SACRAMENTO AREA SEWER DISTRICT

STANDARDS AND SPECIFICATIONS

EFFECTIVE DATE: SEPTEMBER 27, 2023

Sacramento Area Sewer District
10060 Goethe Road
Sacramento CA 95827

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DOCUMENT OUTLINE

SECTION 100: GENERAL

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SECTION 400: REHABILITATION

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SECTION 100: GENERAL

100 OVERVIEW

100.1 PURPOSE

The purpose of these Standards and Specifications is to provide specific minimum requirements for the planning, design, construction, and rehabilitation of SacSewer's public sewer collection system. These Standards apply to the public sewer collection system that SacSewer maintains and operates, any of the activities that require SacSewer's approval, or new infrastructure installed within existing or new public ROWs or public sewer dedicated easements.

100.2 BACKGROUND

The public sewer collection system includes pump stations, gravity sewers, force mains, pressurized systems, and related appurtenances. These Standards provide for the safety and general welfare of the public and the environment. These Standards are periodically updated to reflect changes to planning, design, construction, and rehabilitation requirements. Users of the Standards should verify with SacSewer that the version they are using is the most up-to-date. All references within these Standards refer to this document unless otherwise noted.

These Standards are separated into five sections:

Section 100: General

Section 200: Design

Section 300: Construction

Section 400: Rehabilitation

Section 501: Standard Plans

100.3 DESIGN PRACTICE

It is impossible to anticipate all situations that may arise in the planning, design, construction, and rehabilitation of sewer facilities or to prescribe standards applicable to every situation. Any situations not included in these Standards must be planned, designed, and constructed in accordance with accepted engineering practices. All designs must be signed and stamped as appropriate by a Professional Engineer licensed to practice in the State of California.

100.4 ENFORCEMENT

Enforcement authority is detailed in the *SacSewer Sewer Ordinance* available on SacSewer's website at www.sacsewer.com.

100.5 CHANGES

The District Engineer or designee may issue clarifications and make changes to this document as required.

100.6 DEVIATIONS

SacSewer reserves the right to deviate from any standard or specification for a particular application. Each deviation from these Standards requires justification and SacSewer's approval before implementation. To request a deviation, submit a *Request for Deviation from Standards and Specifications*, available on SacSewer's website at www.sacsewer.com.

100.7 FINAL AUTHORITY

The District Engineer or designee has the final authority on any questions regarding the interpretation of these Standards. The District Engineer's or designee's decision is final, and they have the authority to enforce and make effective such decisions.

100.8 DISCLAIMER AND APPLICABILITY

These Standards are intended for use in work administered and inspected by SacSewer, for development within public ROWs or public sewer easements, or dedication or incorporation into SacSewer's facilities. Any use of these Standards by any other person, persons, or entity does not create or imply the assumption of any liability or responsibility by SacSewer.

While the information contained in these Standards is believed to be correct at the time of publication, SacSewer and its working parties and agents involved in preparation and publication do not accept any liability for its contents or any consequences arising from its use.

The contractor and all users of these Standards agree to hold SacSewer harmless in all legal action resulting from patent infringements.

100.9 DOCUMENT PRECEDENCE

The components of the Contract Documents are intended to explain each other. Execute any work shown on the plans but not in the specifications, or vice versa, as if indicated in both.

If the Contract Documents conflict, the following order of precedence governs the interpretation of the Contract Documents:

1. Field Instruction or other written directions
2. Project specific specifications
3. Project specific plans
4. SacSewer Standards and Specifications (Standards)
5. County of Sacramento Standard Construction Specifications (County Specifications)
6. Current State of California Standard Specifications (State Specifications)
7. Current State of California Standard Plans

101 INFORMATION

101.1 SACSEWER'S OVERVIEW

SacSewer's public sewer collection system collects sewage from local homes and businesses within the Sacramento region.

It takes thousands of miles of pipelines to serve SacSewer's customers. Sewage from homes and businesses enters SacSewer's system through lower laterals, the portion of the sewer lateral beginning at SacSewer's cleanout (or the intended SacSewer's cleanout location if a SacSewer cleanout is not yet installed). Sewage discharges from lower laterals to main lines. From sewer main lines, sewage flows into larger pipelines called trunk sewer (typically 12 to 36 inches in diameter) that then connect to large interceptor pipelines (typically 36 to 144 inches in diameter) that Regional San owns. Regional San interceptors then convey sewage to Regional San's wastewater treatment plant at 8521 Laguna Station Road, Elk Grove, CA 95758.

This document outlines design requirements for new and replacement sewer facilities. Upgrades or modifications to existing facilities must meet these Standards to the extent practical.

Generally, these Standards apply to facilities with flows less than 10 mgd. Facilities designed for capacities 10 mgd or greater must meet Regional San requirements.

101.2 SacSewer Boundary

All public sewer facilities constructed within *SacSewer's service area* are under SacSewer's jurisdiction and must comply with these Standards. SacSewer cannot provide sewer service to areas outside its service boundary until the developer annexes the property into SacSewer's service area or an agreement for wastewater service by contract has been approved by LAFCO. All wastewater service annexations and agreements must comply with the most current *SacSewer Sewer Ordinance*.

101.3 System Capacity Plan

The *System Capacity Plan*, located on SacSewer's website at www.sacsewer.com, addresses the hydraulic capacity of the collection system focusing on the trunk system. It describes potential relief and expansion projects for the collection system through the buildout of *SacSewer's service area*. This document includes planning level project scopes and cost estimates that form the basis of the Capital Funding Projections.

101.4 Existing Facility Information

Information about existing SacSewer facilities can be requested from SacSewer's Development Services Group by calling 916-876-PLAN (916-876-7526), emailing plancheck@sacsewer.com or submitting a written request by mail to the following address:

Sacramento Area Sewer District
10060 Goethe Road
Sacramento CA 95827

102 Definitions and Abbreviations

102.1 Definitions

Whenever the following terms or titles are used in these Standards or when used in contracts, agreements, documents, or instruments where these Standards apply, the intent and meaning are as follows:

1. **AIR RELEASE VALVE**: An air valve that enables air to be released from a pressurized pipe or force main.
2. **AS-BUILTS**: Drawings prepared by the contractor that document changes to, additions to, or deductions from the contract documents and represents the work as constructed.
3. **BOARD OF DIRECTORS**: The governing body of the Sacramento Area Sewer District, as set by the California State Code. Also referred to as the "Board."

4. **BUTT FUSION**: The welding process used to join two different pieces of plastic pipe. This process involves heating both pieces simultaneously and pressing them together.
5. **CATHODIC PROTECTION SYSTEM**: The system that protects metallic materials from corrosion damage due to stray electrical currents and to control corrosion from aggressive soils.
6. **COLLECTOR (ALSO CALLED COLLECTOR SEWER OR COLLECTOR SEWER FACILITY)**: A sewer facility designed to carry less than one mgd peak wet weather flow and receiving wastewater from another collector, sewer lateral, or sewer facility that services only one user.
7. **COMBINATION AIR RELEASE VALVE**: A combination air and vacuum valve that enables air to be released from a pressurized pipe or force main, and that prevents a vacuum from developing during draining or water column separation of the system.
8. **CONTRACTOR**: Any person that is responsible for the construction, maintenance or repair of sewer facilities within SacSewer's service area. All contractors under contract to do work must be licensed according to the laws of the State of California.
9. **CUSTOMER**: Owner of the parcel being served by SacSewer's sewer collection system.
10. **DESIGN ENGINEER**: That person legally authorized to practice civil engineering in the State of California who prepares or submits improvement plans or specifications to SacSewer for approval. When SacSewer's Standards and Specifications require that approval be obtained from SacSewer, such approval must be requested by the design engineer.
11. **DEVELOPER**: Any person or persons, firm, partnership, corporation, or combination that is financially responsible for the construction of approved sewer facilities within SacSewer.
12. **DIN RAIL**: A metal rail of a standard type widely used for mounting circuit breakers and industrial control equipment inside equipment racks.
13. **DISTRICT ENGINEER**: The District Engineer is appointed by the Regional San Board of Directors to oversee the operations of the Sacramento Regional County Sanitation District and the Sacramento Area Sewer District.
14. **EASEMENT**: An acquired legal right to use land in the manner specified in the legal document. The easement is itself a real property interest, but legal title to the underlying land is retained by the landowner for all other purposes than those specified. The landowner who grants the easement cannot build structures within the easement area or use fencing that would hinder access.
15. **ENERGY GRADE LINE**: A line representing the elevation of the energy head (in feet) of water flowing in a pipe.
16. **ENGINEERED FILL**: Fill that is selected, placed, and compacted to an appropriate specification so that it will exhibit the required engineering behavior.

17. **EQUIVALENT SINGLE-FAMILY DWELLING**: A parameter used to identify the sewage discharge on the basis of a single-family detached residential dwelling.
18. **FLUSHER BRANCH**: The upstream end of a main line pipe that ends as a cleanout at ground level. A flusher branch may consist of either an elbow with an angled riser to the ground surface or a wye or tee fitting with a vertical riser to the ground surface and a plug or stub line at the end of the pipe.
19. **FORCE MAIN**: The pressurized sewer facilities that convey sewage from a pump or lift station into a gravity pipeline.
20. **GRAVITY PIPELINE**: The non-pressurized conveyance facilities of the sewer collection system.
21. **GREASE INTERCEPTOR**: A device designed and installed to separate grease, oil, solids, and other related undesirable matter from normal wastes and retain them, permitting normal liquid wastes to discharge into SacSewer's sewer collection system. The device must be consistent with the requirements of the California Plumbing Code.
22. **GROSS ACRE**: An area of 43,560 SF, which includes the total area within the property lines of a lot or parcel of land before public ROWs are deducted from such lot or parcel.
23. **GROUNDWATER**: Water held underground in soil or permeable rock.
24. **H-20 LOADING**: American Association of State Highway Transportation Officials (AASHTO) published its bridge design criteria, commonly known as H-20 or HS-20. It consists of truck axle loading of 32,000 lbs or wheel loading of 16,000 lbs.
25. **INFILTRATION**: Any water entering SacSewer's sewer collection system from the ground, through means including, but not limited to, defective pipes, pipe joints, connections, or manhole walls.
26. **INFLOW**: Any water entering or discharging into SacSewer's sewer collection system from sources including, but not limited to the following: roof leaders, cellars, yard and area drains, fountain drains, crushed laterals, cooling water discharges, drains from springs and swampy areas, manhole covers, cross-connections from storm sewers and combined sewers, catch basins, storm waters, surface runoff, street wash waters, or street wash drainage.
27. **INTERCEPTOR SEWER**: An existing sewer (including pumping facilities and in-line treatment facilities belonging to that sewer) described in the Master Interagency Agreement and any future sanitary sewers that meet either of the following criteria:
    i. Any sanitary sewer designed to carry a peak wet weather flow of 10 mgd or greater
    ii. Any sanitary sewer that has its upstream and downstream end adjacent and connected to an existing interceptor sewer described in the Master Interagency Agreement

