 Electric Hoist and Monorail									
41-22-13.13	Overhead bridge crane, under hung hoist, electric operating, 1 girder, 2 ton, Installed	1.0 ea	3,255.57	25,400.00	-	141.42	-	28,796.99 /ea	28,797
	Electric Hoist and Monorail	**1.0 Each**	**3,255.57**	**25,400.00**		**141.42**		**28,796.99 /Each**	**28,797**
22999 Tie Ins Work Allownace									
22-05-00.10	Allowance - Piping, Process - Tie Ins work	1.0 ls	-	-	100,000.00	-	-	100,000.00 /ls	100,000
	Tie Ins Work Allownace	**1.0 LS**			**100,000.00**			**100,000.00 /LS**	**100,000**
23999 Foul Air Fans and Ducting									
23-36-16.10	Duct accessories, mixing box, variable air volume, cool only, fan powered, damper, actuator and thermostat, 1250 CFM	2.0 ea	338.99	1,325.00	-	-	-	1,663.99 /ea	3,328
23-34-00.00	Fans, supply, 460 scfm	2.0 ea	771.37	2,652.65	-		-	3,424.02 /ea	6,848
23-34-00.00	Fans, in-line cntfgl, sply/exhaust, 460 CFM, 12" dia conn	3.0 ea	1,079.91	995.00	-		-	2,074.91 /ea	6,225
22-05-00.10	Allowance - Piping, Process - Foul Air Piping	1.0 ls	35,000.00	50,000.00		15,000.00	-	100,000.00 /ls	100,000
22-20-00.45	18" FRP Dampers, volume control	4.0 ea	61.00	620.00	-	-	-	681.00 /ea	2,724
22-20-00.45	16" FRP Dampers, volume control	7.0 ea	57.23	540.00	-	-	-	597.23 /ea	4,181
	Foul Air Fans and Ducting	**1.0 LSUM**	**41,105.05**	**67,200.30**		**15,000.00**		**123,305.35 /LSUM**	**123,305**
26321 Emergency Generator Set and Tank									
26-32-13.13	Generator set, diesel, 3 phase 4 wire, 277/480 V, 750 kW, incl battery, charger, muffler, & day tank, excl conduit, wiring, & concrete	1.0 ea	11,875.39	175,000.00	-	503.29	-	187,378.68 /ea	187,379
46-06-16.00	Fuel Trasfer Pumps	2.0 ea	1,799.38	7,957.95	-	618.75		10,376.08 /ea	20,752
22-05-00.10	Allowance - Piping, Process - Allowance	1.0 ls	7,500.00	7,500.00		5,000.00	-	20,000.00 /ls	20,000
	Emergency Generator Set and Tank	**1.0 Each**	**22,974.14**	**198,415.90**		**6,740.79**		**228,130.83 /Each**	**228,131**
26999 Electrical Allowance									
26-00-00.02	Electrical and Instrumentation Subcontract - Allowance	1.0 ls			1,500,000.00	-	-	1,500,000.00 /ls	1,500,000
	Electrical Allowance	**1.0 LS**			**1,500,000.00**			**1,500,000.00 /LS**	**1,500,000**
27999 Combination Vault W/San Carlos Flowmeter									
27-20-03.00	30" Magnetic flowmeters, 150# AWWA flanges	1.0 ea	228.91	23,214.00	-	-	-	23,442.91 /ea	23,443
33-05-16.13	Utility structures, utility vaults precast concrete, meter pit, Stacked 11' x 22', 28' deep, excludes excavation and backfill	1.0 ea	2,706.40	19,650.00	-	619.15	-	22,975.55 /ea	22,976
08-31-13.30	Doors, specialty, access, floor, commercial, aluminum tile, steel frame, double leaf, 4'-0" x 4'-0" opening, L4 crew	1.0 opng	499.66	1,750.00	-	-	-	2,249.66 /opng	2,250

Phase	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
27999 Combination Vault W/San Carlos Flowmeter									
46-06-00.00	Wastewater sampler, isco,refrigirated,composite	1.0 ea	343.36	5,946.00	-	-	-	6,289.36 /ea	6,289
02-99-99.99	Leachate disposal allowance	1.0 LS	-	-	10,000.00	-	-	10,000.00 /LS	10,000
	Combination Vault W/San Carlos Flowmeter	**1.0 Each**	**3,778.33**	**50,560.00**	**10,000.00**	**619.15**		**64,957.48 /Each**	**64,957**
27999 San Carlos Vault									
46-06-00.00	Trash Rack Screen	1.0 ea	11,957.04	90,000.00	-	-	-	101,957.04 /ea	101,957
08-31-13.30	Doors, specialty, access, floor, commercial, aluminum tile, steel frame, double leaf, 4'-0" x 4'-0" opening, L4 crew	1.0 opng	499.66	1,750.00	-	-	-	2,249.66 /opng	2,250
33-05-16.13	Utility structures, utility vaults precast concrete, 5' x 12'-6" I.D., 6" thick, excludes excavation and backfill	26.0 vlf	320.14	687.50	-	62.61	-	1,070.26 /vlf	27,827
	San Carlos Vault	**1.0 Each**	**20,780.42**	**109,625.00**		**1,627.90**		**132,033.32 /Each**	**132,033**
31240 Dewatering Systems - 4 Pumps 60 Days									
31-23-19.20	Dewatering, pumping 8 hours, attended 2 hrs per day, 4" discharge pump used for 8 hours, includes 20 LF of suction hose and 100 LF of discharge hose	240.0 day	230.29	-	-	31.15	-	261.44 /day	62,746
31-23-19.20	Dewatering,sump hole construction,pit with gravel collar,corrugated,12"gravel collar,24"corrugated pipe,14 gauge,includes excavation and gravel pit	60.0 lf	40.60	38.50	-	9.29	-	88.38 /lf	5,303
01-59-07.00	Dewatering, baker storage tank (5 total), water process	0.2 year	-	58,940.00	-	-		58,940.00 /year	8,841
01-59-07.00	Dewatering, baker process tank cleaning	1.0 ea	-	-	500.00	-		500.00 /ea	500
	Dewatering Systems - 4 Pumps 60 Days	**1.0 SET**	**57,705.12**	**11,151.00**	**500.00**	**8,033.71**		**77,389.83 /SET**	**77,390**
31250 Shoring Systems - Combination Vault									
31-41-16.10	Sheet piling, steel, 38 psf, 28' excavation, per S.F., drive, extract and salvage, excludes wales	3,150.0 sf	15.42	10.15	-	6.90	-	32.47 /sf	102,290
31-41-16.10	Sheet piling, wales, connections and struts, 2/3 salvage	9.0 ton	-	480.00	-	-	-	480.00 /ton	4,320
	Shoring Systems - Combination Vault	**3,150.0 SQFT**	**15.42**	**11.52**		**6.90**		**33.85 /SQFT**	**106,610**
31315 Excavation and Backfill - Comb. Vault									
31-23-16.42	Excavating, bulk bank measure, 1-1/2 C.Y. capacity = 160 C.Y./hour, shovel, excluding truck loading	384.4 bcy	0.95	-	-	0.99	-	1.94 /bcy	745

Phase	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
31315 Excavation and Backfill - Comb. Vault									
31-23-23.18	Hauling, excavated borrow material, loose cubic yards, 20 mile round trip, 0.4 loads/hour, 16.5 c.y. dump trailer, highway haulers, excludes loading	768.9 lcy	10.06	-	-	13.72	-	23.78 /lcy	18,282
31-05-16.10	Aggregate for earthwork, bank run gravel, spread with 200 H.P. dozer, includes load at pit and haul, 2 miles round trip, excludes compaction	231.1 lcy	3.35	22.00	-	4.71	-	30.05 /lcy	6,946
31-23-23.13	Backfill, bulk, 6" to 12" lifts, dozer backfilling, compaction with sheepsfoot roller	231.1 ecy	1.23	-	-	2.47	-	3.69 /ecy	854
31-23-23.17	Fill, gravel fill, compacted, under floor slabs, 12" deep	450.0 sf	0.52	1.47	-	0.03	-	2.02 /sf	909
	Excavation and Backfill - Comb. Vault	**768.9 cy**	**12.21**	**7.47**		**16.39**		**36.07 /cy**	**27,734**
31315 Excavation and Backfill - SC - Vault									
31-23-16.42	Excavating, bulk bank measure, 1-1/2 C.Y. capacity = 160 C.Y./hour, shovel, excluding truck loading	48.1 bcy	0.95	-	-	0.99	-	1.94 /bcy	93
31-23-23.18	Hauling, excavated borrow material, loose cubic yards, 20 mile round trip, 0.4 loads/hour, 16.5 c.y. dump trailer, highway haulers, excludes loading	96.3 lcy	10.06	-	-	13.72	-	23.78 /lcy	2,290
31-05-16.10	Aggregate for earthwork, bank run gravel, spread with 200 H.P. dozer, includes load at pit and haul, 2 miles round trip, excludes compaction	51.9 lcy	3.35	22.00	-	4.71	-	30.05 /lcy	1,558
31-23-23.13	Backfill, bulk, air tamped compaction, add	51.0 ecy	14.04	-	-	3.85	-	17.89 /ecy	912
31-23-23.17	Fill, gravel fill, compacted, under floor slabs, 12" deep	200.0 sf	0.52	1.47	-	0.03	-	2.02 /sf	404
01-54-33.40	Rent trench box 12,000 pounds 10' x 20'	14.0 day	-	-	-	161.60	-	161.60 /day	2,262
	Excavation and Backfill - SC - Vault	**96.3 cy**	**20.86**	**14.90**		**42.34**		**78.09 /cy**	**7,520**
40120 Ductile Iron Piping and Valves Spools									
40-05-19.20	Pipe Plain End-Ductile Iron--C-151 16 Inch (400mm)	32.7 lf	-	60.00	-	-	-	60.00 /lf	1,960
40-05-19.20	Pipe Plain End-Ductile Iron--C-151 18 Inch (450mm)	29.3 lf	-	64.00	-	-	-	64.00 /lf	1,872
40-05-19.20	Pipe Plain End-Ductile Iron--C-151 24 Inch (600mm)	19.0 lf	-	110.00	-	-	-	110.00 /lf	2,090
40-05-19.20	Fitting Flanged & Bolted-Ductile Iron-Ell90-Non-Specific 16 Inch (400mm)	6.0 ea	-	2,400.00	-	-	-	2,400.00 /ea	14,400
40-05-19.20	Fitting Flanged & Bolted-Ductile Iron-Ell90-Non-Specific 18 Inch (450mm)	6.0 ea	-	3,225.00	-	-	-	3,225.00 /ea	19,350
40-05-19.20	Fitting Flanged & Bolted-Ductile Iron-Ell90-Non-Specific 24 Inch (600mm)	6.0 ea	-	6,275.00	-	-	-	6,275.00 /ea	37,650

Phase	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
40120 Ductile Iron Piping and Valves Spools									
40-05-19.20	Fitting Flanged & Bolted-Ductile Iron-Reducer 1 Dia-Non-Specific 16 Inch (400mm)	3.0 ea	-	2,272.77	-	-	-	2,272.77 /ea	6,818
40-05-19.20	Fitting Flanged & Bolted-Ductile Iron-Reducer 1 Dia-Non-Specific 18 Inch (450mm)	3.0 ea	-	3,077.47	-	-	-	3,077.47 /ea	9,232
40-05-19.20	Fitting Flanged & Bolted-Ductile Iron-Reducer 1 Dia-Non-Specific 24 Inch (600mm)	3.0 ea	-	5,340.31	-	-	-	5,340.31 /ea	16,021
40-05-19.20	Fitting Flanged & Bolted-Ductile Iron-Tee-Non-Specific 24 Inch (600mm)	3.0 ea	-	11,870.51	-	-	-	11,870.51 /ea	35,612
40-05-19.10	Fitting Flanged & Bolted-Cast Iron-Flange Thr-Cls 125 16 Inch (400mm)	6.0 ea	-	216.90	-	-	-	216.90 /ea	1,301
40-05-19.10	Fitting Flanged & Bolted-Cast Iron-Flange Thr-Non-Specific 18 Inch (450mm)	6.0 ea	-	542.10	-	-	-	542.10 /ea	3,253
40-05-19.10	Fitting Flanged & Bolted-Cast Iron-Flange Thr-Non-Specific 24 Inch (600mm)	2.0 ea	-	1,084.20	-	-	-	1,084.20 /ea	2,168
40-05-05.00	Pipe Erection-Handle Fittings-Metal-Std 16 Inch (400mm)	9.0 ea	172.58	-	-	-	-	172.58 /ea	1,553
40-05-05.00	Pipe Erection-Handle Fittings-Metal-Std 18 Inch (450mm)	9.0 ea	189.01	-	-	-	-	189.01 /ea	1,701
40-05-05.00	Pipe Erection-Handle Fittings-Metal-Std 24 Inch (600mm)	12.0 ea	238.32	-	-	-	-	238.32 /ea	2,860
40-05-62.00	Valve Flanged & Bolted-Cast Steel-Plug-Cls 150 (PN20) 16 Inch (400mm)	3.0 ea	-	10,095.20	-	-	-	10,095.20 /ea	30,286
40-05-62.00	Valve Flanged & Bolted-Cast Steel-Plug-Cls 150 (PN20) 18 Inch (450mm)	3.0 ea	-	13,232.12	-	-	-	13,232.12 /ea	39,696
40-05-51.00	Pipe Erection-Handle Valves-Metal-Cls 150 (PN20) 16 Inch (400mm)	3.0 ea	391.18	-	-	-	-	391.18 /ea	1,174
40-05-51.00	Pipe Erection-Handle Valves-Metal-Cls 150 (PN20) 18 Inch (450mm)	3.0 ea	423.39	-	-	-	-	423.39 /ea	1,270
40-05-19.10	Shop Fabrication-Cast Iron-Shop Cut & Thread & Attach Flange-Class C 16 Inch (400mm)	6.0 ea	-	57.46	-	-	-	57.46 /ea	345
40-05-19.10	Shop Fabrication-Cast Iron-Shop Cut & Thread & Attach Flange-Class C 18 Inch (450mm)	6.0 ea	-	68.45	-	-	-	68.45 /ea	411
40-05-19.10	Shop Fabrication-Cast Iron-Shop Cut & Thread & Attach Flange-Class C 24 Inch (600mm)	2.0 ea	-	103.17	-	-	-	103.17 /ea	206
40-05-19.20	Pipe Erection-Straight Run-Ductile Iron-Non-Specific 16 Inch (400mm)	60.0 lf	86.78	-	-	-	-	86.78 /lf	5,207
40-05-19.20	Pipe Erection-Straight Run-Ductile Iron-Non-Specific 18 Inch (450mm)	60.0 lf	97.63	-	-	-	-	97.63 /lf	5,858