28. **INTERIM TRUNK**: A sewer facility identified during the planning process that is required to allow development in lieu of access to available capacity in a future interceptor or trunk. A sewer facility must meet all the following requirements to be considered an interim trunk:
    i. Designed to carry more than 1 mgd peak wet weather flow
    ii. Located to facilitate abandonment once capacity in an interceptor or trunk becomes available
    iii. Serve more than one development
29. **JURISDICTIONAL AGENCY**: The local public agency, typically the unincorporated county, a local city (for example, Sacramento, Elk Grove, Rancho Cordova, and Citrus Heights) or utility district (for example, the fire department, local water agency, local parks and recreation) that has standards to which SacSewer defers.
30. **LOAD BANK**: A device that develops an electrical load, applies the load to an electrical power source, and converts or dissipates the resultant power output of the source. A Load Bank is intended to accurately mimic the operational or "real" load a power source will see in actual application.
31. **LOWER LATERAL**: Portion of the sewer lateral from the main line to SacSewer's sewer cleanout or, in the absence of a cleanout, to the limits of the public ROW, SacSewer or other public sewer easement where SacSewer maintains the sewer facilities, or public utility easement.
32. **MAIN LINE**: Sewer pipe connecting two nodes designed to accommodate flow typically from more than one sewer lateral. Main line sewers include collectors and trunks.
33. **MANHOLE**: A type of node that provides a point of entry into the sewer collection system. A manhole with an incoming pipe elevated several feet above the manhole invert is termed a "drop manhole." If the drop piping is inside the manhole, it is termed an "inside drop." If the drop piping is located outside the manhole barrel and then terminates inside near the manhole bottom, it is termed an "outside drop."
34. **MANHOLE TAPS**: Taps connecting directly into a manhole.
35. **NODE**: A point of access or inspection such as a manhole, flusher branch, or other sanitary sewer main line structure.
36. **NOTICE TO PROCEED**: The written authorization to the contractor specifying the date the work may begin and any conditions regarding the beginning of the work.
37. **OWNER**: The record owner of real property, residence, or business.
38. **PERCHED WATER**: Groundwater occurring in a saturated zone separated from the main body of groundwater by unsaturated rock.

39. **PLANS**: The plans, drawings, profiles, cross sections, working drawings, and supplemental drawings, or reproductions approved by SacSewer that show the locations, character, dimensions, and details of the work.
40. **PLUMBING SEWER CODE**: The California State Plumbing Code, most current revision.
41. **POINT REPAIR**: Rehabilitation of a short section (less than 50 feet long) in an existing pipeline.
42. **PRIVATE SEWER**: Any sewer facility not owned by SacSewer.
43. **PUBLIC RIGHT-OF-WAY**: Any real property (for example, streets, sidewalks, curbs, gutters, highways, alleys, landscaped corridors or medians) that has been set aside for public use and dedicated as a public ROW in the fee title.
44. **PUBLIC SEWER**: Any sewer that carries domestic or nondomestic wastewater located within an easement or public ROW maintained by SacSewer.
45. **PUBLIC UTILITY EASEMENT**: An easement dedicated to any utility which provides services to the general public, including gases, electric, telephone, sewer, water and television cable system. PUE's are generally strips of land that are created at the time a plat for a new development is designed. PUE's almost always exist along streets and rear lot lines, and sometimes exist between lots.
46. **PUMP STATION**: A pumping facility that pumps sewage through a force main into the nearest manhole, such that sewage can again flow by gravity.
47. **POLYVINYL CHLORIDE:** A synthetic thermoplastic material made from the polymerization of vinyl chloride.
48. **RECORD DRAWINGS**: Final drawings of the project submitted to SacSewer before project acceptance. Record drawings are permanent records and are archived by SacSewer.
49. **RIGHT-OF-WAY**: A type of easement that permits the public to travel over a parcel of land. Typically a ROW is granted on a subdivision or parcel map and is dedicated to the jurisdiction for operation and maintenance of a travel way.
50. **RS-485**: A standard defining the electrical characteristics of drivers and receivers for use in serial communications systems.
51. **SACRAMENTO AREA SEWER DISTRICT**: A county sanitation district under and operating under the authority of the County Sanitation District Act, commencing at California Health and Safety Code Section 4700. Before 2008, SacSewer was legally known as County Sanitation District No. 1 (CSD-1), successor in interest to the following districts: Arden Sanitation District, Central Sanitation District, Cordova Sewer Maintenance District, County Sanitation District No.2, County Sanitation District No.6, Courtland Sanitation District, Highland Estates Sewer Maintenance District, Linwood Sewer Maintenance District, Natomas Sanitation District, Northeast Sacramento County Sanitation District, Sabre City Sewer Maintenance District, and Walnut Grove Sewer

Maintenance District. SacSewer owns and operates sewer facilities usually designed to carry flows less than 10 mgd.

52. **SACRAMENTO LOCAL AGENCY FORMATION COMMISSION**: An agency responsible for (a) coordinating logical and timely changes in local governmental boundaries, including annexations and detachments of territory, incorporations of cities, formations of special districts, and consolidations, mergers, and dissolutions of districts, as well as for (b) reviewing ways to reorganize, simplify, and streamline governmental structure.
53. **SACRAMENTO REGIONAL COUNTY SANITATION DISTRICT**: The regional sanitation district that collects and treats sewage from multiple jurisdictions in the Sacramento area, including the Sacramento Area Sewer District. Generally, Regional San owns and operates sewer facilities designed to carry flows of 10 mgd and more.
54. **SANITARY SEWER**: A sewer facility that carries wastewater.
55. **SCHEMATIC SLOPE**: A pipe slope used for planning purposes within a sewer study or design report. The schematic slope is typically greater than the design slope to allow for unknown factors.
56. **SERVICE AREA**: The geographical area served by SacSewer's sewer collection system as approved by LAFCO.
57. **SEWAGE**: Domestic or nondomestic waste, or both, together with such ground, surface, and stormwaters that enter the sewer collection system.
58. **SEWER**: A pipe or conduit that receives and carries wastewater.
59. **SEWER COLLECTION SYSTEM**: All facilities for collecting, pumping, conveying, controlling, treating, storing, and disposing of wastewater.
60. **SEWER EASEMENT**: An acquired legal right to the exclusive or joint use of a defined portion of land for access, construction, or maintenance of sewers or as defined within the legal description of said easement.
61. **SEWER FACILITIES**: Refers to sewer manholes, wet wells, pump stations, or lift stations, access roads, gravity pipes, force mains, sewer easements, laterals, and any facility over which SacSewer has full jurisdiction.
62. **SEWER LATERAL**: A pipe comprised of the upper and lower lateral that collects sewage (typically residential or commercial) and transports it to SacSewer's main line pipe or manhole. Also called lateral sewer and service sewer.
63. **SEWER SYSTEM CAPACITY PLAN**: The plan that displays or describes SacSewer's intentions to provide sewer service to SacSewer's service area. This document is periodically updated and approved by SacSewer's Board of Directors.
64. **SPRING LINE**: The horizontal centerline of the pipe or in box section, the mid-height of the vertical wall.

65. **STATE STANDARD SPECIFICATIONS OR STATE SPECIFICATIONS**: The Standard Specifications of the State of California, Business and Transportation Agency, Department of Transportation, latest edition.
66. **STUB LINES**: A main line that terminates without direct access. A stub line or flusher branch wye or tee may sometimes have a lower lateral connection at the end.
67. **SUBCONTRACTOR**: A properly licensed party under contract and responsible to the contractor for performing a specified part of the work or to a subcontractor of the contractor.
68. **TAPS**: The location where lower laterals join main lines. Cored and hammer taps are types of connections commonly made to a main line after its original construction.
69. **TRANSITION MANHOLE**: The manhole where a force main connects and pressurized flow ends and gravity flow begins.
70. **TRUNK (ALSO CALLED TRUNK SEWER OR TRUNK SEWER FACILITY)**: A sewer facility designed to carry at least one mgd but less than 10 mgd peak wet weather flow and receiving wastewater from two or more unique users.
71. **UPPER LATERAL**: Portion of the sewer lateral from the upper end of the lower lateral to the limits of the building plumbing.
72. **USER**: Any person who discharges waste directly or indirectly to the sewer collection system, causes, or allows such discharge.
73. **VITRIFIED CLAY PIPE**: Pipe made from a blend of clay and shale subjected to high temperature to achieve vitrification that results in a hard, inert ceramic.
74. **WASTEWATER**: The liquid and water-carried non-domestic and domestic wastes, whether treated or untreated.
75. **WATER TABLE**: The upper limit of the portion of the ground wholly saturated with water.
76. **WORK**: All actions that the contractor is required to do as specified, indicated, shown, contemplated, or implied in the contract to construct the work, including all alterations, amendments, or extensions made by contract change order, other written orders, or SacSewer's directives. Unless specified otherwise in the contract, the work includes furnishing all materials, supplies, equipment, tools, labor, transportation, supervision, and all incidentals necessary to complete the work.

102.2 ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ABS	Acrylonitrile-Butadiene-Styrene
AC	Alternating Current
ACI	American Concrete Institute
ACP	Asbestos Cement Pipe
ADWF	Average Dry Weather Flow
AGC	Associated General Contractors
AH	Ampere Hours
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
APWA	American Public Works Association
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
ATS	Automatic Transfer Switch
AWG	American Wire Gauge
AWWA	American Water Works Association
BC	Begin Curve
BEP	Best Efficiency Point
BMP	Best Management Practices
Cal OSHA	California Occupational Safety and Health Administration
Caltrans	California Department of Transportation
CARV	Combined Air and Vacuum Release Valve
CCA	Copper Chrome Arsenate
CCR	California Code of Regulations
CP-FM	Cathodic Protection-Force Main
CIPP	Cured in Place Pipe
CKE	Centrifuge Kerosene Equivalent Test
CLSM	Controlled Low Strength Material
CRI	Color Rendering Index
CT	Current Transformer
cy	Cubic Yard
d/D	depth to inside Diameter of the pipe ratio
DC	Direct Current
DFT	Dry Film Thickness
DIP	Ductile Iron Pipe
DIPRA	Ductile Iron Pipe Research Association

DNP3	Distributed Network Protocol version 3
DR	Dimension Ratio
EC	End Curve
EPA	Environmental Protection Agency
EPDM	Ethylene Propylene Diene Monomer
ESD	Equivalent Single Family Dwelling
FLS	Float Leakage Sensor
ft	Foot or Feet
gal	Gallons
GD	General Duty
GFI	Ground Fault Interrupter
gpd	Gallons per day
gpm	Gallons per minute
GPS	Global Positioning System
HDPE	High-Density Polyethylene
HOA	Homeowners Association
I/I	Inflow and Infiltration
I/O	Input/Output
ID	Inside Diameter
IEEE	Institute of Electrical and Electronics Engineers
in	Inch(es)
JPEG	Joint Photographic Experts Group
kpsi	Kilo-pounds per square inch
KVA	Kilovolt-Ampere
LAFCO	Local Agency Formation Commission
lb	Pound
LDPE	Low-Density Polyethylene
LED	Light Emitting Diode
m	Meter
MCC	Motor Control Center
MCP	Motor Circuit Protector
mgd	Million Gallons per Day
mil	1/1000 of an inch
Mpsi	Mega-pound per square inch
MTBM	Microtunnel Boring Machine
MTW	Machine Tool Wire
NACE	National Association of Corrosion Engineers

NAD 83	North American Datum of 1983
NAVD 88	North American Vertical Datum of 1988
NEC	National Electric Code
NEMA	National Electrical Manufacturer's Association
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association
NGVD 29	National Geodetic Vertical Datum of 1929
NIOSH	US National Institute for Occupational Safety and Health
NPSHA	Net Positive Suction Head Available
NPSHR	Net Positive Suction Head Required
NRS	Non-Rising Stem
OD	Outside Diameter
OIP	Operator Interface Panel
oz	ounce
PCC	Portland Cement Concrete
PDWF	Peak Dry Weather Flow
PF	Peaking Factor
PLC	Programmable Logic Controller
psi	Pounds per square inch
PT	Potential Transformer
PUE	Public Utility Easement
PVC	Polyvinyl Chloride
PWWF	Peak Wet Weather Flow
RAP	Reclaimed Asphalt Pavement
Regional San	Sacramento Regional County Sanitation District
RFID	Radio Frequency Identification
ROW	Right of Way
RPPA	Reduced Pressure Backflow Preventer Assembly
RTU	Remote Telemetry Unit
SacSewer	Sacramento Area Sewer District
SBR	Styrene-Butadiene-Rubber
SCADA	Supervisory Control and Data Acquisition
SDS	Safety Data Sheet
SDR	Standard Dimension Ratio
SF	Square foot (feet)
SSPWC	Standard Specifications for Public Works Construction
SWPPP	Storm Water Pollution Prevention Plan

TDH	Total Dynamic Head
THHN	Thermoplastic High-Heat Resistant Nylon
THW	Thermoplastic Heat and Water Resistant
THWN	Thermoplastic Heat and Water-Resistant Nylon
TIF	Tagged Image File
Title 8	Title 8 (Construction Safety Orders) of the California Code of Regulations
Title 22	Title 22 (Drinking Water) of the California Code of Regulations
TV	Television
TVI	Television Inspection
TVSS	Transient Voltage Surge Suppressors
UBC	Uniform Building Code (latest edition)
UL	Underwriter's Laboratory, Inc.
UMC	Uniform Mechanical Code
UPS	Uninterruptible Power Supply
US	United States
USACE	United States Army Corps of Engineers
UV	Ultraviolet
VCP	Vitrified Clay Pipe
VDC	Volts Direct Current
VFD	Variable Frequency Drive
WDR	State Waste Discharge Requirement
WPCP	Water Pollution Control Plan

103 GENERAL PROVISIONS

103.1 CORRESPONDENCE

The design engineer for a sewer facility must coordinate the sewer facility design with SacSewer.

All correspondence and requests for information on development projects must be made through SacSewer's Development Services Group or its representative that routes submittals and requests for information as appropriate.

103.2 JURISDICTION

All facilities must satisfy the jurisdictional agency regulations. Facilities must also satisfy other regulations, including those published by the Cal OSHA, the NFPA, NEC, and others, as applicable. SacSewer will resolve conflicts on a case-by-case basis.

103.3 SUBMITTALS

The submittal requirements are listed at www.sacsewer.com/standards-specifications/.

103.4 DESIGN AND CONSTRUCTION

All projects must adhere to these Standards, Section 1 through 10 of the *County Specifications*, the latest edition, and the jurisdictional agency's requirements.

103.5 PUBLIC NOTIFICATION

SacSewer's goal is to perform all planned rehabilitation or maintenance work efficiently with as little disruption as possible to its customers. Property owners and/or tenants must be notified if access to their property is required for planned non-emergency work. The specific public notification requirements will differ depending on the type of work proposed and the impacts of the work.

There are several reasons to notify SacSewer's customers:

- Work is scheduled to be performed on their property or in their neighborhood that may have related traffic, ingress/egress, odor, sewer service, or other reasonably anticipated work-related impacts.
- Work requires backyard or easement access.

When required or necessary, notification to affected customers must be provided in writing via a SacSewer-issued door hanger or flyer at least 48 business hours before starting work. The notice must include and clearly state the following:

- The purpose of the work
- Appropriate SacSewer's and/or contractor's contact information
- Pertinent work details

For projects where main lines or lower laterals will be out of service for more than two hours, customers must be notified at least two weeks in advance and again at least 48 business hours

before a planned loss of service. All customer notifications must be provided in writing via a SacSewer-issued door hanger or flyer. The notice must include and clearly state the following:

- The purpose of the work
- Advisement against water usage until the main line or lower lateral is placed back in service due to the potential for a sewer backup to occur if water is used during the time that the sewer line is out of service
- Appropriate SacSewer and/or contractor contact information

103.6 PHASING AND DEFERRAL OF DESIGN AND CONSTRUCTION

Phasing and deferrals must follow the *SacSewer Sewer Ordinance*.

103.7 REIMBURSEMENT AGREEMENTS

All reimbursement agreements must follow the *SacSewer Sewer Ordinance*.

SECTION 200: DESIGN

This section outlines design requirements, including the following:

- Standard submittals
- Capacity
- Real Estate and easements
- Gravity and pressurized pipelines
- Pump stations, SCADA, and instrumentation
- Standard equipment

200 GENERAL REQUIREMENTS AND PROCEDURES

200.1 DEVELOPMENT APPLICATIONS

An application is associated with the entitlement process and allows SacSewer to provide requirements or conditions for development plans within the SacSewer service area. Applications are filed in accordance with the local land-use authorities.

200.2 SEWER STUDIES

A Sewer Study is a plan to provide sewer service for a proposed project and must follow SacSewer's *Minimum Sewer Study Requirements* posted on SacSewer's website at www.sacsewer.com. A Sewer Study describes the area to be served by the local collection and trunk facilities and defines the sewer facilities necessary to provide service to that area. Approved Sewer Studies become part of SacSewer's organizational knowledge and historical documentation for future planning.

200.3 DESIGN REPORT

After an approved sewer study, a Design Report is required for all pump station facilities. It must identify whether the proposed facilities will be used on an interim or permanent basis. A Design Report must follow SacSewer's *Minimum Design Report Requirements*.

200.4 PROJECT SPECIFIC PLANS AND SPECIFICATIONS

200.4.1 PROJECT REQUIREMENTS

Project plans and specifications may be referred to as plans.

200.4.2 PLANS AND SPECIFICATIONS

Original signatures are needed on SacSewer's plans and specifications before advertising for bid. All plan sheets and specifications for sewer collection systems, private or public that are prepared for approval by SacSewer must be prepared, stamped, and signed by a Professional Engineer in the appropriate field currently licensed to practice within the State of California.

200.4.3 PLAN SHEET FORMAT

Prepare all plans on 22 inches x 34 inches or 24 inches x 36 inches sheets, plan and profile sheets, or special design engineer's sheets that have been accepted in writing by SacSewer. Drawing scales for plan and profile sheets are as follows:

- Horizontal: 1 inch = 20 feet, 40 feet, or 50 feet
- Vertical: 1 inch = 2 feet, 4 feet, or 5 feet

Only use the horizontal or vertical scale for which the sheet was intended and set up. Use break lines if the scale is not adequate to show the details.

200.4.4 DRAFTING STANDARDS

All plans submitted for SacSewer's approval must be in clear, legible prints. All lines must be clear, sharp, and heavy. Use letters and numerals at least $^{1}/_{8}$ inch high, well-formed, and sharp. Do not bisect numerals showing profile elevations by station grid lines. Terminate dimension lines with sharp solid arrowheads.

200.4.5 TITLE SHEET

Plans containing less than three sheets do not need a title sheet, but all information typically included on the title sheet must be provided on the other sheets of the plans.

For plans that exceed three sheets in a set, include a title sheet that shows the following:

- The project or subdivision name and the name and address of the developer and owner

- Assessor Parcel Number or address, if available
- A plan of the overall subdivision, parcel, or project
- Show both new and existing sewer main line sizes, the direction of sewer flow, and sewer node locations
- Boundaries of SacSewer, cities, county, and assessment district (if they exist)
- Street names and widths
- Section lines, grant lines, property lines, and corners
- Names of adjacent subdivisions, lot lines, and lot numbers
- Public easements and ROWs
- Vicinity and location maps
- Scale of drawings and details
- North arrow where appropriate
- Index of sheets
- Legend of symbols and lines
- Standard and special notes
- SacSewer's signature block (please refer to Section 502, Drawings G-01A and G-01B of these Standards)

200.4.6 TITLE BLOCKS

Every sheet of a set of plans submitted to SacSewer for approval must have a title block showing project or subdivision name, sheet title, sheet number, date, scale, design engineer's business address and phone number, and other pertinent information. The preferred location for the title block is along the right-hand end of the sheet so that the title block information is visible when the plans are rolled up.