Phase	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
40120 Ductile Iron Piping and Valves Spools									
40-05-19.20	Pipe Erection-Straight Run-Ductile Iron-Non-Specific 24 Inch (600mm)	60.0 lf	132.15	-	-	-	-	132.15 /lf	7,929
40-05-05.00	Make Up Bolted Joint incl B-7 Nuts, Bolts, 1/16 Inch Rubber Gasket-Cls 150 (PN20) 16 Inch (400mm)	3.0 ea	109.57	225.30	-	-	-	334.87 /ea	1,005
40-05-05.00	Make Up Bolted Joint incl B-7 Nuts, Bolts, 1/16 Inch Rubber Gasket-Cls 150 (PN20) 18 Inch (450mm)	3.0 ea	109.57	306.54	-	-	-	416.11 /ea	1,248
40-05-05.00	Make Up Bolted Joint incl B-7 Nuts, Bolts, 1/16 Inch Rubber Gasket-Cls 150 (PN20) 24 Inch (600mm)	1.0 ea	109.57	537.94	-	-	-	647.51 /ea	648
40-05-07.00	Pipe Support 16 Inch (400mm)	3.0 ea	136.97	50.00	-	-	-	186.97 /ea	561
40-05-07.00	Pipe Support 18 Inch (450mm)	3.0 ea	136.97	50.00	-	-	-	186.97 /ea	561
40-05-07.00	Pipe Support 24 Inch (600mm)	3.0 ea	197.23	75.00	-	-	-	272.23 /ea	817
40-05-07.00	Hilti-Chemical Anchor - Pipe Support Size 16 Inch (400mm)	12.0 ea	54.79	45.00	-	-	-	99.79 /ea	1,197
40-05-07.00	Hilti-Chemical Anchor - Pipe Support Size 18 Inch (450mm)	12.0 ea	54.79	45.00	-	-	-	99.79 /ea	1,197
40-05-07.00	Hilti-Chemical Anchor - Pipe Support Size 24 Inch (600mm)	12.0 ea	54.79	55.00	-	-	-	109.79 /ea	1,317
40-46-16.00	FBEpoxy Coating 40 mil-Factory-16 Inch (400mm)	60.0 lf	-	7.88	-	-	-	7.88 /lf	473
40-46-16.00	FBEpoxy Coating 40 mil-Factory-18 Inch (450mm)	60.0 lf	-	9.34	-	-	-	9.34 /lf	561
40-46-16.00	FBEpoxy Coating 40 mil-Factory-24 Inch (600mm)	60.0 lf	-	13.19	-	-	-	13.19 /lf	791
40-05-05.00	Field Testing-Hydrotest-Non-Specific 16 Inch (400mm)	60.0 lf	26.30	-	-	-	-	26.30 /lf	1,578
40-05-05.00	Field Testing-Hydrotest-Non-Specific 18 Inch (450mm)	60.0 lf	33.09	-	-	-	-	33.09 /lf	1,985
40-05-05.00	Field Testing-Hydrotest-Non-Specific 24 Inch (600mm)	60.0 lf	57.86	-	-	-	-	57.86 /lf	3,471
22-11-19.34	Sleeve, pipe, steel with water stop, 12" long, 24" diam. for 18" carrier pipe, includes link seal	4.0 ea	425.41	1,050.00	-	-	-	1,475.41 /ea	5,902
	Ductile Iron Piping and Valves Spools	**180.0 lf**	**224.67**	**1,294.97**				**1,519.64 /lf**	**273,535**
46999 New Stop and Slide Gates									
46-06-10.00	Sluice gate, HD, self cont,motor operated &w/crank, 36" X 36"	1.0 ea	9,009.50	25,783.76	-	2,037.97	-	36,831.23 /ea	36,831
46-06-06.00	Hydraulic structures, slide gate, self contained, ab & grout,36" x 36"	2.0 ea	1,175.15	4,250.00	-	265.82	-	5,690.97 /ea	11,382
	New Stop and Slide Gates	**3.0 Each**	**3,786.60**	**11,427.92**		**856.54**		**16,071.06 /Each**	**48,213**
	02 BELMONT PUMP STATION MODIFICATIONS	**1.0 LSUM**	**331,947.17**	**1,342,889.84**	**1,610,500.00**	**77,909.77**		**3,363,246.78 /LSUM**	**3,363,247**

Phase	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
03 YARD AND CONVEYANCE PIPING									
22999 30" Above Ground Belmont Pipe and Sampler									
33-11-13.15	Water supply distribution piping,ductile iron pipe,cement lined,mechanical joint,fittings,18'lengths,18"diameter,class 50,excludes excavation backfill	40.0 lf	49.82	126.00	-	7.00	-	182.82 /lf	7,313
22-11-13.47	Flange, steel, forged steel, slip-on, 150 lb., 18" pipe size, welded front and back, includes weld machine	2.0 ea	1,454.04	440.00	-	32.70	-	1,926.74 /ea	3,853
46-06-00.00	Wastewater sampler, isco,refrigirated,composite,	1.0 ea	343.36	5,946.00	-	-	-	6,289.36 /ea	6,289
40-05-07.00	Hilti-Chemical Anchor - Pipe Support Size 18 Inch (450mm)	2.0 ea	54.79	45.00	-	-	-	99.79 /ea	200
40-05-07.00	Pipe Support 18 Inch (450mm)	8.0 ea	136.97	50.00	-	-	-	186.97 /ea	1,496
27-20-03.00	18" Magnetic flowmeters, 150# AWWA flanges	1.0 ea	228.91	13,928.40	-	-	-	14,157.31 /ea	14,157
33-11-13.15	Water supply distribution piping, fitting, reducer, ductile iron, cement lined, mechanical joint, AWWA C110, 30" X 8" diameter, class 50 water piping	2.0 ea	386.56	1,250.00	-	54.33	-	1,690.89 /ea	3,382
33-11-13.15	Water supply distribution piping,fitting,90 degree bend elbow,mechanical joint,ductile iron,cement lined,awwa c110,18"diameter,class 50 water piping	2.0 ea	497.98	2,125.00	-	69.98	-	2,692.96 /ea	5,386
33-11-13.15	Water supply distribution piping, fitting, wye or tee, ductile iron, cement lined, mechanical joint, AWWA C110, 18" diameter, class 50 water piping	1.0 ea	746.97	3,900.00	-	104.97	-	4,751.94 /ea	4,752
22-20-03.00	Pipe, steel ftngs, flg cplg adapter, 18"	1.0 ea	436.21	2,000.00	-		-	2,436.21 /ea	2,436
22-05-23.20	Valves, air relief, sewage, SS, for 18" forcemain	1.0 ea	457.81	1,500.00	-	-	-	1,957.81 /ea	1,958
22-20-00.61	Pipe, plastic, HDPE, flange adapter w/ring, 30" dia	2.0 ea		3,690.00	-		-	3,690.00 /ea	7,380
33-11-13.15	Water supply distribution piping,fitting,90 degree bend elbow,mechanical joint,ductile iron,cement lined,awwa c110,18"diameter,class 50 water piping	2.0 ea	497.98	2,125.00	-	69.98	-	2,692.96 /ea	5,386
33-11-13.15	Water supply distribution piping, fitting, wye or tee, ductile iron, cement lined, mechanical joint, AWWA C110, 18" diameter, class 50 water piping	1.0 ea	746.97	3,900.00	-	104.97	-	4,751.94 /ea	4,752
40-05-19.20	Fitting Flanged & Bolted-Ductile Iron-Ell90-Non-Specific 30 Inch (750mm)	2.0 ea	-	8,189.00	-	-	-	8,189.00 /ea	16,378
40-05-19.20	Pipe Erection-Straight Run-Ductile Iron-Non-Specific 30 Inch (750mm)	10.0 lf	165.67	-	-	-	-	165.67 /lf	1,657

Phase	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
	30" Above Ground Belmont Pipe and Sampler	**40.0 LFT**	**337.21**	**1,808.56**		**23.60**		**2,169.36 /LFT**	**86,775**
31240 Dewatering Systems									
31-23-19.20	Dewatering, pumping 8 hours, attended 2 hrs per day, 4" discharge pump used for 8 hours, includes 20 LF of suction hose and 100 LF of discharge hose	600.0 day	230.29	-	-	31.15	-	261.44 /day	156,865
31-23-19.20	Dewatering,sump hole construction,pit with gravel collar,corrugated,12"gravel collar,24"corrugated pipe,14 gauge,includes excavation and gravel pit	300.0 lf	40.60	38.50	-	9.29	-	88.38 /lf	26,515
01-59-07.00	Dewatering, baker storage tank (5 total), water process	0.3 year	-	58,940.00	-	-		58,940.00 /year	14,735
01-59-07.00	Dewatering, baker process tank cleaning	5.0 ea	-	-	500.00	-		500.00 /ea	2,500
	Dewatering Systems	**5.0 SET**	**30,070.44**	**5,257.00**	**500.00**	**4,295.47**		**40,122.91 /SET**	**200,615**
31315 SLIPLINE INSERTION PITS									
31-23-16.42	Excavating, bulk bank measure, 1-1/2 C.Y. capacity = 160 C.Y./hour, shovel, excluding truck loading	667.0 bcy	0.95	-	-	0.99	-	1.94 /bcy	1,292
31-23-23.18	Hauling, excavated or borrow material, loose cubic yards, 5 mile round trip, 1 load/hour, 16.5 C.Y. dump trailer, highway haulers, excludes loading	1,333.3 lcy	5.03	-	-	6.86	-	11.89 /lcy	15,851
31-23-23.17	Fill, gravel fill, compacted, under floor slabs, 12" deep	1,200.0 sf	0.52	1.47	-	0.03	-	2.02 /sf	2,424
01-54-36.50	Mobilization or demobilization, dozer, loader, backhoe or excavator, above 150 H.P., up to 50 miles	2.0 ea	180.99	-	-	322.73	-	503.72 /ea	1,007
31-23-23.14	Backfill, structural, crushed stone, 105 H.P. dozer, excludes compaction	667.0 lcy	0.75	20.57	-	0.50	-	21.82 /lcy	14,557
31-23-23.23	Compaction, riding, vibrating roller, 4 passes, 6" lifts	667.0 ecy	0.49	-	-	0.30	-	0.78 /ecy	520
31-41-16.10	Sheet piling, steel, 22 psf, 15' excavation, per S.F., drive, extract and salvage, excludes wales	3,080.0 sf	15.65	5.70	-	7.01	-	28.35 /sf	87,325
31-41-16.10	Sheet piling, wales, connections and struts, 2/3 salvage	3.4 ton	-	480.00	-	-	-	480.00 /ton	1,632
	SLIPLINE INSERTION PITS	**2.0 Each**	**28,672.24**	**17,336.10**		**16,295.73**		**62,304.07 /Each**	**124,608**
31315 SLIPLINE PULL PIT									
31-23-16.42	Excavating, bulk bank measure, 1-1/2 C.Y. capacity = 160 C.Y./hour, shovel, excluding truck loading	222.2 bcy	0.95	-	-	0.99	-	1.94 /bcy	430

Phase	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
31315 SLIPLINE PULL PIT									
31-23-23.18	Hauling, excavated or borrow material, loose cubic yards, 5 mile round trip, 1 load/hour, 16.5 C.Y. dump trailer, highway haulers, excludes loading	444.4 lcy	5.03	-	-	6.86	-	11.89 /lcy	5,284
31-23-23.17	Fill, gravel fill, compacted, under floor slabs, 12" deep	400.0 sf	0.52	1.47	-	0.03	-	2.02 /sf	808
31-23-23.14	Backfill, structural, crushed stone, 105 H.P. dozer, excludes compaction	222.0 lcy	0.75	20.57	-	0.50	-	21.82 /lcy	4,845
31-23-23.23	Compaction, riding, vibrating roller, 4 passes, 6" lifts	222.0 ecy	0.49	-	-	0.30	-	0.78 /ecy	173
31-41-16.10	Sheet piling, steel, 22 psf, 15' excavation, per S.F., drive, extract and salvage, excludes wales	1,520.0 sf	15.65	5.70	-	7.01	-	28.35 /sf	43,095
31-41-16.10	Sheet piling, wales, connections and struts, 2/3 salvage	1.7 ton	-	480.00	-	-	-	480.00 /ton	816
	SLIPLINE PULL PIT	**1.0 Each**	**26,712.58**	**14,634.54**		**14,104.49**		**55,451.61 /Each**	**55,452**
31315 CIPP ACCESS PITS									
31-23-16.42	Excavating, bulk bank measure, 1-1/2 C.Y. capacity = 160 C.Y./hour, shovel, excluding truck loading	200.0 bcy	0.95	-	-	0.99	-	1.94 /bcy	387
31-23-23.18	Hauling, excavated or borrow material, loose cubic yards, 5 mile round trip, 1 load/hour, 16.5 C.Y. dump trailer, highway haulers, excludes loading	400.0 lcy	5.03	-	-	6.86	-	11.89 /lcy	4,755
31-23-23.17	Fill, gravel fill, compacted, under floor slabs, 12" deep	450.0 sf	0.52	1.47	-	0.03	-	2.02 /sf	909
31-23-23.14	Backfill, structural, crushed stone, 105 H.P. dozer, excludes compaction	200.0 lcy	0.75	20.57	-	0.50	-	21.82 /lcy	4,365
31-23-23.23	Compaction, riding, vibrating roller, 4 passes, 6" lifts	200.0 ecy	0.49	-	-	0.30	-	0.78 /ecy	156
31-41-16.10	Sheet piling, steel, 22 psf, 15' excavation, per S.F., drive, extract and salvage, excludes wales	2,640.0 sf	15.65	5.70	-	7.01	-	28.35 /sf	74,850
31-41-16.10	Sheet piling, wales, connections and struts, 2/3 salvage	2.9 ton	-	480.00	-	-	-	480.00 /ton	1,392
	CIPP ACCESS PITS	**2.0 Each**	**21,995.52**	**10,607.75**		**10,803.99**		**43,407.25 /Each**	**86,815**
33500 30" HDPE TRENCH - OPEN CUT (SCPS)									
31-23-16.13	Excavating, trench or continuous footing, common earth, 1-1/2 C.Y. excavator, 10' to 14' deep, excludes sheeting or dewatering	622.2 bcy	2.26	-	-	1.95	-	4.20 /bcy	2,614
31-23-23.16	Fill by borrow and utility bedding, for pipe and conduit, sand, dead or bank, excludes compaction	545.8 lcy	10.83	17.85	-	2.48	-	31.15 /lcy	17,001