200.4.7 GENERAL REQUIREMENTS

Plans for projects must include a layout sheet, plan and profile of each main line, and all necessary detail drawings. The plans must be clearly legible and conform to accepted practice with respect to drafting standards. All information that in SacSewer's opinion, is necessary for the satisfactory design, review, construction, and maintenance of a project must be provided and, where applicable, shown on the plans.

Layout Sheet

Include an overall map that shows the project boundaries, main lines, nodes, and other essential items of the work as determined by SacSewer in all project plans.

Overall Sheet

Prior to plan approval, submit an overall plan showing the overall subdivision, parcel, or project, including main line sizes, the direction of flow, and node locations. The overall plan scale must be no more than 1 inch = 400 feet. This overall sheet does not need to be a part of the final project plans. The plan may be a reduced layout sheet as specified above.

200.4.8 PLAN AND PROFILE SHEETS

Show sewer collection systems that SacSewer will own and maintain in both plan and profile views on SacSewer's approved plan and profile sheets.

Sewer Facilities

Draw main lines, manholes, and other nodes on the profile with scaled parallel lines. Label slopes $^1/_8$ inch above the pipe segment or between the parallel lines, preferably parallel to the pipe segment. Label the length, size, and material of each pipe segment parallel to the horizontal grid lines and approximately halfway between the ground surfaces and the main line.

Label all pipe invert elevations at nodes on the profile. Label these inverts parallel to the horizontal grid lines, underscored by a line that runs 45 degrees from the corresponding pipe invert. Label the elevations of manholes, manholes with drop connections, flusher branches, or other appurtenances on the profile.

Draw existing facilities on the profile using dashed lines, with the word "existing" printed $^1/_8$ inch above and preferably parallel to the line. Node identification on the plan view may be oblique. Label node stations directly under the node at the lower edge of the profile grid.

In improved areas, identify the location of each lower lateral proposed on the plans by stationing or by reference to a permanent, well-defined structure, if available. In new subdivisions, identify the locations of each lower lateral with stationing, dimensioning to a lot line, or by notation to install at the center of the lot. If the invert of the cleanout is not at standard depth, label the depth on the plans.

Improvements or lots shown on a plan sheet but served by a main line shown on another plan sheet must have the direction of service shown by a small triangle and the letter “s.”

Easements

Show both permanent and temporary construction easements to scale on the plans. Dimension each easement and tie it to both the property line and the main line. Identify the recorded book and page number for each permanent easement shown on the plans. The design engineer must provide the book and page number. For easements submitted but not yet recorded before the approved plans, leave blank lines for the design engineer to fill in the recordation information on the Record or As-built Drawings prior to submittal to SacSewer.

Trenches

Indicate the limiting maximum trench width for rigid pipe and minimum trench width for flexible pipe, as measured at the top of the pipeline, on the plans between well-defined points of application; the pipe material and class, if more than one class is available; and the bedding backfill type. Unlimited trench width need not be shown on the plans. If more than one combination of pipe class, trench width, or bedding type is available, show a practical range of combinations on the plans.

Dimension proposed main lines from the street centerline. If the main line is to be located in an easement, show sufficient dimensions and bearings from physical features to locate the main line in the field on the plans.

Landscaping

Trees and other objects within 10 feet of the construction trench zone must have their correct location and clearance from the construction centerline shown on the plans. Note the diameter of tree trunks and interfering heavy tree branches on the plans. Note the removal of trees and objects and other special handling on the plans. The design engineer assumes full responsibility for such notes as SacSewer assumes that all necessary arrangements with the owner of the tree or object to be handled have been made.

If there is no easement document, SacSewer requires written documentation of all special arrangements regarding property preservation made between the property owners and the design engineer. If an easement is negotiated, include all special arrangements in the easement document. Tree removals within an existing easement or within a public utility easement where there are SacSewer pipelines require SacSewer’s notification. SacSewer

may require a tree removal and restoration plan before tree removal within these easements.

Drainage

Show culverts on the plan and profile when crossed by the construction or when parallel and within 20 feet of the construction line. Label the size and type of all such culverts and when the culvert crosses or is perpendicular or nearly so and within 20 feet of the construction line, label the invert of the culvert end nearest the construction line.

In improved areas, label the addresses of buildings on the plan view within the outline of the building. Only show the front line and indication of sidelines of buildings.

200.4.9 Grading Sheets

Label manholes with flow arrows and provide rim elevations on the grading sheets.

200.4.10 Detail Drawings and Specifications

Show items not contained in these Standards with detail drawings, either on the plan sheets or on a separate detail sheet, and included in the project's specific specifications as necessary to convey the work required.

200.4.11 Plan Details

Show additional details on plans submitted for approval as needed. This requirement does not, in any way, exempt the design engineer from the responsibility of preparing neat, accurate, and comprehensive plans in keeping with the standards of the profession.

200.4.12 Record and Survey Information

Label temporary, existing, and proposed ROWs, lot boundaries fronting on streets, drainage easements, utility easements, planting easements, section lines and corners, land grant boundaries, and construction easements on the plans. Properly dimension the record and survey information.

200.4.13 Topography

Show all pertinent topographic features, including but not limited to the following items:

- Curbs
- Drainage ditches

- Driveways (on both sides of the street when within 40 feet of the median ending)
- Existing structures
- Fire hydrants
- Flood plains
- Horizontal and vertical location and size of storm drain and sewer pipelines
- Masonry structures
- Medians
- Retaining walls
- Sidewalks
- Shoulders
- Street lines
- Traffic signals street lights and pull boxes
- Trees (6 inches and larger) and other foliage
- Underground electrical conduits
- Water lines, gas lines, telephone conduits, and other underground utilities
- Utility poles
- Any other features of the area that may affect the design requirements.

When a potential utility conflict exists, the design engineer must verify the as-built elevations of the utilities.

200.4.14 CONTOURS AND ELEVATIONS

Show existing contours or elevations on all plans. The scale must be such that the plans are both readable and representative of the existing or planned site.

200.4.15 PROFILES

Show the profile of all roadway centerlines, edges of pavement, curb and gutter flow lines, drainage ditches, water mains, storm drain pipelines, and sewer pipelines. Label pipeline slopes, vertical alignment data, and invert elevations at manhole pipe inlets and outlets. All manholes must show the finished grade, pipe inlet and outlet elevations, and station number.

Show the existing ground profile along all alignments and for at least 200 feet beyond temporary street endings to facilitate setting proper vertical alignment within the proposed project limits. Increase the 200-foot minimum when required by SacSewer.

200.4.16 Stationing and Orientation

The stationing on plan and profile sheets reads from left to right. Stationing increases from south to north or from west to east. Arrange plans so that the North arrow points toward the top or right of the sheet, as practical.

200.4.17 Benchmarks

Clearly delineate benchmarks and datum on the plans as to location, description, and elevations. Use the NAD 83 for the horizontal datum. Provide NAVD 88 and the conversion factor to the NGVD 29 for the vertical datum.

200.4.18 Typical Sections

A typical section for each type of roadway or other facility within the project, setting out the structural features, must be a part of the plans.

For example, a typical street section must show the dimensioned ROWs and easements; joint trench; dimensioned location of medians, sidewalks, pavement, and other surface improvements; the location of the water, sewer, and storm drain pipelines dimensioned from the centerline of the road to the centerline of each pipe; the location of other existing or proposed utilities not located in a joint trench measured from the centerline of the road; and all other existing or proposed features that may affect the design of the sewer collection system.

200.4.19 Cross Sections

Include cross sections in the plans where determined necessary by SacSewer. When unusual topographic features or special conditions occur that would affect the work, show individual cross sections on the pertinent plan sheets.

200.4.20 Special Notes

Clearly show special notes and indicate on the plans that all construction work and installations must conform to these Standards, and all work is subject to SacSewer's approval. Notes must contain a statement regarding obtaining encroachment permits from other agencies when applicable.

200.4.21 Reference to SacSewer's Standards and Specifications

The General Notes and Special Provisions of all plans must include the note, "All sewer collection system construction and materials must be in accordance with the latest version of *SacSewer's Standards and Specifications."*

200.4.22 Project Specific Specifications

Use project-specific specifications when these Standards do not provide sufficient detail for the project construction. The cover sheet must show the project or subdivision name, the signature, and stamp of the design engineer, and a signature block for SacSewer's approval. Provide a table of contents for specifications longer than 10 pages. Provide contact information for the project developer and owner, project engineer, Geotechnical Engineer, and the agencies that have oversight of the project as applicable. Provide a glossary and table of abbreviations for terms and abbreviations not used or defined in the *SacSewer Sewer Ordinance* (latest edition) or these Standards. The technical portion of the project-specific specifications must follow the same general order as these Standards. No part of these Standards needs to be repeated in the project-specific specifications.

200.4.23 Construction Initiation

Please refer to Section 300.3.1, "Construction Initiation" of these Standards.

200.4.24 Plan and Specifications Revisions During Construction

Please refer to Section 300.3.2, "Revisions During Construction" of these Standards.

200.4.25 Conflicts, Errors, and Omissions

Excepted from approval are all features of the plans and specifications that are contrary to, in conflict with, or do not conform to State of California Law, *SacSewer Sewer Ordinance*, SacSewer's Board resolutions, the conditions of approval, or generally accepted good engineering practice keeping with the standards of the profession, even though such errors, omissions, or conflicts may have been overlooked in SacSewer's review of the plans and specifications.

200.4.26 Utilities

Show the type and diameter or size of all existing and proposed utilities on the plan and profile sheets. Utilities crossing or within 5 feet horizontally of sewer facilities must be accurate to within 1 foot. Accuracy for all other utilities must be as great as practical. If, in

the opinion of SacSewer, a conflict exists between an existing utility and a proposed sewer facility, SacSewer may require potholing before approving improvement plans.

The project proponent is responsible for potholing costs. Potholing details must be signed and stamped by a Professional Civil Engineer or Licensed Land Surveyor licensed to practice in the State of California. The accuracy of potholing details must be within 0.05 feet vertically and 0.1 feet horizontally. The design engineer must submit preliminary and approved plans and specifications to the jurisdictional agency involved.

200.4.27 Partial Plans

The approved Tentative Map must accompany the plans and specifications when the plans and specifications submitted only cover only a portion of the ultimate development. If there is no approved Tentative Map, submit a study plan showing topographic features of the ultimate development at an adequate scale to show clearly the proposed project.