Phase	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
33500 30" HDPE TRENCH - OPEN CUT (SCPS)									
31-23-23.16	Fill by borrow and utility bedding, for pipe and conduit, compacting bedding in trench	545.8 ecy	5.56	-	-	0.41	-	5.97 /ecy	3,258
33-05-26.10	Utility line signs, markers, and flags, underground tape, detectable, reinforced, aluminum foil core, 2", excludes excavation and backfill	4.0 clf	3.34	6.50	-	-	-	9.84 /clf	39
01-54-33.40	Roadway steel plates, 8' x 20' x 1"thick, avg cost per sf, monthly	320.0 sf	-	-	0.49	-	-	0.49 /sf	157
31-23-23.13	Backfill, trench, 6" to 12" lifts, dozer backfilling, compaction with sheepsfoot roller	311.1 ecy	1.42	-	-	2.85	-	4.26 /ecy	1,326
31-23-23.18	Hauling, excavated or borrow material, loose cubic yards, 5 mile round trip , 1 loads/hour, 12 C.Y. truck, highway haulers, excludes loading	545.0 lcy	6.96	-	-	9.04	-	16.00 /lcy	8,718
31-41-16.10	Sheet piling, steel, 22 psf, 15' excavation, per S.F., drive, extract and salvage, excludes wales	11,760.0 sf	15.65	5.70	-	7.01	-	28.35 /sf	333,423
31-41-16.10	Sheet piling, wales, connections and struts, 2/3 salvage	12.9 ton	-	480.00	-	-	-	480.00 /ton	6,192
	30" HDPE TRENCH - OPEN CUT (SCPS)	**420.0 LFT**	**472.85**	**197.60**	**0.37**	**216.63**		**887.45 /LFT**	**372,728**
33500 42" HDPE TRENCH - OPEN CUT (SPCS)									
31-23-16.13	Excavating, trench or continuous footing, common earth, 1-1/2 C.Y. excavator, 10' to 14' deep, excludes sheeting or dewatering	29.6 bcy	2.26	-	-	1.95	-	4.20 /bcy	124
31-23-23.16	Fill by borrow and utility bedding, for pipe and conduit, sand, dead or bank, excludes compaction	30.0 lcy	10.83	17.85	-	2.48	-	31.15 /lcy	935
31-23-23.16	Fill by borrow and utility bedding, for pipe and conduit, compacting bedding in trench	30.0 ecy	5.56	-	-	0.41	-	5.97 /ecy	179
31-23-23.13	Backfill, trench, 6" to 12" lifts, dozer backfilling, compaction with sheepsfoot roller	28.1 ecy	1.42	-	-	2.85	-	4.26 /ecy	120
31-23-23.18	Hauling, excavated or borrow material, loose cubic yards, 5 mile round trip , 1 loads/hour, 12 C.Y. truck, highway haulers, excludes loading	30.0 lcy	6.96	-	-	9.04	-	16.00 /lcy	480
31-41-16.10	Sheet piling, steel, 22 psf, 15' excavation, per S.F., drive, extract and salvage, excludes wales	560.0 sf	15.65	5.70	-	7.01	-	28.35 /sf	15,877
31-41-16.10	Sheet piling, wales, connections and struts, 2/3 salvage	0.6 ton	-	480.00	-	-	-	480.00 /ton	288
	42" HDPE TRENCH - OPEN CUT (SPCS)	**20.0 LFT**	**478.46**	**200.78**		**220.93**		**900.16 /LFT**	**18,003**
33500 10" HDPE TRENCH - OPEN CUT									

Phase	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
33500 10" HDPE TRENCH - OPEN CUT									
31-23-16.13	Excavating, trench or continuous footing, common earth, 1-1/2 C.Y. excavator, 10' to 14' deep, excludes sheeting or dewatering	333.3 bcy	2.26	-	-	1.95	-	4.20 /bcy	1,400
31-23-23.16	Fill by borrow and utility bedding, for pipe and conduit, sand, dead or bank, excludes compaction	320.0 lcy	10.83	17.85	-	2.48	-	31.15 /lcy	9,969
31-23-23.16	Fill by borrow and utility bedding, for pipe and conduit, compacting bedding in trench	320.0 ecy	5.56	-	-	0.41	-	5.97 /ecy	1,910
33-05-26.10	Utility line signs, markers, and flags, underground tape, detectable, reinforced, aluminum foil core, 2", excludes excavation and backfill	2.0 clf	3.34	6.50	-	-	-	9.84 /clf	20
01-54-33.40	Roadway steel plates, 8' x 20' x 1"thick, avg cost per sf, monthly	320.0 sf	-	-	0.49	-	-	0.49 /sf	157
31-23-23.13	Backfill, trench, 6" to 12" lifts, dozer backfilling, compaction with sheepsfoot roller	166.7 ecy	1.42	-	-	2.85	-	4.26 /ecy	710
31-23-23.18	Hauling, excavated or borrow material, loose cubic yards, 5 mile round trip , 1 loads/hour, 12 C.Y. truck, highway haulers, excludes loading	320.0 lcy	6.96	-	-	9.04	-	16.00 /lcy	5,119
31-41-16.10	Sheet piling, steel, 22 psf, 15' excavation, per S.F., drive, extract and salvage, excludes wales	6,300.0 sf	15.65	5.70	-	7.01	-	28.35 /sf	178,619
31-41-16.10	Sheet piling, wales, connections and struts, 2/3 salvage	6.9 ton	-	480.00	-	-	-	480.00 /ton	3,312
	10" HDPE TRENCH - OPEN CUT	**225.0 LFT**	**475.73**	**199.76**	**0.70**	**218.11**		**894.30 /LFT**	**201,216**
33999 30" HPDE LINING									
33-01-30.74	Hdpe pipe lining,30"diameter, SDR17,excludes cleaning and video inspection	3,100.0 lf	41.08	308.84	-	12.47	-	362.39 /lf	1,123,421
33-01-30.16	Pipe, internal cleaning and inspection, cleaning, power rodder with header & cutters, 30" diameter	3,100.0 lf	-	-	9.00	-	-	9.00 /lf	27,900
40-05-33.00	Field Butt Weld-HDPE-SDR17 30 Inch (750mm)	78.0 ea	57.39	-	-	-	-	57.39 /ea	4,477
03-52-16.13	Insulating lightweight cellular concrete, 1:6 field mix	1,263.0 cy	74.80	252.00	-	14.69	-	341.49 /cy	431,301
	30" HPDE LINING	**3,100.0 LFT**	**73.00**	**411.51**	**9.00**	**18.46**		**511.97 /LFT**	**1,587,099**
33999 CIPP LINING									
33-01-10.21	Cured in place pipe, press, flex felt resin, 400', 24" diam.	1,200.0 lnft		-	300.00	-		300.00 /lnft	360,000

Phase	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
33999 CIPP LINING									
33-01-30.16	Pipe, internal cleaning and inspection, cleaning, power rodder with header & cutters, 14"-24" diameter	1,200.0 lf	-	-	6.21	-	-	6.21 /lf	7,452
	CIPP LINING	**1,200.0 LFT**			**306.21**			**306.21 /LFT**	**367,452**
40530 HDPE Butt Fusion Field Run									
40-05-33.00	Pipe Plain End-HDPE--SDR17 10 Inch (250mm)	225.0 lf	-	29.07	-	-	-	29.07 /lf	6,540
40-05-33.00	Pipe Plain End-HDPE--SDR17 30 Inch (750mm)	420.0 lf	-	308.84	-	-	-	308.84 /lf	129,712
40-05-33.00	Pipe Plain End-HDPE--SDR17 42 Inch (1050mm)	20.0 lf	-	605.32	-	-	-	605.32 /lf	12,106
40-05-33.00	Pipe Erection-Straight Run-HDPE-Non-Specific 10 Inch (250mm)	225.0 lf	21.70	-	-	-	-	21.70 /lf	4,881
40-05-33.00	Pipe Erection-Straight Run-HDPE-Non-Specific 30 Inch (750mm)	420.0 lf	66.07	-	-	-	-	66.07 /lf	27,750
40-05-33.00	Pipe Erection-Straight Run-HDPE-Non-Specific 42 Inch (1050mm)	20.0 lf	93.69	-	-	-	-	93.69 /lf	1,874
40-05-33.00	Field Butt Fusion Weld-HDPE-SDR17 10 Inch (250mm)	8.0 ea	27.61	-	-	50.00	-	77.61 /ea	621
40-05-33.00	Field Butt Weld-HDPE-SDR17 30 Inch (750mm)	12.0 ea	57.39	-	-	100.00	-	157.39 /ea	1,889
40-05-33.00	Field Butt Weld-HDPE-SDR17 42 Inch (1050mm)	2.0 ea	78.37	-	-	250.00	-	328.37 /ea	657
40-05-05.00	Field Testing-Hydrotest-Non-Specific 10 Inch (250mm)	225.0 lf	12.49	-	-	-	-	12.49 /lf	2,811
40-05-05.00	Field Testing-Hydrotest-Non-Specific 30 Inch (750mm)	420.0 lf	89.85	-	-	-	-	89.85 /lf	37,737
40-05-05.00	Field Testing-Hydrotest-Non-Specific 42 Inch (1050mm)	20.0 lf	175.10	-	-	-	-	175.10 /lf	3,502
	HDPE Butt Fusion Field Run	**665.0 LFT**	**119.73**	**223.10**		**3.16**		**345.99 /LFT**	**230,080**
	03 YARD AND CONVEYANCE PIPING	**4,965.0 LFT**	**183.89**	**347.46**	**80.19**	**59.32**		**670.86 /LFT**	**3,330,842**

Phase	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
04 BELMONT SITE CIVIL ALLOWANCES									
01999 Traffic Control Allowance									
01-99-99.99	Traffic Control Allowance	1.0 LS	-	-	100,000.00	-	-	100,000.00 /LS	100,000
	Traffic Control Allowance	**1.0 LSUM**			**100,000.00**			**100,000.00 /LSUM**	**100,000**
02999 Potholing Allowance									
02-99-99.99	Potholing Allowacne	1.0 LS	-	-	20,000.00	-	-	20,000.00 /LS	20,000
	Potholing Allowance	**1.0 LSUM**			**20,000.00**			**20,000.00 /LSUM**	**20,000**
22999 Potable Water Allowance									
22-99-99.99	Potable Water Sevice	1.0 LS	10,000.00	10,000.00		5,000.00	-	25,000.00 /LS	25,000
	Potable Water Allowance	**1.0 LSUM**	**10,000.00**	**10,000.00**		**5,000.00**		**25,000.00 /LSUM**	**25,000**
32740 Asphalt Paving And Grading									
32-11-23.23	Base course drainage layers, aggregate base course for roadways and large paved areas, bank run gravel, spread and compacted, 12" deep	1,444.4 sy	0.60	8.65	-	0.57	-	9.82 /sy	14,186
32-01-13.66	Fog seal, sealcoating, prepare and clean surface for sealcoating	1,444.4 sy	0.18	-	-	0.03	-	0.21 /sy	302
32-12-16.13	Plant-mix asphalt paving, for highways and large paved areas, pavement replacement over trench, 6" thick, no hauling included	1,444.4 sy	57.10	25.00	-	2.92	-	85.02 /sy	122,812
32-01-13.66	Fog seal, seal coating, coal tar pitch emulsion, 2 coat, 1000 to 10,000 S.Y.	1,444.4 sy	0.40	0.90	-	0.31	-	1.61 /sy	2,329
	Asphalt Paving And Grading	**13,000.0 SQFT**	**6.48**	**3.84**		**0.43**		**10.74 /SQFT**	**139,629**
32740 Sidewalk Allowance									
31-22-16.10	Fine grading, for roadway, base or leveling course, large area, 6,000 S.Y. or more	55.6 sy	0.59	-	-	0.38	-	0.96 /sy	53
32-06-10.10	Sidewalks, driveways, and patios, sidewalk, concrete, cast-in-place with 6 x 6 - W1.4 x W1.4 mesh, broomed finish, 3000 psi, 6" thick, excludes base	500.0 sf	3.44	2.64	-	-	-	6.08 /sf	3,042
32-06-10.10	Sidewalks, driveways, and patios, sidewalks, concrete, excludes base, for 8" thick bank run gravel base, add	500.0 sf	0.95	1.04	-	0.03	-	2.02 /sf	1,009
	Sidewalk Allowance	**500.0 SQFT**	**4.46**	**3.68**		**0.07**		**8.21 /SQFT**	**4,104**
32999 New Gate Allowance									
08-34-56.10	Security gate, driveway, steel, dual leaf, 25 wide, includes frame, rollers and hardware	1.0 opng	2,116.30	2,200.00	-	-	-	4,316.30 /opng	4,316
08-34-56.10	Security gate, driveway, opener 12 VDC, wireless	1.0 ea	-	1,800.00	-	-	-	1,800.00 /ea	1,800

Phase	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
	New Gate Allowance	**25.0 LFT**	**84.65**	**160.00**				**244.65 /LFT**	**6,116**
33630 Storm Drainage Piping - Allowance									
33-31-13.25	Public sanitary utility sewerage piping, piping polyvinyl chloride pipe, B & S, 13' lengths, 12" diameter, SDR 35, excludes excavation or backfill	200.0 lf	5.86	12.75	-	0.44	-	19.05 /lf	3,810
33-49-13.10	Headwall slab, including forms, reinforcing, place & finish, 8" thick	2.5 cy	229.70	118.00	-	0.82	-	348.53 /cy	860
33-49-13.10	Headwall and tapered wings, form, reinf., place/finish, 8" thick	3.1 cy	1,133.17	165.00	-	50.16	-	1,348.32 /cy	4,157
31-37-13.10	Rip-rap and rock lining, random, broken stone, 18" minimum thickness, machine placed for slope protection, not grouted	22.2 sy	72.49	18.90	-	14.18	-	105.56 /sy	2,346
	Storm Drainage Piping - Allowance	**200.0 LFT**	**34.22**	**18.85**		**2.80**		**55.86 /LFT**	**11,173**
33635 Manholes Allowance - 6' DIA Assumes 10 VLF									
33-49-13.10	Storm drainage manholes, frames and covers, concrete, precast, 6' inside diameter, 8' deep, excludes footing, excavation, backfill, frame and cover	3.0 ea	1,623.84	3,200.00	-	371.49	-	5,195.33 /ea	15,586
33-49-13.10	Storm drainage manholes,frames and covers,concrete,precast,6'inside diam,excludes footing,excavation,backfill,frame and cover,add for depths over 8'	6.0 vlf	202.98	380.00	-	46.44	-	629.42 /vlf	3,777
33-49-13.10	Storm drainage manholes, frames and covers, precast concrete, 6' diameter manhole, 8" thick top	3.0 ea	231.98	635.00	-	53.07	-	920.05 /ea	2,760
33-44-13.13	Utility area drain,catch basins manholes catch basins manholes frames and covers,cast iron,heavy traffic,36"diam,1150lb, excluding footing&excavation	3.0 ea	541.28	795.00	-	123.83	-	1,460.11 /ea	4,380
33-49-13.10	Storm drainage manholes, frames and covers, steps, standard sizes, galvanized steel	27.0 ea	16.25	22.00	-	-	-	38.25 /ea	1,033
33-44-13.13	Base slab; form, resteel and concrete to 8" thick, avg cost per CY	7.4 cy	229.70	200.00	-	0.82	-	430.53 /cy	3,186
31-23-16.13	Excavate pit, common earth, hyd backhoe, 3/4 CY bucket	133.3 cy	13.54	-	-	7.42	-	20.96 /cy	2,794
31-41-13.10	Trench box and jacks, cost per sfca trench wall, monthly rental	1,320.0 sf	-	-	4.53	-	-	4.53 /sf	5,980
31-23-23.13	Backfill, trench, air tamped compaction, add	79.2 ecy	14.04	-	-	3.85	-	17.89 /ecy	1,416

Phase	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
33635 Manholes Allowance - 6' DIA Assumes 10 VLF									
31-23-23.18	Hauling, excavated or borrow material, loose cubic yards, 3 mile round trip, 2.1 loads/hour, 6 C.Y. dump truck, highway haulers, excludes loading	54.2 lcy	6.79	-	-	5.24	-	12.03 /lcy	652
	Manholes Allowance - 6' DIA Assumes 10 VLF	**3.0 ea**	**4,610.60**	**6,081.33**	**1,993.20**	**1,169.26**		**13,854.39 /ea**	**41,563**
33635 Catch Basin - Allowance									
33-49-13.10	Storm drainage manholes, frames and covers, concrete, cast place, 4' x 4', 8" thick, 8' deep, excludes footing, excavation, backfill, frame and cover	2.0 ea	3,847.01	1,050.00	-	31.83	-	4,928.84 /ea	9,858
33-49-13.10	Storm drainage manholes,frames and covers,concrete,cast place,4'dm,8"thick,excludes footing,excavation,backfill,frame and cover,add for depths over 8'	4.0 vlf	480.88	119.00	-	3.98	-	603.85 /vlf	2,415
33-44-13.13	Utility area drain,catch basins manholes catch basins manholes frames and covers,cast iron,heavy traffic,36"diam,1150lb, excluding footing&excavation	2.0 ea	541.28	795.00	-	123.83	-	1,460.11 /ea	2,920
33-49-13.10	Storm drainage manholes, frames and covers, steps, standard sizes, galvanized steel	18.0 ea	16.25	22.00	-	-	-	38.25 /ea	688
31-23-16.13	Excavate pit, common earth, hyd backhoe, 3/4 CY bucket	88.9 cy	13.54	-	-	7.42	-	20.96 /cy	1,863
31-41-13.10	Trench box and jacks, cost per sfca trench wall, monthly rental	880.0 sf	-	-	4.53	-	-	4.53 /sf	3,986
31-23-23.13	Backfill, trench, air tamped compaction, add	67.9 ecy	14.04	-	-	3.85	-	17.89 /ecy	1,215
31-23-23.18	Hauling, excavated or borrow material, loose cubic yards, 3 mile round trip, 2.1 loads/hour, 6 C.Y. dump truck, highway haulers, excludes loading	21.0 lcy	6.79	-	-	5.24	-	12.03 /lcy	252
	Catch Basin - Allowance	**2.0 ea**	**6,645.92**	**2,281.00**	**1,993.20**	**679.01**		**11,599.13 /ea**	**23,198**
	04 BELMONT SITE CIVIL ALLOWANCES	**1.0 LSUM**	**132,504.26**	**92,321.35**	**129,966.00**	**15,991.52**		**370,783.13 /LSUM**	**370,783**
	01 SVCW BELMONT PUMPSTATION	**1.0 LSUM**	**1,491,755.03**	**3,162,758.57**	**2,155,231.60**	**411,610.64**		**7,221,355.84 /LSUM**	**7,221,356**

Estimate Totals

Description	Rate	Hours	Amount	Totals
Labor		17,670 hrs	1,491,755	
Material			3,162,759	
Subcontract			2,155,232	
Equipment		10,863 hrs	411,611	
			7,221,357	**7,221,357**
Labor Mark-up	15.000 %		223,763	
Material Mark-up	10.000 %		316,276	
Subcontractor Mark-up	10.000 %		215,523	
Construction Equipment Mark-up	10.000 %		41,161	
			796,723	**8,018,080**
Material Shipping & Handling	2.000 %		63,255	
Material Sales Tax	9.000 %		313,113	
Net Markups			**376,368**	**8,394,448**
Contractor General Conditions	12.000 %		1,007,334	
MOBE/DEMOB	5.000 %		419,722	
			1,427,056	**9,821,504**
Start-Up, Training, O&M	2.000 %		196,430	
			196,430	**10,017,934**
Contractor Bonds & Insurance	2.000 %		200,359	
			200,359	**10,218,293**
Bldg Risk, Liability Auto Ins	1.000 %		102,183	
			102,183	**10,320,476**
CGL Insurance	1.500 %		154,807	
Gross Markups			**154,807**	**10,475,283**
Total				**10,475,283**

Appendix J: Belmont Conveyance Project LCC Analysis

The following LCC Analyses as prepared by Brown and Caldwell, August 31, 2016

- Belmont Force Main LCC
- BPS LCC
- SCPS LCC

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Belmont Force Main LCC

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August 31, 2016

Mr. Bob Donaldson
Collaborative Strategies Consulting, Inc.
2785 Canyon Creek Drive
San Ramon CA 94583

Project No. 146228

Subject: Belmont Force Main Life Cycle Analysis

Dear Mr. Donaldson:

This letter summarizes the assumptions and sources of information for the cost components incorporated into the Belmont Force Main (FM) Life Cycle Cost (LCC) analysis model. The major considerations in developing the Belmont FM LCC include capital cost, annual operation and maintenance (O&M) running costs, replacement/rehabilitation costs and overall project schedule.

Construction Costs. The Belmont Force Main project will consist of rehabilitating the existing force main that conveys the wastewater flow from the City of Belmont to the SVCW system, back to the existing San Carlos Pump Station (SCPS) location. The construction costs include Cured-in-Place Pipe (CIPP) rehabilitation of an existing 1,150 foot 24-inch segment of the force main and slipline of 3,550 feet of the 54-inch force main. Additionally, construction costs include three CIPP access pits, two slipline insertion pits, and a single slipline pull pit.

Construction costs were calculated by Brown and Caldwell. The construction costs were converted into capital costs by applying soft costs, project contingencies, and market fluctuations to each individual cost component.

The construction contingencies, soft costs, and market fluctuations are summarized in Table 1. Market fluctuations are applied to capture the range of costs that could potentially occur over the construction period for the entire conveyance system program upgrade.

Table 1. Capital Cost Factors	
Cost Factor	Markup
Construction Contingency[1]	**25%**
Soft Costs[2]	
Construction Management, Engineering Services During Construction, Testing, Inspection	15%
Contract Change Orders (CCO)	5%
Planning	5%
Design	10%
Project Management	5%
Soft Cost Subtotal	**40%**
Market Fluctuations[3]	
Low	-5%
High	15%

Notes:

[1,2]Construction contingency and soft costs developed by SVCW as presented in the comparison of construction cost estimates during the June 2, 2016 Department Head Meeting.

[3]Market fluctuations developed by SVCW. Source: SVCW Conveyance System Construction Cost Analysis, Front of Plant, Revision Date: April 22, 2015, Revision 28b.

O&M Costs. Future Annual O&M Costs are assumed to be included in the conveyance system pump stations; therefore, do not need to be accounted for in this analysis. The force main does not require regular cleaning; therefore, there are no cleaning costs associated with the Belmont Force Main. Pipe inspections are completed by acoustic Doppler technology every ten years after rehabilitation. It is assumed that the cost to inspect is $10/foot, thus $47,000 annually. There are no power requirements at the Belmont FM, so no electrical costs were calculated.

Rehabilitation/ Replacement Costs. The anticipated design life for new the force main is 75 years; thus, no rehabilitation or replacement costs are assumed since the design life occurs outside of the analysis window of 50 years.

Schedule. The Belmont FM project construction is expected to begin in June 2022 and end in June 2023. Capital costs are applied in the LCC model at the midpoint year of construction. The Year 2022 is used as the midpoint year of construction. The end year of construction is used to establish the start of recurring inspection costs. The Year of Analysis for the entire conveyance system program is the Year of Beneficial Use. The Year of Beneficial Use is the year major facilities of the conveyance system (i.e., Tunnel, Receiving Lift Station and Headworks) start up. Based on the current program-wide schedule (Version 13 dated June 23, 2016) developed by SVCW, the Year of Beneficial Use is the Year 2022.

Escalation and Discount Rates. To determine the present value of costs for the Year of Analysis, their values were escalated to future values and discounted back to the Year of Analysis. The discount and escalation rates used in the Belmont FM LCC Analysis were developed by SVCW based on current and projected investment return rates as summarized in Table 3.

Table 3. Escalation and Discount Rates

Factor	Rate
Escalation	4%
Capital Project and Rehabilitation/Replacement Discount	7%
O&M Discount	3%

The LCC analysis summarizes all cost components over a 50-Year period ending in the Year 2066. The calculation for determining the Belmont FM LCC is located in Attachment A. The total 50-year LCC for Belmont FM is $11.2 million with a range of $10.9 to $12.2 million accounting for market fluctuations.

Very truly yours,

Brown and Caldwell

Charlie Joyce, Project Manager
Walnut Creek, CA

cc: Kim Hackett, SVCW
Roanne Ross, Whitley Burchett & Associates

Attachments (1)

- Attachment A: Belmont Force Main LCC Calculation

Attachment A: SVCW Life Cycle Cost (LCC) Belmont Force Main Calculation

A. Purpose: This sheet provides a the Belmont Force Main LCC calculation for a 50-year analysis period. The equations used below are further explained in TM 11-3: Life Cycle Cost Analysis Guidelines.

B. Conversion of Construction Cost to Capital Cost:The following equation is used to convert the construction cost developed by each team into a capital cost. Contingency, soft cost and market fluctuation cost factors are displayed below.

Capital Cost = Construction Cost x [1 + Project Contingency + Σ(Soft Costs) + Market Fluctuations]

1. Project Contingency (all projects except Gravity Pipeline), Cont: $\text{Cont} := 25\%$

2. Soft Costs, SC:

- Construction Management and Engineering Service for Pipeline Projects: $SC_{CM} := 15\%$
- Conract Change Orders: $SC_{CCO} := 5\%$
- Planning: $SC_{Plan} := 5\%$
- Design: $SC_{Design} := 10\%$
- Project Management $SC_{PM} := 5\%$

3. Market Fluctuation, MF:
Curently set by SVCW

$MF_{low} := -5\%$

$MF_{base} := 0\%$

$MF_{high} := 15\%$

4. Capital Cost, CC: For the Belmont Force Main Project, the construction cost is $5,205,750 (2016 dollars) and occurs in the midyear of construction.

Display Unit of Dollars: $\text{dollars} := 1$

$\text{Cost}_{Construction} := 5205750\text{dollars}$

Note: From the Belmont Pump Station Conceptual Level Class 3 Estimate, May 2016, prepared by BC.

$$\text{Cost}_{Capital\_low} := \text{Cost}_{Construction}\cdot\left(1 + \text{Cont} + SC_{CM} + SC_{CCO} + SC_{Plan} + SC_{Design} + SC_{PM} + MF_{low}\right) = 8.33 \times 10^{6}\cdot\text{dollars}$$

$$\text{Cost}_{Capital\_base} := \text{Cost}_{Construction}\cdot\left(1 + \text{Cont} + SC_{CM} + SC_{CCO} + SC_{Plan} + SC_{Design} + SC_{PM} + MF_{base}\right) = 8.59 \times 10^{6}\cdot\text{dollars}$$

$$Cost_{Capital\_high} := Cost_{Construction} \cdot \left(1 + Cont + SC_{CM} + SC_{CCO} + SC_{Plan} + SC_{Design} + SC_{PM} + MF_{high}\right) = 9.37 \times 10^{6} \cdot dollars$$

$Y_{capital}$ = Midpoint Year of Construction $Y_{capital} := 2022$

C. Operation and Maintenance (O&M) Costs: The following O&M assumptions are made for the Belmont Force Main:

1. Future Annual O&M Costs are assumed to be included in the conveyance system pump stations; therefore, do not need to be accounted for in this analysis.
2. The force main does not require regular cleaning; therefore, there are no cleaning costs associated with the Belmont Force Main.
3. Inspections are completed by acoustic doppler technology every 10 years after rehabilitation at the cost shown below.

1. Pipe Inspections

- Construction Finish Year, $Y_{EndConst}$: $Y_{EndConst} := 2023$
- Inspection Cost, $Cost_{Unit\_Inspect}$: $Cost_{Unit\_Inspect} := \frac{10dollars}{ft}$
- Length of Belmont Force Main, L_{FM}: $L_{FM} := 4700ft$

Annual cost for pipe inspections is calculated as follows:

$$Cost_{Annual\_Inspect} := L_{FM} \cdot Cost_{Unit\_Inspect} = 47 \times 10^{3} \cdot dollars$$

Inspection occurs every 10 years under a 50-year cycle; therefore, inspections occur in the following years:

$$Y_{OM\_1} := Y_{EndConst} + 10 = 2033$$

$$Y_{OM\_2} := Y_{EndConst} + 20 = 2043$$

$$Y_{OM\_3} := Y_{EndConst} + 30 = 2053$$

$$Y_{OM\_4} := Y_{EndConst} + 40 = 2063$$

D. Rehabilitation and Replacement Costs: The anticipated design life for new force main is 75 years; thus, no rehabilitation or replacement costs need to be calculated for the force main since the design life occurs outside of the analysis window of 50 years.