200.4.28 Storm Water Pollution Prevention Plan

The SWPPP (most current version) must be provided to and approved by the jurisdictional agency as required. The project documents must include directions regarding disposal of all water encountered during construction and used for testing of facilities. Please refer to Section 305, "Water Used In Construction," of these Standards.

200.4.29 Other Agency Notifications

The design engineer is responsible for obtaining the approval and necessary permits of all governmental or municipal agencies when its facilities are involved. The design engineer must secure grading permits from the jurisdictional agency if applicable.

200.5 Geotechnical Reports

Refer to SacSewer's *Minimum Geotechnical Program Requirements* for geotechnical report requirements available on SacSewer's website at www.sacsewer.com.

200.6 Upper Laterals

Upper laterals require a plumbing permit from the jurisdictional agency. They must meet the *California Plumbing Code* requirements adopted by the State of California and any applicable jurisdictional agency requirements.

200.7 GREASE INTERCEPTORS

Grease interceptors may be required in accordance with the *SacSewer Sewer Ordinance* and the *California Plumbing Code*.

200.8 SAND OR GRIT INTERCEPTORS

Sand or grit interceptors may be required in accordance with the *SacSewer Sewer Ordinance*.

201 CAPACITY DESIGN

201.1 FLOW ESTIMATION

201.1.1 DESIGN

Collection system design within a developing area must include provisions for size and capacity to convey adequately all domestic, commercial, institutional, and industrial sewage that can be reasonably anticipated under conditions of full ultimate development.

Use the PWWF for design. Base the determination of PWWF on the best available land use and density information to quantify present and future sewage design flows. Estimate this information from land use plans from the County of Sacramento or jurisdictional agencies. This information may include approved land use and density in accordance with current zoning in the absence of more specific information about expected development.

201.1.2 AVERAGE DRY WEATHER FLOW

ADWF is based upon the ESD units, defined in the *SacSewer Sewer Ordinance*, and the design domestic flow factor of 310 gallons/day/ESD. The ADWF is calculated as the largest of the following methods:

- 6 ESDs per gross acre
- The number of units for a project
- The most recent zoning, if the number of units is unknown

Please refer to Table 201-1 for a summary of ADWF based on usage type.

201.1.3 RESIDENTIAL FLOWS

Single-family units are considered 1 ESD per unit. Multi-family units (e.g., duplexes, multiplexes, condominiums, and townhouses) are considered at 75% of the number of

residential units. For example, 10 duplexes are designed as 10 duplexes * 2 residential units/duplex * 75% = 15 ESDs.

201.1.4 COMMERCIAL FLOWS

Base design flows on total building area, use category, number of fixtures, and number of employees. In the absence of specific information, the design flow will be determined using 6 ESDs per gross acre.

Table 201-1: ADWF Summary

Usage Type	Standards Section	ESD	Flow Rate (gal/day)
Base ADWF (1 ESD)	201.1.2	1	310
Per Residential Single-family Unit	201.1.3	1	310
Per Residential Multi-family Unit	201.1.3	0.75	233
Per Acre of Commercial Development	201.1.4	6	1,900
Per Acre of School Site	201.1.5	6	1,900
Preschool, Nursery, Daycare, and Elementary (grades K-8) (Up to 1,000 Capita)	201.1.5	81	25,000
Additional per Capita for Preschool, Nursery, Daycare, and Elementary	201.1.5	0.08	25
Middle and Junior High (Grades 6-9) (Up to 1,500 Capita)	201.1.5	190	60,000
High School (Grades 9-12) (Up to 2,000 Capita)	201.1.5	260	80,000
Additional per Capita for Middle, Junior, and High School	201.1.5	0.13	40
Per Acre of Industrial Development	201.1.6	6	1,900
Per Acre of Other Usages	201.1.7	6	1,900

201.1.5 SCHOOL FLOWS

Use the larger flow, as determined by one of the following methods:

- The entire school area is considered as 6 ESDs per gross acre
- Based on the type of school shown in Table 201-2, with the indicated capita limits including the ultimate student population plus administration, teaching, and operating personnel.

Table 201-2: School Flows

Type of School	ADWF	Capita Limit
Preschool, Nursery, Daycare, Elementary (Grades K-5, K-6, or K-8)	0.025 mgd	1,000
Middle, Junior High (Grades 6-8, 7-8, or 7-9)	0.060 mgd	1,500
High School (Grades 9-12 or 10-12)	0.080 mgd	2,000

- For enrollments and personnel over the limits indicated above, add 25 gpd per additional capita in elementary schools and 40 gpd per additional capita in middle and high schools

201.1.6 INDUSTRIAL FLOWS

Use the larger flow, as determined by one of the following methods:

- Specific known industrial development
- 6 ESDs per gross acre

201.1.7 OTHER FLOWS

Open space, recreational areas, parks, and all other unidentified uses will use a minimum design flow of 6 ESDs per gross acre unless otherwise approved by SacSewer.

Preserve areas and other conservation areas that will remain undeveloped in perpetuity are not assigned ESDs.

201.2 FLOW FORMULAS

SacSewer uses the following equations to determine flows:

- PWWF (mgd) = (ADWF * PF) + I/I
- ADWF (mgd) = (310 gpd/ESD) * (# ESDs/acre) * (# acres) / 1,000,000
- PF = 3.5 - 1.8 * $ADWF^{0.05}$ where ADWF is in mgd, and a minimum value of PF is 1.2
- I/I (mgd) = 1,600 gpd/acre * (# acres) / 1,000,000

201.3 CAPACITY

Main line capacity, in all cases, must be adequate to carry the designed PWWF from the entire tributary area, even if said area is not within the project boundaries. The proposed designed PWWF for each pipe in the sewer collection system must not exceed the full pipe capacity.

201.4 EASEMENTS

201.4.1 GENERAL

Provide sewer easements for all sewer facilities located outside the public road ROW in accordance with the *SacSewer Sewer Ordinance*. Dedicate easements to SacSewer in a form approved by SacSewer. SacSewer will not accept new sewer facilities located within a public utility easement. Provide new sewer easements within the limits of a proposed project to SacSewer before project improvement plan approval. Upgrade existing substandard sewer easements within the limits of the proposed project to current SacSewer Standards before approval of the project improvement plans.

For pump stations or facilities with above-grade improvements, provide a title for the property or grant deed to SacSewer at the time of SacSewer's acceptance of the facility.

201.4.2 LOCATION OF EASEMENTS

Easements must be fully accessible to SacSewer's personnel and equipment. Easements in backyards and side yards are not permitted unless approved by SacSewer.

201.4.3 WIDTH OF EASEMENTS

The minimum width of all sewer easements over main lines is 20 feet. SacSewer will determine the minimum width of all sewer easements over lower laterals. Wider easements may be required depending on location, type of soil, size and depth of line, locations of manholes, or as determined necessary by SacSewer. Whenever possible, sewer easements must be centered over the pipe. A minimum horizontal distance of 5 feet is required from the edge of all manholes to the edge of the sewer easement. The sewer pipe must be no less than 5 feet as measured from the edge of the pipe to the edge of the easement.

201.4.4 ACQUISITION

The project proponent is responsible for all costs associated with easement acquisition, including, but not limited to, land (onsite and offsite of the proposed project), administration, surveys, permits, and document preparation.

201.4.5 ABANDONMENT

Requests for abandonment of a sewer easement dedicated to SacSewer or a predecessor agency to SacSewer must be submitted to SacSewer's Development Services Group, and may require approval from SacSewer's Board of Directors.

Requests for abandonment of sewer easements dedicated to the County of Sacramento must be directed to the County of Sacramento Technical Resources Unit of the Land Division Site Improvement Review Section for processing and requires approval of the Sacramento County Board of Supervisors.

201.4.6 LANDSCAPING WITHIN EASEMENTS

Any landscaping within easement areas is limited to the lawn or similar groundcover or plant species that are not environmentally protected and whose mature growth does not exceed five feet in height. When planting, place a root barrier system, such as trifluralin fabric, between the main lines or laterals and any trees or shrubs planted within the easement area.

202 GRAVITY COLLECTION SYSTEM

202.1 HYDRAULIC REQUIREMENTS

202.1.1 SIZE

The minimum size of a pipeline is defined as the nominal diameter of the pipe. The minimum size of the main lines is 8 inches.

202.1.2 VELOCITY

The minimum velocity is 2 feet per second, and the maximum velocity is 8 feet per second when the main line is flowing half full. Use Manning's formula to determine the relation of the slope, design flow, velocity, and diameter. For design purposes, the "n" value is 0.013 for all main line materials.

202.1.3 SLOPE

Calculate pipe slope as the difference in elevation at each end of the main line segment divided by the horizontal length of the main line. Maintain a constant slope between nodes.

202.1.4 RATIO OF DEPTH OF FLOW TO PIPE DIAMETER

Size new main lines to carry the projected PWWF of less than 1 mgd at a depth not greater than 70% of the inside diameter of the pipe (i.e., use a d/D of 0.7). Size new trunk lines to carry the projected PWWF of 1 mgd or larger assuming the pipe runs full (i.e., d/D of 1.0).

202.1.5 SLOPES AND CAPACITY

Table 202-1 shows minimum slopes and design flow capacities for various main line diameters. Do not use pipeline slopes less than those listed Table 202-1. The slopes indicated are based on a minimum velocity of 2 feet per second when the pipe is flowing half full. Table 202-1 is only a guideline. The minimum slope on collectors serving less than 6 ESDs is 0.007. Maximum slopes must not allow a velocity greater than 8 feet per second unless these Standards specify otherwise.

When the pipe alignment is known, use a fixed slope for all construction and design plans. Use a schematic slope when specific pipe alignment is unknown (such as in a Sewer Study). SacSewer does not permit new construction with 6-inch main lines.

Table 202-1: Minimum Slopes

Main Line Diameter (in)	Minimum Fixed Slope	Minimum Schematic Slope	Design Capacity (mgd)	d/D	Approximate ESDs Served
8*	0.0070	--	--	--	Less than 6
8	0.0035	0.0060	0.39	0.7	480
10	0.0025	0.0035	0.59	0.7	740
12	0.0020	0.0024	0.86	0.7	1,090
12	0.0020	0.0024	1.03	1.0	1,320
15	0.0015	0.0018	1.62	1.0	2,100
18	0.0012	0.0014	2.36	1.0	3,100
21	0.0011	0.0012	3.41	1.0	4,540
24	0.0010	0.0011	4.64	1.0	6,250
27	0.0010	0.0010	6.35	1.0	8,670
30	0.0010	0.0010	8.41	1.0	11,620
33	0.0010	0.0010	10.84	1.0	15,150
36	0.0010	0.0010	13.67	1.0	19,300

* The minimum slope on collectors serving less than 6 ESDs is 0.007.

202.1.6 HYDRAULIC JUMPS

Hydraulic jumps are prohibited.

202.2 DEPTH

Collector main lines with lower laterals must not exceed a depth of 19 feet at the invert. The collector main lines must be deep enough to provide a 2% minimum slope for the lateral. The

collectors must also be deep enough to allow the building sewer to be at least 12 inches deep at all buildable locations within the properties to be served. The proposed building floor pad elevations must be a minimum of 0.1-foot above the lowest upstream node rim. Where the pad elevations are not 0.1 foot above the lowest upstream node rim, a backwater prevention valve must be noted on the project-specific plans and building plans. Install backwater prevention valves during the construction of the public underground projects.

All collectors and trunks located within traffic areas must have a minimum cover of 5 feet from the crown of the pipe to the finish grade. The minimum depth of cover for all other pipelines is 4 feet from the crown of the pipe to the finish grade.

202.3 MATERIALS

Unless approved by SacSewer, use VCP for gravity pipelines. When groundwater is known or expected to exist within the pipe zone, SacSewer may allow the use of HDPE, PVC C900, PVC C905, or SDR 26. For lower laterals, please refer to Section 202.11.5, "Materials" of these Standards.

Use standard bell and spigot pipe or butt fusion for connecting pipes. Use flexible connections to accommodate ground settling (e.g., pipe connections outside manholes and wet wells and pipe connections outside of casings). These connections consist of a series of pipe lengths sequenced as a 1-foot pipe segment that is placed outside of the point of settlement followed by a 2-foot length at which point the standard pipe lengths are to be used.

202.4 GROUNDWATER REQUIREMENTS

202.4.1 TRENCH DAMS

Install trench dams whenever the known or expected groundwater elevation is higher than the invert of the main line, or groundwater is encountered during construction, and spaced in accordance with the recommendation of the geotechnical report, or as follows:

- Construct a trench dam at a minimum of one location at approximately the midpoint of each main line segment.
- Construct a trench dam next to every flusher branch located at the end of a main line to enable tying into and continuing construction of that main line in the future.

202.4.2 DEWATERING

When groundwater is known or expected to exist and is anticipated to be encountered during construction, the design engineer must include information necessary to provide the equipment necessary to construct the facilities shown on the plans.

Dewatering for installing structures and pipelines must start when groundwater is first encountered and will continue until the excavation is backfilled.

Dispose of water from dewatering operations as required by the jurisdictional agency and in accordance with the latest edition of the SWPPP.

202.4.3 TRENCH FOUNDATION

If groundwater is expected to be encountered during construction, make provisions in the design and project-specific specifications to ensure that the trench foundation has been adequately dewatered, over-excavated, and re-compacted with the appropriate material needed to provide a firm foundation to lay the pipe and to construct the manholes.

The geotechnical report will make recommendations that will be followed for the design and through the construction. A Geotechnical Engineer is required to verify that the trench foundation is suitable during construction.

202.4.4 LIME, CEMENT, OR OTHER SOIL TREATMENT

The Geotechnical Engineer will make any recommendations if the soil and groundwater conditions require the use of lime, cement, or other soil to provide adequate foundation stability or backfill. SacSewer will not pay for lime, cement, or other soil treatment to expedite the construction of a project on a reimbursable project. SacSewer recommends that the schedule allow for drying and conditioning of wet native material before its use in the backfill unless a less costly method or material is available for backfill. The jurisdictional agency must approve the use of lime, cement, or other soil outside of the pipe zone (1 foot above the crown of the pipe) on all projects.

202.5 TRENCH LOADING CONDITIONS AND PIPELINE DESIGN

202.5.1 VCP CONDUIT LOADING

On VCP conduits, use Marston's equation to determine the load placed on the pipe by backfill. The procedure for rigid pipe is described in the latest edition of the *Vitrified Clay Pipe Engineering Manual*, *ASCE Manual, and Report of Engineering Practice No. 60* and similar handbooks. In the absence of specific soil mechanics data, as determined by a

Geotechnical Engineer, use a soil weight of 130 pounds per cubic foot and a Ku factor of 0.110. Minimum strength requirements for VCP must be as specified in accordance with *ASTM C700* for extra strength VCP.

202.5.2 Safety Factor

On VCP conduits, use a safety factor of 1.25. Only use the three edge-bearing strength of the pipe in the computations for rigid pipe.

202.5.3 Maximum Trench Width for Clay Pipe

Calculate the maximum trench width for VCP using the Marston Equation and design parameters found in these Standards and the Vitrified Clay Pipe Engineering Manual. For all conditions where the geotechnical report determines a maximum trench width less than the transition width, submit the calculations with the plans for review. Show trench width tables on the plans to identify the sections of pipe that have critical trench widths. Include a note on the plans that Type III bedding is required in areas that exceed the maximum trench width.

202.5.4 Flexible Conduit Loading

On flexible conduits, use Marston's formula for flexible conduits as shown in the *ASCE Manual and Report of Engineering Practice No. 60* and in other similar handbooks to determine the load placed on the pipe by the backfill. Determine the maximum load allowable by pipe deflections computed by the Iowa Deflection Formula (or Spangler's Formula).

Estimate the Modulus Soil Reaction E' using a method acceptable to SacSewer and consider the modulus values of both the native and the bedding materials (Abwassertechnischen Vereinigung [ATV] method). The bedding Modulus Soil Reaction E' used in the deflection calculation must be 1,000 psi for Type II bedding, utilizing imported material to 12 inches above the top of the pipe.

Use a deflection lag factor of 1.5. In the absence of specific soil data, as determined by a Geotechnical Engineer, use a soil weight of 130 pounds per cubic foot, a Ku factor of 0.110, and a bedding constant of 0.110. Placement of flexible conduit within soils equivalent to Class V and Types MH and CH of Class IV *ASTM D2321* material will not be permitted.

202.5.5 Allowable Deflection

On flexible conduits, the maximum allowable deflection is 3%. Measure deflection as prescribed by industry standards, using the actual pipe inside diameter. Submit calculations showing the deflection and ability of the conduit to withstand local buckling.

202.6 Bedding and Initial Backfill

Bedding and initial backfill type are determined by the height of cover over the pipeline, trench width, pipe strength, and other factors used to determine safe pipe loading. Give special attention to backfill requirements for pipes located in state ROWs and for pipelines placed in areas where trench width is excessive, such as in the vicinity of bore pits. Note special backfill requirements on the project-specific plans and specified in the project-specific specifications.

202.6.1 Type

Bedding and initial backfill for all non-pressure pipe sizes is Type II or III. The minimum trench width for all rigid collector main lines is pipe OD plus 12 inches. The minimum trench width for rigid trunk main lines must is OD plus 18 inches.

Type III bedding, concrete encasement, or designed bedding is required if the calculated maximum trench width does not provide a minimum 1.25 safety factor based on the minimum trench width for collector main lines or trunk sewer as determined above. If bedding other than Type II is used, document the type of bedding in the record drawings.

202.6.2 Bedding and Initial Backfill

Graded sand must be compacted to at least 90 percent relative compaction and placed 12 inches above the top of the pipeline. The minimum trench width for a flexible pipeline must be equal to OD plus 12 inches for pipes 6-inch diameter and smaller and OD plus 24 inches for pipes larger than 6-inch diameter. Please refer to Section 502, Drawing P-01, for additional requirements.. Alternatively, the manufacturer's recommendations for pipe bedding may be submitted with the plans for consideration and approval. If allowed, it must be noted appropriately on the plans. The plans must contain a detail or trench width table addressing this design parameter.

202.7 Cathodic Protection

The geotechnical report must provide a corrosivity analysis for all metallic structures (e.g., steel casing and DIP) along the alignment of the pipeline and make recommendations for the design of the cathodic protection system. Cathodic protection systems must be designed by a

NACE certified Cathodic Protection Specialist or licensed Corrosion Engineer. The cathodic protection system must be such that the anode bed can sustain protection for a minimum of 50 years. Include a corrosion protection study with the plan and specification submittals for all DIP and all steel facilities being constructed. SacSewer will consider special coatings on a case-by-case basis.

202.8 MANHOLE CRITERIA

Please refer to SacSewer's website at www.sacsewer.com for a list of *SacSewer's Approved Manhole Manufacturers*.

202.8.1 GENERAL

Manholes are required to comply with *ASTM C478*. Place manholes at all the following locations:

- Intersections of all main lines
- At all changes in main line size
- At all changes in main line slope
- At the end of all main lines terminating with a cul-de-sac having five or more fronting lots
- At the end of all permanent main lines 120 feet or more in length
- At the end of temporary main lines more than 200 feet in length

Saddle manholes are not permitted for collector lines.

Collector main lines must connect to trunk main lines at a manhole. Locate manholes to reduce or eliminate the need to curve collector main lines. Place manholes in the center of the drive lane whenever possible.

202.8.2 INSPECTION OF EXISTING MANHOLES

Unauthorized personnel are not permitted to remove existing SacSewer manhole covers because potentially dangerous, lethal, and poisonous gases may be present. If access to an existing SacSewer manhole is necessary for design or construction purposes, submit an Access Permit package to SacSewer for review and approval. Please refer to SacSewer's website at www.sacsewer.com for an Access Permit form and procedure for submittal.

202.8.3 LOCATION

SacSewer does not allow manholes in street intersections larger than residential (typically with a pavement width exceeding 36 feet, please refer to Section 502, Drawing MH-01 of these Standards). For these intersections, locate the manholes outside the intersection in a configuration that allows maintenance to be performed by blocking only one lane of traffic at a time. Do not locate manholes within crosswalks or other alignments designated for pedestrian travel. Do not locate manholes in areas designated for on-street parking.

Do not locate manholes in medians or near raised concrete structures. Maintain a minimum clearance of 1 foot from the edge of the manhole lid to all existing and proposed medians and concrete structures.

202.8.4 SPACING

Maximum manhole spacing is 400 feet for all straight collector main lines and 500 feet for trunk main lines. A collector main line with a radius greater than 400 feet will be considered as straight for purposes of this section. Manhole spacing on main lines on a continuous curve of 191-foot radius (minimum allowable) will be 200 feet. Manhole spacing on curved main lines of radius between 191 and 400 feet, or where only a portion of the main line is curved, will be adjusted proportionately.