E. Future Value of All Costs:

- Current Year, $Y_{current}$: $Y_{current} := 2016$
- Escalation, i: $i := 4\%$
- Calculate future values, FV using TM 11-3, EQ 4-1:

FV = PV x $(1+i)^{Yn-Ycurrent}$,
where Y_n is the year the cost occurs and PV = present value.

$$FV_{capital\_low} := Cost_{Capital\_low} \cdot (1+i)^{Y_{capital} - Y_{current}} = 10.54 \times 10^6 \cdot dollars$$

$$FV_{capital\_base} := Cost_{Capital\_base} \cdot (1+i)^{Y_{capital} - Y_{current}} = 10.87 \times 10^6 \cdot dollars$$

$$FV_{capital\_high} := Cost_{Capital\_high} \cdot (1+i)^{Y_{capital} - Y_{current}} = 11.86 \times 10^6 \cdot dollars$$

$$FV_{OM\_1} := round\left[Cost_{Annual\_Inspect} \cdot (1+i)^{Y_{OM\_1} - Y_{current}}, -4\right] = 90 \times 10^3 \cdot dollars$$

$$FV_{OM\_2} := round\left[Cost_{Annual\_Inspect} \cdot (1+i)^{Y_{OM\_2} - Y_{current}}, -4\right] = 140 \times 10^3 \cdot dollars$$

$$FV_{OM\_3} := round\left[Cost_{Annual\_Inspect} \cdot (1+i)^{Y_{OM\_3} - Y_{current}}, -4\right] = 200 \times 10^3 \cdot dollars$$

$$FV_{OM\_4} := round\left[Cost_{Annual\_Inspect} \cdot (1+i)^{Y_{OM\_4} - Y_{current}}, -4\right] = 300 \times 10^3 \cdot dollars$$

F. Present Value at Year of Beneficial Use:

- Year of Beneficial Use, Y_{BFU}: $Y_{BFU} := 2022$
- Discount Rate for O&M, r_{OM}: $r_{OM} := 3\%$
- Discount Rate for Capital and Rehab/Replace, $r_{capital}$: $r_{capital} := 7\%$
- Present Values for all Years above Year of Beneficial Use is calculated using TM 11-3, EQ 4-2:

Z = FV x (1+r)^-(Y_n-Y_{BFU}),
where Z is the cost at the Year of Beneficial Use and FV is
the future value calcuated in Section E and n is the year of occurence.

$$Z_{capital\_low} := \text{if}\left[Y_{capital} \le Y_{BFU}, FV_{capital\_low}, FV_{capital\_low} \cdot \left(1 + r_{capital}\right)^{-\left(Y_{capital} - Y_{BFU}\right)}\right] = 10.54 \times 10^{6} \cdot \text{dollars}$$

$$Z_{capital\_base} := \text{if}\left[Y_{capital} \le Y_{BFU}, FV_{capital\_base}, FV_{capital\_base} \cdot \left(1 + r_{capital}\right)^{-\left(Y_{capital} - Y_{BFU}\right)}\right] = 10.87 \times 10^{6} \cdot \text{dollars}$$

$$Z_{capital\_high} := \text{if}\left[Y_{capital} \le Y_{BFU}, FV_{capital\_high}, FV_{capital\_high} \cdot \left(1 + r_{capital}\right)^{-\left(Y_{capital} - Y_{BFU}\right)}\right] = 11.86 \times 10^{6} \cdot \text{dollars}$$

$$Z_{OM\_1} := \text{round}\left[\text{if}\left[Y_{OM\_1} \le Y_{BFU}, FV_{OM\_1}, FV_{OM\_1} \cdot \left(1 + r_{OM}\right)^{-\left(Y_{OM\_1} - Y_{BFU}\right)}\right], -4\right] = 70 \times 10^{3} \cdot \text{dollars}$$

$$Z_{OM\_2} := \text{round}\left[\text{if}\left[Y_{OM\_2} \le Y_{BFU}, FV_{OM\_2}, FV_{OM\_2} \cdot \left(1 + r_{OM}\right)^{-\left(Y_{OM\_2} - Y_{BFU}\right)}\right], -4\right] = 80 \times 10^{3} \cdot \text{dollars}$$

$$Z_{OM\_3} := \text{round}\left[\text{if}\left[Y_{OM\_3} \le Y_{BFU}, FV_{OM\_3}, FV_{OM\_3} \cdot \left(1 + r_{OM}\right)^{-\left(Y_{OM\_3} - Y_{BFU}\right)}\right], -4\right] = 80 \times 10^{3} \cdot \text{dollars}$$

$$Z_{OM\_4} := \text{round}\left[\text{if}\left[Y_{OM\_4} \le Y_{BFU}, FV_{OM\_4}, FV_{OM\_4} \cdot \left(1 + r_{OM}\right)^{-\left(Y_{OM\_4} - Y_{BFU}\right)}\right], -4\right] = 90 \times 10^{3} \cdot \text{dollars}$$

G. Total Cost for the Year of Beneficial Use :

$$Z_{total\_low} := Z_{capital\_low} + Z_{OM\_1} + Z_{OM\_2} + Z_{OM\_3} + Z_{OM\_4} = 10.86 \times 10^{6} \cdot \text{dollars}$$

$$Z_{total\_base} := Z_{capital\_base} + Z_{OM\_1} + Z_{OM\_2} + Z_{OM\_3} + Z_{OM\_4} = 11.19 \times 10^{6} \cdot \text{dollars}$$

$$Z_{total\_high} := Z_{capital\_high} + Z_{OM\_1} + Z_{OM\_2} + Z_{OM\_3} + Z_{OM\_4} = 12.18 \times 10^{6} \cdot \text{dollars}$$

The total 50-Year LCC for the Year of Beneficial Use is $11.2 million for the Belmont Force Main with a range of $10.9 million to $12.2 million accounting for market fluctuations.

BPS LCC

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August 31, 2016

Brown AND Caldwell

Mr. Bob Donaldson
Collaborative Strategies Consulting, Inc.
2785 Canyon Creek Drive
San Ramon CA 94583

Project No. 146228

Subject: Belmont Pump Station Life Cycle Analysis

Dear Mr. Donaldson:

This letter summarizes the assumptions and sources of information for the cost components incorporated into the Belmont Pump Station (BPS) Life Cycle Cost (LCC) analysis model. The major considerations in developing the BPS LCC include capital cost, annual operation and maintenance (O&M) running costs, replacement/rehabilitation costs and overall project schedule.

Construction Costs. The Belmont Pump Station Rehabilitation includes rehabilitation of the pump station and replacement of the three existing pumps with new dry pit submersible pumps that can accommodate future flow rates and pressures. The existing piping, isolation gates, electrical equipment, diminutor, controls, and standby generator have reached the end of their useful and will be replaced with new equipment.

Construction costs were calculated by Brown and Caldwell. The construction costs were converted into capital costs by applying soft costs, project contingencies, and market fluctuations to each individual cost component.

The construction contingencies, soft costs, and market fluctuations are summarized in Table 1. Market fluctuations are applied to capture the range of costs that could potentially occur over the construction period for the entire conveyance system program upgrade.

Table 1. Capital Cost Factors

Cost Factor	Markup
Construction Contingency[1]	**25%**
Soft Costs[2]	
Construction Management, Engineering Services During Construction, Testing, Inspection	18%
Contract Change Orders (CCO)	5%
Planning	5%
Design	10%
Project Management	5%
Soft Cost Subtotal	**43%**
Market Fluctuations[3]	
Low	-5%
High	15%

Notes:

[1,2] Construction contingency and soft costs developed by SVCW as presented in the comparison of construction cost estimates during the June 2, 2016 Department Head Meeting.

[3] Market fluctuations developed by SVCW. Source: SVCW Conveyance System Construction Cost Analysis, Front of Plant, Revision Date: April 22, 2015, Revision 28b.

O&M Costs. The BPS O&M annual costs were included as part of the Menlo Park Pump Station (MPPS) and Redwood City Pump Station (RCPS) general maintenance costs; therefore, do not need to be accounted for in this analysis. Please see MPPS and RCPS LCC analysis technical memoranda. Pump inspection is included in the general maintenance cost due to the size of BPS, per SVCW's direction during the original LCC analysis completed in May 2015. Odor control costs are included in this analysis and include costs for chemical and water to operate the system on an annual basis at an estimated cost of $13,500/year. Electrical costs are calculated using the location of the facility and the electrical rates, along with calculated equipment power usage. The electrical rate of $0.196/KWh will be used and is based on current SVCW electrical bills. The total BPS annual equipment power usage is 100,241 kW (11.4 kWh).

Rehabilitation/ Replacement Costs. The following rehabilitation and replacement assumptions were made for the Belmont PS:

1. The dry pit submersible pumps will be rebuilt once every 5 years. The cost to rebuild is assumed to be 50 percent of a purchase cost of $227,000 for all three pumps based on vendor supplied costs.

2. The pumps will be replaced once every 25 years. The cost to replace is assumed to be purchase cost of $227,000 for all three pumps, not counting the rebuild costs during that year.

3. Electrical equipment will be replaced once every 25 years and instrumentation and control once every 15 years. Electrical equipment replacement cost is assumed to be $1,604,000 and the instrumentation and control equipment replacement cost is assumed to be $178,000.

4. Structural rehabilitation or replacement will occur once every 30 years for BPS since it will not be a new station. The structural rehabilitation/replacement cost is assumed to be the construction cost minus pump rebuild and electrical replacement in that year. The structural rehabilitation/replacement includes piping, valves, HVAC, and odor control replacement costs as these are considered to be minor costs compared to pump and electrical replacement.

5. Comminutor/grinder replacement occurs once every 20 years at a cost of $83,490.

Schedule. The BPS project construction is expected to begin in October 2023 and end in May 2024. Capital costs are applied in the LCC model at the midpoint year of construction. The Year 2023 is used as the midpoint year of construction. The end year of construction is used to establish the start of recurring O&M and rehabilitation/replacement costs. The Year of Analysis for the entire conveyance system program is the Year of Beneficial Use. The Year of Beneficial Use is the year major facilities of the conveyance system (i.e., Tunnel, Receiving Lift Station and Headworks) start up. Based on the current program-wide schedule (Version 13 dated June 23, 2016) developed by SVCW, the Year of Beneficial Use is the Year 2022.

Escalation and Discount Rates. To determine the present value of costs for the Year of Analysis, their values are escalated to future values and discounted back to the Year of Analysis. The discount and escalation rates used in the BPS LCC Analysis were developed by SVCW based on current and projected investment return rates as summarized in Table 3.

Table 3. Escalation and Discount Rates

Factor	Rate
Escalation	4%
Capital Project and Rehabilitation/Replacement Discount	7%
O&M Discount	3%

The LCC analysis summarizes all cost components over a 50-Year period ending in the Year 2066. The calculation for determining the BPS LCC is located in Attachment A. The total 50-year LCC for BPS is $12.9 million with a range of $12.6 to $13.6 million accounting for market fluctuations.

Very truly yours,

Brown and Caldwell

Charlie Joyce, Project Manager
Walnut Creek, CA

cc: Kim Hackett, SVCW
Roanne Ross, Whitley Burchett & Associates

Attachments (1)

- Attachment A: Belmont Pump Station LCC Calculation

Attachment A: SVCW Life Cycle Cost (LCC) Belmont Pump Station (BPS) Calculation

A. Purpose: This sheet provides the Belmont Pump Station LCC calculation for a 50-year analysis period.

B. Step 1: Conversion from Construction Cost to Capital Cost: The equation below is used to convert the construction cost into a capital cost. Contingency, soft cost and market fluctuation cost factors are displayed below.

Capital Cost = Construction Cost x [1 + Project Contingency + Σ(Soft Costs) + Market Fluctuations]

1. Project Contingency (all projects except Gravity Pipeline), Cont: $\text{Cont} := 25\%$

2. Soft Costs, SC:

- Construction Management and Engineering Services: $SC_{CM} := 15\%$
- Contract Change Orders: $SC_{CCO} := 5\%$
- Planning: $SC_{Plan} := 5\%$
- Design: $SC_{Design} := 10\%$
- Project Management $SC_{PM} := 5\%$

3. Market Fluctuation, MF:
Curently set by SVCW

$MF_{low} := -5\%$

$MF_{base} := 0\%$

$MF_{high} := 15\%$

4. Capital Cost, CC: For the Belmont PS Rehab, the construction cost is $4,137,000 (2016 dollars) and occurs in the midyear of construction.

Display Unit of Dollars: $\mathrm{dollars} := 1$

$\mathrm{Cost}_{\mathrm{Construction}} := 4137000\mathrm{dollars}$ *Note: From Belmont Pump Station Conceptual Level Class 3 Estimate, May 2016 prepared by BC.*

$$\mathrm{Cost}_{\mathrm{Capital\_low}} := \mathrm{Cost}_{\mathrm{Construction}} \cdot \left(1 + \mathrm{Cont} + \mathrm{SC}_{\mathrm{CM}} + \mathrm{SC}_{\mathrm{CCO}} + \mathrm{SC}_{\mathrm{Plan}} + \mathrm{SC}_{\mathrm{Design}} + \mathrm{SC}_{\mathrm{PM}} + \mathrm{MF}_{\mathrm{low}}\right) = 6.62 \times 10^{6} \cdot \mathrm{dollars}$$

$$\mathrm{Cost}_{\mathrm{Capital\_base}} := \mathrm{Cost}_{\mathrm{Construction}} \cdot \left(1 + \mathrm{Cont} + \mathrm{SC}_{\mathrm{CM}} + \mathrm{SC}_{\mathrm{CCO}} + \mathrm{SC}_{\mathrm{Plan}} + \mathrm{SC}_{\mathrm{Design}} + \mathrm{SC}_{\mathrm{PM}} + \mathrm{MF}_{\mathrm{base}}\right) = 6.83 \times 10^{6} \cdot \mathrm{dollars}$$

$$\mathrm{Cost}_{\mathrm{Capital\_high}} := \mathrm{Cost}_{\mathrm{Construction}} \cdot \left(1 + \mathrm{Cont} + \mathrm{SC}_{\mathrm{CM}} + \mathrm{SC}_{\mathrm{CCO}} + \mathrm{SC}_{\mathrm{Plan}} + \mathrm{SC}_{\mathrm{Design}} + \mathrm{SC}_{\mathrm{PM}} + \mathrm{MF}_{\mathrm{high}}\right) = 7.45 \times 10^{6} \cdot \mathrm{dollars}$$

Y_{capital} = Midpoint Year of Construction $Y_{\mathrm{capital}} := 2023$

C. Step 2: Calculate Operation and Maintenance (O&M) Costs: The following O&M assumptions are made for the Belmont PS:

1. The BPS O&M annual costs were included as part of the MPPS and RCPS general maintenance costs; therefore, do not need to be accounted for in this analysis. Pump inspection is included in the general maintenance costs.