Manholes are required at the beginning or at the end of horizontal curves. Reverse curves require a manhole at the point of tangency between the curves. A manhole is required at all changes in vertical alignment. Place a manhole at all abrupt changes in horizontal alignment and at all changes in main line material.

202.8.5 SIZE CRITERIA

For pipes up to 21 inches in diameter, use 48-inch (inside diameter) precast reinforced concrete manholes. When pipe sizes 18 inches and larger enter a manhole such that the flow of one must change direction by more than 20 degrees, use a 60-inch or larger manhole. The designer must confirm the manhole base can be constructed by any of *SacSewer's Approved Pre-Cast Manhole Manufacturers*.

When three or more 12-inch and larger pipes intersect at a manhole base, use a 60-inch or larger manhole. The designer must confirm the manhole base can be constructed by any of *SacSewer's Approved Pre-Cast Manhole Manufacturers*.

202.8.6 Elevation Criteria

Standard flow-through drops in manholes are as follows:

- When two pipelines of the same size enter a manhole such that the flow does not change directions or changes 20 degrees or less, the invert grade at the exit must be at least 0.05-foot below that of the entrance pipe for precast manhole bases.
- When two pipelines of the same size enter a manhole such that the flow of one must change direction more than 20 degrees or if flow in a single pipeline must change direction more than that amount, the invert grade at the exit must be at least 0.10-foot below that of the entrance pipe for precast manhole bases.
- If the pipes entering and exiting a manhole are not the same size, match the pipes crown to crown. If the exit pipe is trunk sized, typically 12-inch and larger in diameter, the pipe invert of the incoming collector pipe must match the crown elevation of the exiting pipe. The above elevation requirements do not govern drop connections.

202.8.7 Elevation Criteria for Lower Laterals

Install lower laterals entering a manhole with the invert elevation of the lower lateral pipe matching the crown elevation of the exit pipe, except when an internal drop connection is used. For manholes, at the end of a cul-de-sac or end of a line with no extension, the invert of any lower lateral must be a minimum of 1 inch above the invert elevation of the exit pipe with an individual smooth transition channel.

202.8.8 Construction Requirements

Within easements and areas that are subject to flooding, use lock-type or pressure-type manhole as follows:

- Use bolt-down type frames and covers with $^1/_4$ inch O-ring secured with adhesive on manholes located in areas subject to flooding.
- Use locking type frame and cover in accordance with Section 502, Manhole Plans series of these Standards, on manholes located in unimproved easement areas.
- Set the manhole cover flush with the final grade of the paved road or access road. There must be a 24-hour, all-weather access road to all manholes and appurtenances. The area adjacent to the manhole must drain away from the manhole.
- Within improved streets, if the distance from the crown of the pipe to the top of the rim is less than 6 feet I inches, use a minimum 18 inch cone.

- Within improved streets, use concentric 36-inch diameter flat slab tops for manholes that have through pipelines and less than 5 feet 8 inches from the crown of the pipe to the rim.
- Manholes must be such that flexing of the pipe does not result in infiltration or exfiltration at the interface between manhole and pipe. Use and install integrally cast bells, so the joints do not exceed 75% of the manufacturer's recommended maximum deflection. Special design consideration is required in locations where groundwater elevation is expected to be higher than the pipe invert.

202.8.9 Exterior Walls

SacSewer requires a coal tar emulsion-waterproofing agent to be applied to the exterior walls of vaults, wet wells, and manholes when groundwater within the pipe zone is identified. Apply no less than two coats of coal tar emulsion for a DFT of 25 to 35 mils.

202.8.10 Connections to the Interceptor System

Regional San must review and approve plans that require a connection to a Regional San system. If required by Regional San, add a signature block for Regional San approval to the plan title sheet. A note must specify that an access permit form must be submitted to Regional San staff at least 14 working days in advance of the start of intended construction or as otherwise required by Regional San. This requirement is necessary to allow for the special inspection procedures that will apply to such construction. Connection to the Regional San interceptor system must be as illustrated in Section 502, Drawing P-03 of these Standards. The first manhole from the interceptor must be Armorock or approved equal.

202.9 Drop Connection Criteria

Use an inside drop connection for collector and lower lateral inlets from 4 to 10 inches in diameter. If an elevation difference as measured from the invert into the spring line out of at least 3 feet is not available, increase the slope of the incoming pipeline to eliminate the need for the drop.

Only two inside drop connections are allowed into a 48-inch diameter manhole. Drop connections on 10-inch inlet pipes may require a 60-inch diameter manhole or larger as recommended by a precast manhole manufacturer. Drop connections on inlet pipe sizes larger than 12 inches must be designed on a case-by-case basis and approved by SacSewer. If approved, install these larger drop connections in a 60-inch diameter manhole or larger as recommended by the precast manhole manufacturer.

The maximum change in flow direction must not exceed 100 degrees.

202.10 Flusher Branch Criteria

A flusher branch may be used in lieu of a manhole at the end of collectors less than 120 feet in length. A flusher branch may be used at the end of a collector less than 200 feet in length if the collector extends to a subdivision boundary and there are definite plans for its extension. Do not cap main lines. Flusher branches must conform to Section 502, Drawing MH-02A or MH-02B of these Standards.

Do not connect lower laterals to flusher branches.

202.11 Lower Lateral Design

202.11.1 General

Install an SacSewer cleanout with a sewer relief valve for all lower laterals. Supply a plan of any lateral to SacSewer upon request.

Use factory-type Y connections from the lateral to the main line at all connections.

202.11.2 Size Criteria

Lower laterals serving single-family dwelling residential properties are required to be a minimum of 4-inch diameter. Lower laterals serving multi-family and commercial properties are required to be a minimum of 6-inch diameter. Lower laterals larger than 6-inch diameter may be required to serve schools and other developments expected to contribute high sewage flows.

In addition, lower laterals must not be smaller than the upper lateral that should be sized according to requirements of the *California Plumbing Code* and the determination of the design engineer. If the lower lateral and collector are the same size, construct a manhole at the connection. If the collector is larger than the lower lateral, a factory wye fitting at the connection is satisfactory. Lower lateral connections to trunk main lines are only allowed at a manhole.

202.11.3 Connections to Existing SacSewer's System

Upon sewer impact permit issuance and receipt of required fees, SacSewer staff will construct lower lateral tap connections from individual residential lots and from commercial, multi-family residential, and industrial developments to existing SacSewer's operated and maintained main lines and manholes. Sewer tap construction fees are

provided in the *SacSewer Sewer Ordinance*. The developer or owner is responsible for all connection costs.

The developer's or owner's contractor will perform all excavation, shoring, backfill, and installation of the remainder of the lower lateral and upper lateral. Place a note to this effect on all plan sheets that indicate a connection to the existing system.

202.11.4 CONNECTION LIMITATIONS

Lower laterals must not directly connect to trunk main lines (1 mgd flow and greater), main lines designed to flow full, or to main lines more than 19 feet deep.

Provide a separate and independent lateral for every lot, building, and structure. Two or more buildings located on the same parcel may share a single lower lateral connection. A separate lower lateral is required for a lot/parcel split.

A secondary suite, ancillary dwelling, or additional separate dwelling unit on a property that would normally accommodate only one dwelling unit may be connected through the primary residence.

No more than five 4-inch lower lateral connections into a single 48-inch diameter precast manhole base are allowed.

202.11.5 MATERIALS

The lower lateral pipe must be one of the following materials: VCP, ABS Schedule 40 solid pipe (cellular or foam core is not allowed), HDPE DR 17, PVC C900, and SDR 26. Pipe fittings must be made of the same material as the lateral pipe when possible. See Section 202.3. "Materials" for specific information regarding allowable pipe material for gravity pipelines. Please refer to Section 202.11.7, "Depth" of these Standards for special material requirements based on the depth.

202.11.6 LOCATION

Please note that the back of the sidewalk does not determine the location or existence of the ROW. Not all roadways have a PUE or dedicated easement outside the ROW. Contact SacSewer at 916-876-PLAN ((916)-876-7526) or SacSewer Plan Check if there is any question about the location of the ROW, PUE, or dedicated easement. SacSewer's facilities cannot be located outside a ROW, PUE, or dedicated sewer easement.

New Lower Laterals

If a property can be served from either an easement or a ROW, design the service from the ROW. Consider trees, driveways, and other improvements to minimize conflicts when the upper laterals are extended to serve the property.

Do not locate lower laterals in front of driveways unless no alternative exists. Do not locate lower laterals within 5 feet of water meters or water services measured from center to center. Avoid locating the lower lateral within 10 feet of trees or shrubs that are or will be 5 feet and higher at maturity or within 10 feet of utility poles and light standards. Place lower laterals on the low side of all parcels with a slope of 2% or greater to the main line.

Do not locate laterals where health standards would be violated.

Show a lower lateral to each lot perpendicular to the main line. Design the lower lateral extending from the main line to an SacSewer cleanout at the inside edge of the public ROW if there is no PUE or within three feet outside of the public ROW if a PUE exists. Extend the upper lateral to within 1 foot of grade and cap to prevent material or water from entering the sewer system. Indicate the end of the constructed upper lateral at grade with a 4 inches x 4 inches pressure treated stake. Please refer to Section 502, Drawing LL-01A of these Standards.

On private roads, extend lower laterals 1 foot outside the edge of the pavement to an SacSewer cleanout where the PUE or dedicated easement extends.

Existing Lower Laterals

Show SacSewer's cleanout a maximum of 3 feet from the back of ROW when there is a PUE or dedicated easement outside the ROW in accordance with Section 502, Drawing LL-02 of these Standards. Show SacSewer's cleanout at the ROW if no PUE or dedicated easement exists outside the ROW.

When the main line is located in a PUE or dedicated easement (no ROW), show SacSewer's cleanout inside the PUE or dedicated easement boundaries. Obtain easements of adequate width to accommodate the maintenance and repair of the lower lateral.

202.11.7 DEPTH

The design engineer must verify the adequacy of the upper lateral depth at SacSewer's cleanout. A depth of 4 to 5 feet to the crown of pipe, measured from the existing ground surface or edge of the adjacent roadway, whatever is lower, will be considered normal upper lateral depth at the easement or ROW.

Whenever greater depth is required, the design engineer must label the invert elevation of the lower lateral at SacSewer's cleanout. If the lower lateral has less than 3 feet of cover, use HDPE DR 17, PVC C900, or PVC SDR 26, conforming to *ASTM D3034*.