2. Odor control costs are included in this analysis and include costs for chemical and water to operate the system on an annual basis. Estimated cost is $13,500/year.

3. Electrical costs are calculated from total pump station annual power requirements and electrical rates based on current SVCW electrical bills.

1. Odor Control

- Estimated cost based on PS predesign planning chemical scrubber, $\text{Cost}_{\text{Unit\_Odor}}$
- Estimated Annual Cost, $\text{Cost}_{\text{Annual\_Odor}}$
- Odor Control O&M occurs annually from end of construction to end of LCC analysis (2024 to 2066)

$$\text{Cost}_{\text{Unit\_Odor}} := 13500$$

Annual cost for odor control is as follows:

$$\text{Cost}_{\text{Annual\_Odor}} := \text{Cost}_{\text{Unit\_Odor}} = 13.5 \times 10^{3} \cdot \text{dollars}$$

- End of construction, Y_{EndConst} — $Y_{\text{EndConst}} := 2024$
- End of analysis, Y_{Analysis} — $Y_{\text{Analysis}} := 2066$

2. Electrical

- Estimated pump station power required (based on equipment load) kWh, Power
- Electrical rate for BPS ($/KWh), Rate
- Estimated annual cost, $\text{Cost}_{\text{Annual\_Elec}}$
- Electrical costs occur annually from end of construction to end of LCC analysis (2024 to 2066):

$\text{kWh} := 1$

$\text{hour} := 1$

$\text{days} := 1$

$\text{year} := 1$

$$\text{Power} := 11.4\text{kWh}$$

$$\text{Rate} := 0.196 \cdot \frac{\text{dollars}}{\text{kWh}}$$

$$\mathrm{Cost}_{\mathrm{Annual\_Elec}} := \mathrm{Power}\cdot\mathrm{Rate}\cdot 24\,\frac{\mathrm{hour}}{\mathrm{days}}\cdot 365\,\frac{\mathrm{days}}{\mathrm{year}} = 19.57\times 10^{3}\cdot\mathrm{dollars}$$

D. Step 3: Calculate Rehabilitation and Replacement Costs: The following R&R assumptions are made for the Belmont PS:

1. The pumps are assumed to be rebuilt once every 5 years; cost is assumed to be 50% of purchase cost from the May 2016 cost estimate.
2. Pumps will be replaced once every 25 years; cost is assumed to be purchase cost from the May 2016 cost estimate.
3. Electrical equipment replacement once every 25 years and Instrumentation and Control equipment will be replaced once every 15 years, cost is assumed to be the construction cost from the May 2016 cost estimate.
4. Structural rehabilitation/replacement once every 30 years for BPS since it will not be a new station. The structural rehabilitation/replacement cost is assumed to be the construction cost from the May 2016 cost estimate minus pump replacement and electrical replacement in that year. The structural rehabilitation/replacement includes piping, valves, HVAC, and odor control replacement costs as these are considered to be minor costs compared to pump and electrical replacement.
5. Grinder is assumed to be replaced once every 20 years. Replacement cost is assumed to be purchase cost from May 2016 cost estimate.

1. Pump Rebuild

- Dry pit submersible pump cost (from May 2016 cost estimate), $\mathrm{Cost}_{\mathrm{Pump}}$
- Assume 50% of purchase cost, $\mathrm{Cost}_{\mathrm{Pump\ Rebuild}}$

$$\mathrm{Cost}_{\mathrm{Pump}} := 227000\cdot\mathrm{dollars}$$

$$\mathrm{Cost}_{\mathrm{Pump\_Rebuild}} := \mathrm{Cost}_{\mathrm{Pump}}\cdot .5 = 113.5\times 10^{3}\cdot\mathrm{dollars}$$

Rebuild occurs every 5 years under a 50-year cycle except for years when pumps are replaced (2049); therefore, pump rebuild occurs in the following years:

$$\mathrm{Y}_{\mathrm{Pump\_Rebuild\_1}} := \mathrm{Y}_{\mathrm{EndConst}} + 5 = 2.029\times 10^{3}$$

$$\mathrm{Y}_{\mathrm{Pump\_Rebuild\_2}} := \mathrm{Y}_{\mathrm{EndConst}} + 10 = 2.034\times 10^{3}$$

$$Y_{Pump\_Rebuild\_3} := Y_{EndConst} + 15 = 2.039 \times 10^{3}$$

$$Y_{Pump\_Rebuild\_4} := Y_{EndConst} + 20 = 2.044 \times 10^{3}$$

$$Y_{Pump\_Rebuild\_5} := Y_{EndConst} + 30 = 2.054 \times 10^{3}$$

$$Y_{Pump\_Rebuild\_6} := Y_{EndConst} + 35 = 2.059 \times 10^{3}$$

$$Y_{Pump\_Rebuild\_7} := Y_{EndConst} + 40 = 2.064 \times 10^{3}$$

2. Pump Replacement

- Total pump cost (from May 2016 cost estimate), $Cost_{Pump}$
- Assume purchase cost, $Cost_{Pump\ Repl}$

$$Cost_{Pump\_Repl} := Cost_{Pump} = 227 \times 10^{3} \cdot dollars$$

Pump replacement occurs every 25 years under a 50-year cycle; therefore, pump replacement occurs in the following years:

$$Y_{Pump\_Repl\_1} := Y_{EndConst} + 25 = 2.049 \times 10^{3}$$

3. Electrical Equipment Replacement

- The Electrical cost allowance from the May 2016 allowance, $Cost_{Electrical\_Allowance}$
- Electrical cost (assumed to be 90% of lump electrical allowance from May 2016 construction cost), $Cost_{Electrical\_RR}$
- I&C replacement cost (assumed to be 10% of lump electrical allowance from May 2016 construction cost), $Cost_{IC\_RR}$

$$Cost_{Electrical\_Allowance} := 1782000 \cdot dollars$$

$$Cost_{Electrical\_RR} := 0.9 \cdot Cost_{Electrical\_Allowance} = 1.6 \times 10^{6} \cdot dollars$$

$$\mathrm{Cost}_{\mathrm{IC\_RR}} := 0.1 \cdot \mathrm{Cost}_{\mathrm{Electrical\_Allowance}} = 178.2 \times 10^{3} \cdot \mathrm{dollars}$$

Electrical Equipment Replacement occurs every 25 years under a 50-year cycle; therefore, electrical equipment replacement occurs in the following year:

$$\mathrm{Y}_{\mathrm{Electrical\_RR\_1}} := \mathrm{Y}_{\mathrm{EndConst}} + 25 = 2.049 \times 10^{3}$$

I&C equipment replacement occurs every 15 years under a 50-year cycle; therefore, I&C replacement occurs in the following year:

$$\mathrm{Y}_{\mathrm{IC\_RR\_1}} := \mathrm{Y}_{\mathrm{EndConst}} + 15 = 2.039 \times 10^{3}$$

$$\mathrm{Y}_{\mathrm{IC\_RR\_2}} := \mathrm{Y}_{\mathrm{EndConst}} + 30 = 2.054 \times 10^{3}$$

4. Structural Rehab or Replacement

- Structural Rehab/Replacement, $\mathrm{Cost}_{\mathrm{Structural\_RR}}$
- Electrical R&R Costs, $\mathrm{Cost}_{\mathrm{Electrical\_RR}}$
- Pump Cost, $\mathrm{Cost}_{\mathrm{Pump}}$

$$\mathrm{Cost}_{\mathrm{Structural\_RR}} := \mathrm{Cost}_{\mathrm{Construction}} - \mathrm{Cost}_{\mathrm{Electrical\_RR}} - \mathrm{Cost}_{\mathrm{Pump}}$$

$$\mathrm{Cost}_{\mathrm{Structural\_RR}} = 2.31 \times 10^{6} \cdot \mathrm{dollars}$$

Structural Rehab/Replacement occurs every 30 years under a 50-year cycle; therefore, structural R&R occurs in the following year:

$$\mathrm{Y}_{\mathrm{Structural\_RR\_1}} := \mathrm{Y}_{\mathrm{EndConst}} + 30 = 2.054 \times 10^{3}$$

5. Grinder replacement

- Grinder replacement cost from the May 2016 estimate, $\text{Cost}_{\text{Grinder\_RR}}$

$$\text{Cost}_{\text{Grinder\_RR}} := 55250\text{dollars}$$

Grinder replacement occurs every 20 years under a 50-year cycle; therefore, grinder replacement occurs in the following years:

$$Y_{\text{Grinder\_RR\_1}} := Y_{\text{EndConst}} + 20 = 2.044 \times 10^{3}$$

$$Y_{\text{Grinder\_RR\_2}} := Y_{\text{EndConst}} + 40 = 2.064 \times 10^{3}$$

E. Step 4: Future Value of All Costs calculation:

- Current Year, Y_{current}: $Y_{\text{current}} := 2016$
- Escalation, i: $i := 4\%$
- Calculate future values, FV using TM 11-3, EQ 4-1:

FV = PV x $(1+i)^{Yn-Ycurrent}$,

where Y_n is the year the cost occurs and PV = present value.

For annual costs: FV= PV x $\dfrac{\left[(1+i)^{n} - 1\right]}{i}$, where n is number of years. Assume FV occurs in end of analysis year.

$$FV_{\text{capital\_low}} := \text{Cost}_{\text{Capital\_low}} \cdot (1+i)^{Y_{\text{capital}} - Y_{\text{current}}} = 8.71 \times 10^{6} \cdot \text{dollars}$$

$$FV_{\text{capital\_base}} := \text{Cost}_{\text{Capital\_base}} \cdot (1+i)^{Y_{\text{capital}} - Y_{\text{current}}} = 8.98 \times 10^{6} \cdot \text{dollars}$$

$$FV_{capital\_high} := Cost_{Capital\_high} \cdot (1+i)^{Y_{capital} - Y_{current}} = 9.8 \times 10^{6} \cdot dollars$$

$$FV_{Pump\_Rebuild\_1} := round\left[Cost_{Pump\_Rebuild} \cdot (1+i)^{Y_{Pump\_Rebuild\_1} - Y_{current}}, -4\right] = 190 \times 10^{3} \cdot dollars$$

$$FV_{Pump\_Rebuild\_2} := round\left[Cost_{Pump\_Rebuild} \cdot (1+i)^{Y_{Pump\_Rebuild\_2} - Y_{current}}, -4\right] = 230 \times 10^{3} \cdot dollars$$

$$FV_{Pump\_Rebuild\_3} := round\left[Cost_{Pump\_Rebuild} \cdot (1+i)^{Y_{Pump\_Rebuild\_3} - Y_{current}}, -4\right] = 280 \times 10^{3} \cdot dollars$$

$$FV_{Pump\_Rebuild\_4} := round\left[Cost_{Pump\_Rebuild} \cdot (1+i)^{Y_{Pump\_Rebuild\_4} - Y_{current}}, -4\right] = 340 \times 10^{3} \cdot dollars$$

$$FV_{Pump\_Rebuild\_5} := round\left[Cost_{Pump\_Rebuild} \cdot (1+i)^{Y_{Pump\_Rebuild\_5} - Y_{current}}, -4\right] = 500 \times 10^{3} \cdot dollars$$

$$FV_{Pump\_Rebuild\_6} := round\left[Cost_{Pump\_Rebuild} \cdot (1+i)^{Y_{Pump\_Rebuild\_6} - Y_{current}}, -4\right] = 610 \times 10^{3} \cdot dollars$$

$$FV_{Pump\_Rebuild\_7} := round\left[Cost_{Pump\_Rebuild} \cdot (1+i)^{Y_{Pump\_Rebuild\_7} - Y_{current}}, -4\right] = 750 \times 10^{3} \cdot dollars$$

$$FV_{Pump\_Repl\_1} := round\left[Cost_{Pump\_Repl} \cdot (1+i)^{Y_{Pump\_Repl\_1} - Y_{current}}, -4\right] = 830 \times 10^{3} \cdot dollars$$

$$FV_{Electrical\_RR\_1} := round\left[Cost_{Electrical\_RR} \cdot (1+i)^{Y_{Electrical\_RR\_1} - Y_{current}}, -4\right] = 5.85 \times 10^{6} \cdot dollars$$

$$FV_{IC\_RR\_1} := round\left[Cost_{IC\_RR} \cdot (1+i)^{Y_{IC\_RR\_1} - Y_{current}}, -4\right] = 440 \times 10^{3} \cdot dollars$$

$$FV_{IC\_RR\_2} := round\left[Cost_{IC\_RR} \cdot (1+i)^{Y_{IC\_RR\_2} - Y_{current}}, -4\right] = 790 \times 10^{3} \cdot dollars$$

$$FV_{Structural\_RR\_1} := \text{round}\left[Cost_{Structural\_RR} \cdot (1+i)^{Y_{Structural\_RR\_1} - Y_{current}}, -4\right] = 10.24 \times 10^{6} \cdot \text{dollars}$$

$$FV_{Grinder\_RR\_1} := \text{round}\left[Cost_{Grinder\_RR} \cdot (1+i)^{Y_{Grinder\_RR\_1} - Y_{current}}, -4\right] = 170 \times 10^{3} \cdot \text{dollars}$$

$$FV_{Grinder\_RR\_2} := \text{round}\left[Cost_{Grinder\_RR} \cdot (1+i)^{Y_{Grinder\_RR\_2} - Y_{current}}, -4\right] = 360 \times 10^{3} \cdot \text{dollars}$$

4b Future value of annual costs:

Escalate 2016 annual values to end of construction (2024):

$$FV_{ODOR\_OM\_a} := \text{round}\left[Cost_{Annual\_Odor} \cdot (1+i)^{Y_{EndConst} - Y_{current}}, -4\right] = 20 \times 10^{3} \cdot \text{dollars}$$

$$FV_{Electrical\_a} := \text{round}\left[Cost_{Annual\_Elec} \cdot (1+i)^{Y_{EndConst} - Y_{current}}, -4\right] = 30 \times 10^{3} \cdot \text{dollars}$$

Escalate 2024 annual values to end of analysis year (2066):

$$FV_{ODOR\_OM} := \text{round}\left[FV_{ODOR\_OM\_a} \cdot \frac{\left[(1+i)^{Y_{Analysis} - Y_{EndConst}} - 1\right]}{i}, -4\right] = 2.1 \times 10^{6} \cdot \text{dollars}$$

$$FV_{Electrical} := \text{round}\left[FV_{Electrical\_a} \cdot \frac{\left[(1+i)^{Y_{Analysis} - Y_{EndConst}} - 1\right]}{i}, -4\right] = 3.14 \times 10^{6} \cdot \text{dollars}$$

F. Step 5: Present Value at Year of Beneficial Use Calculation:

- Year of Beneficial Use, Y_{BFU}: $Y_{BFU} := 2022$
- Discount Rate for O&M, r_{OM}: $r_{OM} := 3\%$
- Discount Rate for Capital and Rehab/Replace, $r_{capital}$: $r_{capital} := 7\%$
- Calculate Present Values for all Years above Year of Beneficial Use using TM 11-3, EQ 4-2:

Z = FV x (1+r)^-(Y_n-Y_{BFU}),

where Z is the cost at the Year of Beneficial Use and FV is the future value calcuated in Step 4.

For annual costs, Y_n is the end of analysis year (2066).

- For all costs occuring before Year of Beneficial Use, assume these costs are sunk costs in the year it occurs. Therefore, the future value as calculated in Step 4 will be used.

$$Z_{capital\_low} := \text{if}\left[Y_{capital} \le Y_{BFU}, FV_{capital\_low}, FV_{capital\_low} \cdot \left(1 + r_{capital}\right)^{-\left(Y_{capital} - Y_{BFU}\right)}\right] = 8.14 \times 10^{6} \cdot \text{dollars}$$

$$Z_{capital\_base} := \text{if}\left[Y_{capital} \le Y_{BFU}, FV_{capital\_base}, FV_{capital\_base} \cdot \left(1 + r_{capital}\right)^{-\left(Y_{capital} - Y_{BFU}\right)}\right] = 8.39 \times 10^{6} \cdot \text{dollars}$$

$$Z_{capital\_high} := \text{if}\left[Y_{capital} \le Y_{BFU}, FV_{capital\_high}, FV_{capital\_high} \cdot \left(1 + r_{capital}\right)^{-\left(Y_{capital} - Y_{BFU}\right)}\right] = 9.16 \times 10^{6} \cdot \text{dollars}$$

$$Z_{ODOR\_OM} := \text{round}\left[FV_{ODOR\_OM} \cdot \left[\left(1 + r_{OM}\right)^{-\left(Y_{Analysis} - Y_{BFU}\right)}\right], -4\right] = 570 \times 10^{3} \cdot \text{dollars}$$

$$Z_{\text{Electrical}} := \text{round}\left[FV_{\text{Electrical}}\cdot\left[\left(1 + r_{\text{OM}}\right)^{-\left(Y_{\text{Analysis}} - Y_{\text{BFU}}\right)}\right], -4\right] = 860 \times 10^{3} \cdot \text{dollars}$$

$$Z_{\text{Pump\_Rebuild\_1}} := \text{round}\left[\text{if}\left[Y_{\text{Pump\_Rebuild\_1}} \le Y_{\text{BFU}}, FV_{\text{Pump\_Rebuild\_1}}, FV_{\text{Pump\_Rebuild\_1}}\cdot\left(1 + r_{\text{capital}}\right)^{-\left(Y_{\text{Pump\_Rebuild\_1}} - Y_{\text{BFU}}\right)}\right], -4\right] = 120 \times 10^{3} \cdot \text{dollars}$$

$$Z_{\text{Pump\_Rebuild\_2}} := \text{round}\left[\text{if}\left[Y_{\text{Pump\_Rebuild\_2}} \le Y_{\text{BFU}}, FV_{\text{Pump\_Rebuild\_2}}, FV_{\text{Pump\_Rebuild\_2}}\cdot\left(1 + r_{\text{capital}}\right)^{-\left(Y_{\text{Pump\_Rebuild\_2}} - Y_{\text{BFU}}\right)}\right], -4\right] = 100 \times 10^{3} \cdot \text{dollars}$$

$$Z_{\text{Pump\_Rebuild\_3}} := \text{round}\left[\text{if}\left[Y_{\text{Pump\_Rebuild\_3}} \le Y_{\text{BFU}}, FV_{\text{Pump\_Rebuild\_3}}, FV_{\text{Pump\_Rebuild\_3}}\cdot\left(1 + r_{\text{capital}}\right)^{-\left(Y_{\text{Pump\_Rebuild\_3}} - Y_{\text{BFU}}\right)}\right], -4\right] = 90 \times 10^{3} \cdot \text{dollars}$$

$$Z_{\text{Pump\_Rebuild\_4}} := \text{round}\left[\text{if}\left[Y_{\text{Pump\_Rebuild\_4}} \le Y_{\text{BFU}}, FV_{\text{Pump\_Rebuild\_4}}, FV_{\text{Pump\_Rebuild\_4}}\cdot\left(1 + r_{\text{capital}}\right)^{-\left(Y_{\text{Pump\_Rebuild\_4}} - Y_{\text{BFU}}\right)}\right], -4\right] = 80 \times 10^{3} \cdot \text{dollars}$$

$$Z_{\text{Pump\_Rebuild\_5}} := \text{round}\left[\text{if}\left[Y_{\text{Pump\_Rebuild\_5}} \le Y_{\text{BFU}}, FV_{\text{Pump\_Rebuild\_5}}, FV_{\text{Pump\_Rebuild\_5}}\cdot\left(1 + r_{\text{capital}}\right)^{-\left(Y_{\text{Pump\_Rebuild\_5}} - Y_{\text{BFU}}\right)}\right], -4\right] = 60 \times 10^{3} \cdot \text{dollars}$$

$$Z_{\text{Pump\_Rebuild\_6}} := \text{round}\left[\text{if}\left[Y_{\text{Pump\_Rebuild\_6}} \le Y_{\text{BFU}}, FV_{\text{Pump\_Rebuild\_6}}, FV_{\text{Pump\_Rebuild\_6}}\cdot\left(1 + r_{\text{capital}}\right)^{-\left(Y_{\text{Pump\_Rebuild\_6}} - Y_{\text{BFU}}\right)}\right], -4\right] = 50 \times 10^{3} \cdot \text{dollars}$$

$$Z_{\text{Pump\_Rebuild\_7}} := \text{round}\left[\text{if}\left[Y_{\text{Pump\_Rebuild\_7}} \le Y_{\text{BFU}}, FV_{\text{Pump\_Rebuild\_6}}, FV_{\text{Pump\_Rebuild\_7}}\cdot\left(1 + r_{\text{capital}}\right)^{-\left(Y_{\text{Pump\_Rebuild\_7}} - Y_{\text{BFU}}\right)}\right], -4\right] = 40 \times 10^{3} \cdot \text{dollars}$$

$$Z_{\text{Pump\_Repl\_1}} := \text{round}\left[\text{if}\left[Y_{\text{Pump\_Repl\_1}} \le Y_{\text{BFU}}, FV_{\text{Pump\_Repl\_1}}, FV_{\text{Pump\_Repl\_1}}\cdot\left(1 + r_{\text{capital}}\right)^{-\left(Y_{\text{Pump\_Repl\_1}} - Y_{\text{BFU}}\right)}\right], -4\right] = 130 \times 10^{3} \cdot \text{dollars}$$

$$Z_{\text{Electrical\_RR\_1}} := \text{round}\left[\text{if}\left[Y_{\text{Electrical\_RR\_1}} \le Y_{\text{BFU}}, FV_{\text{Electrical\_RR\_1}}, FV_{\text{Electrical\_RR\_1}}\cdot\left(1 + r_{\text{capital}}\right)^{-\left(Y_{\text{Electrical\_RR\_1}} - Y_{\text{BFU}}\right)}\right], -4\right] = 940 \times 10^{3} \cdot \text{dollars}$$

$$Z_{\text{IC\_RR\_1}} := \text{round}\left[\text{if}\left[Y_{\text{IC\_RR\_1}} \le Y_{\text{BFU}}, FV_{\text{IC\_RR\_1}}, FV_{\text{IC\_RR\_1}}\cdot\left(1 + r_{\text{capital}}\right)^{-\left(Y_{\text{IC\_RR\_1}} - Y_{\text{BFU}}\right)}\right], -4\right] = 140 \times 10^{3} \cdot \text{dollars}$$

$$Z_{IC\_RR\_2} := \mathrm{round}\left[\mathrm{if}\left[Y_{IC\_RR\_2} \le Y_{BFU}, FV_{IC\_RR\_2}, FV_{IC\_RR\_2}\cdot\left(1+r_{capital}\right)^{-\left(Y_{IC\_RR\_2}-Y_{BFU}\right)}\right], -4\right] = 90\times 10^{3}\cdot \mathrm{dollars}$$

$$Z_{Structural\_RR\_1} := \mathrm{round}\left[\mathrm{if}\left[Y_{Structural\_RR\_1} \le Y_{BFU}, FV_{Structural\_RR\_1}, FV_{Structural\_RR\_1}\cdot\left(1+r_{capital}\right)^{-\left(Y_{Structural\_RR\_1}-Y_{BFU}\right)}\right], -4\right] = 1.17\times 10^{6}\cdot \mathrm{dollars}$$

$$Z_{Grinder\_RR\_1} := \mathrm{round}\left[\mathrm{if}\left[Y_{Grinder\_RR\_1} \le Y_{BFU}, FV_{Grinder\_RR\_1}, FV_{Grinder\_RR\_1}\cdot\left(1+r_{capital}\right)^{-\left(Y_{Grinder\_RR\_1}-Y_{BFU}\right)}\right], -4\right] = 40\times 10^{3}\cdot \mathrm{dollars}$$

$$Z_{Grinder\_RR\_2} := \mathrm{round}\left[\mathrm{if}\left[Y_{Grinder\_RR\_2} \le Y_{BFU}, FV_{Grinder\_RR\_2}, FV_{Grinder\_RR\_1}\cdot\left(1+r_{capital}\right)^{-\left(Y_{Grinder\_RR\_2}-Y_{BFU}\right)}\right], -4\right] = 10\times 10^{3}\cdot \mathrm{dollars}$$

G. Step 6: Total Cost for the Year of Beneficial Use calculated by Summing the Adjusted Values in Step 5:

$$\begin{aligned} Z_{total\_low} := {} & Z_{capital\_low} + Z_{ODOR\_OM} + Z_{Electrical} + Z_{Pump\_Rebuild\_1} + Z_{Pump\_Rebuild\_2} + Z_{Pump\_Rebuild\_3} \cdots = 12.63\times 10^{6}\cdot \mathrm{dollars} \\ & + Z_{Pump\_Rebuild\_4} + Z_{Pump\_Rebuild\_5} + Z_{Pump\_Rebuild\_6} + Z_{Pump\_Rebuild\_7} \cdots \\ & + Z_{Pump\_Repl\_1} + Z_{Electrical\_RR\_1} + Z_{IC\_RR\_1} + Z_{IC\_RR\_2} + Z_{Structural\_RR\_1} \cdots \\ & + Z_{Grinder\_RR\_1} + Z_{Grinder\_RR\_2} \end{aligned}$$

$$\begin{aligned} Z_{total\_base} := {} & Z_{capital\_base} + Z_{ODOR\_OM} + Z_{Electrical} + Z_{Pump\_Rebuild\_1} + Z_{Pump\_Rebuild\_2} + Z_{Pump\_Rebuild\_3} \cdots = 12.88\times 10^{6}\cdot \mathrm{dollars} \\ & + Z_{Pump\_Rebuild\_4} + Z_{Pump\_Rebuild\_5} + Z_{Pump\_Rebuild\_6} + Z_{Pump\_Rebuild\_7} \cdots \\ & + Z_{Pump\_Repl\_1} + Z_{Electrical\_RR\_1} + Z_{IC\_RR\_1} + Z_{IC\_RR\_2} + Z_{Structural\_RR\_1} \cdots \\ & + Z_{Grinder\_RR\_1} + Z_{Grinder\_RR\_2} \end{aligned}$$

$$\begin{aligned} Z_{total\_high} := {} & Z_{capital\_high} + Z_{ODOR\_OM} + Z_{Electrical} + Z_{Pump\_Rebuild\_1} + Z_{Pump\_Rebuild\_2} + Z_{Pump\_Rebuild\_3} \cdots = 13.65\times 10^{6}\cdot \mathrm{dollars} \\ & + Z_{Pump\_Rebuild\_4} + Z_{Pump\_Rebuild\_5} + Z_{Pump\_Rebuild\_6} + Z_{Pump\_Rebuild\_7} \cdots \\ & + Z_{Pump\_Repl\_1} + Z_{Electrical\_RR\_1} + Z_{IC\_RR\_1} + Z_{IC\_RR\_2} + Z_{Structural\_RR\_1} \cdots \\ & + Z_{Grinder\_RR\_1} + Z_{Grinder\_RR\_2} \end{aligned}$$

The total 50-Year LCC for the Year of Beneficial Use is $12.9 million for the Belmont Pump Station with a range of $12.6 million to $13.6 million accounting for market fluctuations.

SCPS LCC

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August 31, 2016

Mr. Bob Donaldson
Collaborative Strategies Consulting, Inc.
2785 Canyon Creek Drive
San Ramon CA 94583

Project No. 146228

Subject: San Carlos Site Repurposing Life Cycle Analysis

Dear Mr. Donaldson:

This letter summarizes the assumptions and sources of information for the cost components incorporated into the San Carlos Site Repurposing Life Cycle Cost (LCC) analysis model. The major considerations in developing the San Carlos Site Repurposing LCC include capital cost, annual operation and maintenance (O&M) running costs, replacement/rehabilitation costs and overall project schedule.

Construction Costs. The San Carlos Site Repurposing Project will include the installation of the piping and improvements on the site to take the existing pump station off line, provide individual metering and sampling of the San Carlos and Belmont flows, and connect the two pipelines to the Gravity Pipeline at a drop structure connection (drop structure is part of the Gravity Pipeline project). Piping improvements include extending the San Carlos sanitary sewer to the proposed Gravity Pipeline; extending the Belmont force main to connect to the proposed Gravity Pipeline; relocating the 10-inch San Carlos force main to connect to the San Carlos inlet sewer; installing flow metering and sampling structures; and installing a Belmont/San Carlos Combination Structure and 42-inch diameter pipe at the drop structure stub-out to connect to the Gravity Pipeline. On the San Carlos inlet to the Belmont/San Carlos Combination Structure, a trash rack will be placed to remove large debris and to connect the relocated 10-inch San Carlos force main upstream of the San Carlos flow meter.

Construction costs were calculated by Brown and Caldwell. The construction costs were converted into capital costs by applying soft costs, project contingencies, and market fluctuations to each individual cost component.

The construction contingencies, soft costs, and market fluctuations are summarized in Table 1. Market fluctuations are applied to capture the range of costs that could potentially occur over the construction period for the entire conveyance system program upgrade.

Table 1. Capital Cost Factors

Cost Factor	Markup
Construction Contingency[1]	**25%**
Soft Costs[2]	
Construction Management, Engineering Services During Construction, Testing, Inspection	18%
Contract Change Orders (CCO)	5%
Planning	5%
Design	10%
Project Management	5%
Soft Cost Subtotal	**43%**
Market Fluctuations[3]	
Low	-5%
High	15%

Notes:

[1,2] Construction contingency and soft costs developed by SVCW as presented in the comparison of construction cost estimates during the June 2, 2016 Department Head Meeting.

[3] Market fluctuations developed by SVCW. Source: SVCW Conveyance System Construction Cost Analysis, Front of Plant, Revision Date: April 22, 2015, Revision 28b.

O&M Costs. Future Annual O&M Costs are assumed to be included in the conveyance system pump stations; therefore, do not need to be accounted for in this analysis. Annual odor control costs are to be included in San Carlos Odor Control Project LCC completed by CDM. Electrical costs are calculated using the location of the facility and the electrical rates, along with calculated equipment power usage. The electrical rate of $0.161/KWh will be used and is based on current SVCW electrical bills. The total San Carlos Site annual equipment power usage is 76,211 kW (8.70 kWh), not including odor control electrical equipment power.

Rehabilitation/ Replacement Costs. Structural rehabilitation or replacement occurs once every 30 years for the San Carlos Site since it will reuse the existing building structure. The structural rehabilitation/replacement cost will assume the construction cost from the conceptual level, Class 3 estimated developed by Brown and Caldwell in May 2016. The structural rehabilitation/replacement includes piping, trash rack, HVAC, and structural modifications. The odor control replacement costs are assumed to be part of CDM's LCC for the tunnel odor control system.

Schedule. The San Carlos Site Repurposing project construction is expected to begin in April 2019 and end in February 2020. Capital costs are applied in the LCC model at the midpoint year of construction. The Year 2019 is used as the midpoint year of construction. The end year of construction is used to establish the start of recurring inspection costs. The Year of Analysis for the entire conveyance system program is the Year of Beneficial Use. The Year of Beneficial Use is the year major facilities of the conveyance system (i.e., Tunnel, Receiving Lift Station and Headworks) start up. Based on the current program-wide schedule (Version 13 dated June 23, 2016) developed by SVCW, the Year of Beneficial Use is the Year 2022.

Escalation and Discount Rates. To determine the present value of costs for the Year of Analysis, their values are escalated to future values and discounted back to the Year of Analysis. The discount and escalation rates used in the San Carlos Site Repurposing LCC Analysis are developed by SVCW based on current and projected investment return rates as summarized in Table 2.

Table 2. Escalation and Discount Rates

Factor	Rate
Escalation	4%
Capital Project and Rehabilitation/Replacement Discount	7%
O&M Discount	3%

The LCC analysis summarizes all cost components over a 50-Year period ending in the Year 2066. The calculation for determining the San Carlos Site Repurposing LCC is located in Attachment A. The total 50-year LCC for San Carlos Site Repurposing is $3.5 million with a range of $3.4 to $3.7 million accounting for market fluctuations.

Very truly yours,

Brown and Caldwell

Charlie Joyce, Project Manager
Walnut Creek, CA

cc: Kim Hackett, SVCW
Roanne Ross, Whitley Burchett & Associates

Attachments (1)

- Attachment A: San Carlos Site Repurposing LCC Calculation

Attachment A: SVCW Life Cycle Cost (LCC) San Carlos Site Repurposing Calculation

A. Purpose: This sheet provides the San Carlos Site Repurposing LCC calculation for a 50-year analysis period. The equations used below are further explained in TM 11-3: Life Cycle Cost Analysis Guidelines.

B. Step 1: Conversion from Construction Cost to Capital Cost: The following equation is used to convert the construction cost developed by each team into a capital cost. Contingency, soft cost and market fluctuation cost factors are displayed below.

Capital Cost = Construction Cost x [1 + Project Contingency + Σ(Soft Costs) + Market Fluctuations]

1. Project Contingency (all projects except Gravity Pipeline), Cont: $\mathrm{Cont} := 25\%$

2. Soft Costs, SC:

- Construction Management and Engineering Services: $SC_{CM} := 18\%$
- Conract Change Orders: $SC_{CCO} := 5\%$
- Planning: $SC_{Plan} := 5\%$
- Design: $SC_{Design} := 10\%$
- Project Management $SC_{PM} := 5\%$

3. Market Fluctuation, MF:
Curently set by SVCW

$MF_{low} := -5\%$

$MF_{base} := 0\%$

$MF_{high} := 15\%$

4. Capital Cost, CC: For the San Carlos site repurposing, the construction cost is $1,132,745 (2016 dollars) and occurs in the midyear of construction.

Display Unit of Dollars: $\text{dollars} := 1$

$\text{Cost}_{\text{Construction}} := 1132745\text{dollars}$ *Note: From Belmont Pump Station Conceptual Level Class 3 Estimate, May 2016, prepared by BC.*

$$\text{Cost}_{\text{Capital\_low}} := \text{Cost}_{\text{Construction}} \cdot \left(1 + \text{Cont} + \text{SC}_{\text{CM}} + \text{SC}_{\text{CCO}} + \text{SC}_{\text{Plan}} + \text{SC}_{\text{Design}} + \text{SC}_{\text{PM}} + \text{MF}_{\text{low}}\right) = 1.85 \times 10^{6} \cdot \text{dollars}$$

$$\text{Cost}_{\text{Capital\_base}} := \text{Cost}_{\text{Construction}} \cdot \left(1 + \text{Cont} + \text{SC}_{\text{CM}} + \text{SC}_{\text{CCO}} + \text{SC}_{\text{Plan}} + \text{SC}_{\text{Design}} + \text{SC}_{\text{PM}} + \text{MF}_{\text{base}}\right) = 1.9 \times 10^{6} \cdot \text{dollars}$$

$$\text{Cost}_{\text{Capital\_high}} := \text{Cost}_{\text{Construction}} \cdot \left(1 + \text{Cont} + \text{SC}_{\text{CM}} + \text{SC}_{\text{CCO}} + \text{SC}_{\text{Plan}} + \text{SC}_{\text{Design}} + \text{SC}_{\text{PM}} + \text{MF}_{\text{high}}\right) = 2.07 \times 10^{6} \cdot \text{dollars}$$

Y_{capital} = Midpoint Year of Construction $Y_{\text{capital}} := 2019$

C. Step 2: Calculate Operation and Maintenance (O&M) Costs: The following O&M assumptions are made for the San Carlos Site:

1. Annual general maintenance allowance assumed to be part of the MPPS and RCPS allowance due to limited equipment on site. Annual general maintenance of the repurposed SCPS was not included in the original LCC analysis completed in May 2015.
2. Annual odor control costs to be included in San Carlos Odor Control Project LCC completed by CDM.
3. Electrical costs are calculated from the site's annual power requirements (not including odor control equipment power requirements) and electrical rates based on current SVCW electrical bills.

1. Electrical Costs:

- Estimated site power required based on equipment load), kWh, Power.
- Electrical rate for San Carlos, Rate.
- Estimated annual cost, $\text{Cost}_{\text{Annual\_Elec.}}$
- Electrical costs occur annually from end of construction end of LCC Analysis (2019 to 2066):

$\text{kWh} := 1$ $\text{days} := 1$

$\text{hour} := 1$ $\text{year} := 1$

$\text{Power} := 8.7\text{kWh}$

$$\mathrm{Rate} := 0.161\,\frac{\mathrm{dollars}}{\mathrm{kWh}}$$

$$\mathrm{Cost}_{\mathrm{Annual\_Elec}} := \mathrm{Power}\cdot\mathrm{Rate}\cdot 24\,\frac{\mathrm{hour}}{\mathrm{days}}\cdot 365\,\frac{\mathrm{days}}{\mathrm{year}} = 12.27\times 10^{3}\cdot\mathrm{dollars}$$

D. Step 3: Calculate Rehabilitation and Replacement Costs: The following R&R assumptions are made for the San Carlos Site:

1. Structural Rehabilitation or Replacement once every 30 years for SCPS since it will reuse the existing building structure. The structural rehabilitation/replacement cost will assume the construction cost from the May 2016 cost estimate. The structural rehabilitation/replacement includes piping, trash rack, HVAC, and structural modifications.
2. The odor control replacement costs are assumed to be part of CDM's LCC for the tunnel odor control system.

1. Structural Rehab and Replacement

- End of construction, $Y_{EndConst}$
- San Carlos Site Construction Cost from May 2016 cost estimate, $Cost_{Pump}$

$$\mathrm{Y}_{\mathrm{EndConst}} := 2020$$

$$\mathrm{Cost}_{\mathrm{Structural\_RR}} := \mathrm{Cost}_{\mathrm{Construction}} = 1.13\times 10^{6}\cdot\mathrm{dollars}$$

Structural rehabilitation and replacement occurs every 30years under a 50-year cycle, except for years when pumps are replaced (2042 and 2062); therefore, structural R&R occurs in the following year:

$$\mathrm{Y}_{\mathrm{Structural\_RR}} := \mathrm{Y}_{\mathrm{EndConst}} + 30 = 2050$$

E. Step 4: Future Value of All Costs calculation:

- Current Year, $Y_{current}$: $Y_{current} := 2016$
- Escalation, i: $i := 4\%$
- Calculate future values, FV using TM 11-3, EQ 4-1:

FV = PV x $(1+i)^{Yn-Ycurrent}$,

where Y_n is the year the cost occurs and PV = present value.

For annual costs: FV = PV x $[(1+i)^n-1]/i$, where n is the number of years.

Assume FV occurs in end of analysis year.

$$FV_{capital\_low} := Cost_{Capital\_low} \cdot (1+i)^{Y_{capital}-Y_{current}} = 2.08 \times 10^6 \cdot dollars$$

$$FV_{capital\_base} := Cost_{Capital\_base} \cdot (1+i)^{Y_{capital}-Y_{current}} = 2.14 \times 10^6 \cdot dollars$$

$$FV_{capital\_high} := Cost_{Capital\_high} \cdot (1+i)^{Y_{capital}-Y_{current}} = 2.33 \times 10^6 \cdot dollars$$

$$FV_{Structural\_RR} := round\left[Cost_{Structural\_RR} \cdot (1+i)^{Y_{Structural\_RR}-Y_{current}}, -4\right] = 4.3 \times 10^6 \cdot dollars$$

Future values of annual costs:

Escalate 2016 values for all years prior to beneficial use year, Y_{BFU}: $Y_{BFU} := 2022$

Calculate future values for years before and during beneficial use years.

$$FV_{Electrical\_2020} := Cost_{Annual\_Elec} \cdot (1+i)^{Y_{EndConst}-Y_{current}} = 14.35 \times 10^3 \cdot dollars$$

$$FV_{Electrical\_2021} := Cost_{Annual\_Elec} \cdot (1+i)^{2021-Y_{current}} = 14.93 \times 10^{3} \cdot dollars$$

$$FV_{Electrical\_a} := Cost_{Annual\_Elec} \cdot (1+i)^{Y_{BFU}-Y_{current}} = 15.53 \times 10^{3} \cdot dollars$$

Escalate 2022 annual values to end of analysis year (2066): $Y_{Analysis} := 2066$

$$FV_{Electrical} := round\left[\frac{\left[FV_{Electrical\_a} \cdot (1+i)^{Y_{Analysis}-Y_{EndConst}} - 1\right]}{i}, -4\right] = 2.36 \times 10^{6} \cdot dollars$$

F. Step 5: Present Value at Year of Beneficial Use Calculation:

- Discount Rate for O&M, r_{OM}: $r_{OM} := 3\%$
- Discount Rate for Capital and Rehab/Replace, $r_{capital}$: $r_{capital} := 7\%$
- Calculate Present Values for all Years above Year of Beneficial Use using TM 11-3, EQ 4-2:

Z = FV x (1+r)^(Y_{BFU}-$Y_{current}$),
where Z is the cost at the Year of Beneficial Use and FV is the future value calcuated in Step 4.

- For all costs occuring before Year of Beneficial Use, assume these costs are sunk costs in the year it occurs. Therefore, the future value as calculated in Step 4 will be used.

$$Z_{capital\_low} := if\left[Y_{capital} \le Y_{BFU}, FV_{capital\_low}, FV_{capital\_low} \cdot \left(1 + r_{capital}\right)^{-\left(Y_{capital}-Y_{BFU}\right)}\right] = 2.08 \times 10^{6} \cdot dollars$$

$$Z_{capital\_base} := \text{if}\left[Y_{capital} \le Y_{BFU}, FV_{capital\_base}, FV_{capital\_base}\cdot\left(1 + r_{capital}\right)^{-\left(Y_{capital}-Y_{BFU}\right)}\right] = 2.14\times 10^{6}\cdot \text{dollars}$$

$$Z_{capital\_high} := \text{if}\left[Y_{capital} \le Y_{BFU}, FV_{capital\_high}, FV_{capital\_high}\cdot\left(1 + r_{capital}\right)^{-\left(Y_{capital}-Y_{BFU}\right)}\right] = 2.33\times 10^{6}\cdot \text{dollars}$$

$$Z_{Structural\_RR} := \text{round}\left[\text{if}\left[Y_{Structural\_RR} \le Y_{BFU}, FV_{Structural\_RR}, FV_{Structural\_RR}\cdot\left(1 + r_{capital}\right)^{-\left(Y_{Structural\_RR}-Y_{BFU}\right)}\right], -4\right] = 650\times 10^{3}\cdot \text{dollars}$$

$$Z_{Electrical} := \text{round}\left[FV_{Electrical\_2020} + FV_{Electrical\_2021} + FV_{Electrical\_a} + FV_{Electrical}\cdot\left(1 + r_{OM}\right)^{-\left(Y_{Analysis}-Y_{BFU}\right)}, -4\right] = 690\times 10^{3}\cdot \text{dollars}$$

G. Step 6: Total Cost for the Year of Beneficial Use calculated by Summing the Adjusted Values in Step 5:

$$Z_{total\_low} := Z_{capital\_low} + Z_{Electrical} + Z_{Structural\_RR} = 3.42\times 10^{6}\cdot \text{dollars}$$

$$Z_{total\_base} := Z_{capital\_base} + Z_{Electrical} + Z_{Structural\_RR} = 3.48\times 10^{6}\cdot \text{dollars}$$

$$Z_{total\_high} := Z_{capital\_high} + Z_{Electrical} + Z_{Structural\_RR} = 3.67\times 10^{6}\cdot \text{dollars}$$

The total 50-Year LCC for the Year of Beneficial Use is $3.5 million for the San Carlos Site Repurposing with a range of $3.4 million to $3.7 million accounting for market fluctuations.

Prepared by

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