At locations where gravity service is impossible or impractical, the design engineer must clearly indicate the parcels that will require a privately owned and maintained pump station on the plans.

The design engineer must coordinate the grade of laterals with utilities, including utilities located in a joint trench. If using a joint trench, the design engineer must show it on the plans. Sewer main lines must not be located in a joint trench.

202.11.8 Slope

The upper lateral slope must be in accordance with the *California Plumbing Code*. The 4-inch lower laterals must have a 2% slope. When there are less than 4 feet of cover for the lower lateral, a 1% slope may be used with SacSewer's approval. Lateral slopes for 6 inches and larger conveying high flow as determined by SacSewer may have engineered slopes with a minimum velocity of 2 feet per second with the pipe flowing full or half-full.

202.11.9 Regulations and Fees

For regulations and fees regarding the installation of an individual lower lateral, please refer to the *SacSewer Sewer Ordinance* or contact the Development Services Permit Services Unit at (916) 876-6100 or SacSewer Permit Services.

202.11.10 Special Requirements in Developed Areas

In developed areas, provide a lower lateral to each parcel participating in the project and having a property line less than 200 feet from a collector main line. A property owner's request for a service location will be honored whenever practicable. Parcels that have two or more sources of wastewater may have independent laterals provided to each wastewater source that can be separated from the rest of the parcel and sold. Provide a lower lateral to each subdivision lot or lot similar as to size and development possibilities.

202.11.11 Crossing Culvert Pipe

Laterals must have 12 inches vertical clearance minimum below all culverts unless otherwise approved by SacSewer and the drainage agency. The design engineer must check all culvert crossings with the appropriate governing agency to determine if future changes in culvert size or location are anticipated. SacSewer may require encasement within a steel pipe.

202.11.12 Sewer Relief Valves

Install sewer relief valves on all SacSewer's cleanouts. Please refer to Section 502, Drawing LL-02 of these Standards.

202.11.13 Backflow Prevention Valves

Install backflow prevention valves on all upper laterals serving a structure that has a finished floor elevation of less than 0.1-foot above the rim elevation of the next upstream, unsealed node from the lateral tap. Install the backflow valve in accordance with Section 502, Drawing LL-03 of these Standards. Backflow valve operation and maintenance is the sole responsibility of the property owner.

202.12 Waterway Crossing Design

Before starting a waterway crossing design, approval from SacSewer and other appropriate agencies is necessary. SacSewer will only allow waterway crossings if there is not another feasible design option.

202.12.1 General

In all cases, use the proposed future waterway bed elevation for design purposes. Consider the geomorphology of the area to determine the future flowline of the waterway. Show crossing details (e.g., pipe, piers, anchorage, and transition couplings) on a detail sheet of the plans in large scale. For buried crossings, the top of the pipe must maintain a minimum of 3 feet of cover below the scour depth. Aerial crossings are exempt from the depth of cover requirements.

202.12.2 Design

Submit calculations that clearly indicate the design of the pipe and supports regarding but not limited to impact, horizontal and vertical forces, overturning, pier and anchorage reactions, scour, widening, and incising. Provide sufficient depth in all areas subject to erosion to ensure protection from damage due to erosion and scour. Design all above-ground waterway crossing supports to accepted engineering standards. Design must minimize impacts to the waterway.

202.12.3 Buried Waterway Crossings

Encase all buried waterway crossings within an SacSewer-approved conductor casing for the full width of a waterway (top-of-bank to top-of-bank), plus 10 feet on each side.

Provide a firm base for the pipe casing bedding. The plans must specify that all soft and organic material within the waterway banks must be replaced with select imported backfill. Encase the conductor casing pipe in concrete or soil cement if necessary to protect the pipe for the full width of the waterway. The casing and end seal must meet Section 502, Drawing P-04 of these Standards. A clay trench plug is required at each end of the crossing. The plug must be a minimum of 4 feet long, extend the full width of the trench, and extend 12 inches above and below the pipe. The conductor casing must meet the requirements outlined in Section 202.13.2, "Conductor Casing," of these Standards.

202.12.4 Aerial Waterway Crossings

The following are requirements for constructing aerial waterway crossings:

- VCP carrier pipe within an approved coated welded steel conductor casing pipe extending the full width of a waterway (top-of-bank to top-of-bank) plus 10 feet on each side, or
- DIP or welded steel pipe with an approved coating (no encasement required) extending the full width of a waterway (top-of-bank to top-of-bank), plus 10 feet on each side.

If using the VCP option, conductor casing must meet the requirements outlined in Section 202.13.2, "Conductor Casing" of these Standards.

Steel pipe must be lined and coated with fusion-bonded epoxy or approved equal. SacSewer must approve the type and DFT of coating and lining specified and the gauge, class, or thickness of the casing and/or carrier pipe. SacSewer may specify which method is required.

The crossing must be perpendicular to the flow of the waterway. Make provisions to prevent pedestrian traffic from traveling along the top of the aerial waterway crossing. The invert elevation at the point of maximum deflection of the suspended pipe must be higher than the invert of the pipe at its downstream support.

202.12.5 Permits

The developer's or owner's contractor must be in possession of all necessary local, regional, State, and Federal regulatory agency permits before constructing all waterway crossings. SacSewer will not approve construction plans incorporating a waterway crossing until copies of the permits have been provided.

202.12.6 Drainage Basins and Swales

Do not locate sewer main lines within a drainage basin or drainage swale. The horizontal distance between the main line and the top of the bank must be sufficient to maintain the integrity of the drainage swale or basin and provide access for maintenance of the sewer collection system.

202.13 Trenchless Design

All SacSewer's requirements apply equally to the inspection, testing, and acceptance of all pipelines installed, without regard to the use of trenchless technology.

All trenchless projects plans and specifications must contain all the following information:

- Settlement instrumentation and monitoring requirements
- Allowable settlement guidelines
- Geotechnical baseline and data reports

202.13.1 Trenchless Options

SacSewer will consider all the following methods for trenchless construction with prior approval:

- Microtunneling
- Pilot tube
- Auger bore and jack

Trenchless options must be based on:

- ASCE 36, *Standard Construction Guidelines for Microtunneling* (latest edition)
- AASHTO *Highway Drainage Guidelines*, Volume XIV (latest edition)
- Highway Practice 242 – *Trenchless Installation of Conduits beneath Roadways* by the National Cooperative Highway Research Program.

Pilot tube operations may not be suitable in all soil conditions, particularly in soils other than stiff clays containing cobbles or boulders, having a standard penetration blow count greater than 50 per foot, or in areas where the groundwater table is above the flow line of the pipe being installed.

Do not use auger bore and jack in areas of loose soils or in areas where groundwater is less than 3 feet below the equipment.

202.13.2 Conductor Casing

The casing must be long enough to facilitate the maintenance and operation of the carrier pipe. Use a large enough casing to allow dry sand to be blown into the void between the carrier and the conductor and to adjust the carrier pipe to grade.

A minimum inside diameter of 6 inches or greater than the outside diameter of the couplings or bells, whatever is greater, of the carrier pipe is required. Welded steel conductor casing pipe must have a minimum wall thickness of $^{1}/_{2}$ inch for sizes less than and including 24 inches in diameter and $^{5}/_{16}$ inch for sizes equal to and greater than 27 inches in diameter. Terminate all casings at least 10 feet from the outside edge of the manhole wall to allow for excavation and access to the casing if necessary. Steel casing may require cathodic protection as determined by SacSewer. Please refer to Section 309.5, "Conductor Pipe," of these Standards for casing material.

202.13.3 Auger Bore and Jack

Auger bore and jack of the portion of main lines and lower laterals, that pass beneath curbs and gutter, sidewalks, and other obstructions, is permissible where approved by SacSewer.

202.14 Sewer Systems for Multiple Buildings and Parcels

The following design requirements apply to the portion of the sewer collection system within a privately owned multiple ownership development that is onsite and is not an outfall sewer for an upstream area, thereby being considered a private system and not subject to SacSewer's maintenance. These developments require execution of a Private Sewer Maintenance Agreement in accordance with the *SacSewer Sewer Ordinance*.

202.14.1 General

Private sewer collection systems within a privately owned multiple ownership development must meet all requirements for public sewers contained in these Standards, except as specified below:

- Onsite project plans may be prepared without the sewer collection system profile that is required by these Standards. However, the final onsite finished grades and drainage facilities must be shown on the plans on the same sheet as the plan view of the sewer collection system.

- Show pipe dimensions adjacent to the corresponding pipe section.
- The use of tables must not be used alone for pipe dimensioning purposes.

202.14.2 Residential Occupancies with Common Walls

Residential occupancies with common walls such as single-family units with common walls or floors, condominiums, stock cooperatives, community apartments, or similar improvements may have an onsite sewer collection system. Construct this private system in accordance with the *California Plumbing Code*. These plans will require SacSewer's approval in addition to the standard approvals required by the jurisdictional agency.

202.14.3 Multiple Buildings under Common Ownership

The onsite sewer collection system for all developments containing more than one structure must be in accordance with these Standards for public sewer. Each separate building within a multiple building development must have a separate connection to SacSewer's sewer collection system with a separate lower lateral serving only that building. The exceptions to this are:

- Multiple buildings under common ownership: One or more buildings located on one parcel of real property, owned by the same person, may be serviced by the same lower lateral if the jurisdiction is unlikely to approve separate ownership or division of the parcel in the future. If for any reason the ownership of the parcel is subsequently divided, each building under separate ownership must be provided a separate lower lateral before final map recordation.
- Residential occupancies with common walls: The following structures may be served by a common lower lateral: single-family dwelling units with common walls, condominiums, stock cooperatives, community apartments, or other improvements entitling owners of interest to occupy independent ownership interests and make joint use of utility and other services provided by facilities owned in common.

Install main lines within a dedicated public sewer easement in accordance with these Standards.

203 Main Lines

203.1 General

Place all main lines within the public road ROW when possible. The design engineer must satisfactorily demonstrate that placing the main line within a road ROW is not possible before locating a main line within an easement that is dedicated to and in a form approved by

SacSewer. Please refer to Section 201.4, "Easements" of these Standards. Do not locate any manhole or other access structure in an area where access would be restricted. Do not place sewer main lines in any joint trench with other utilities.

The design engineer must consider connections for future development when locating nodes in new main lines.

203.2 ALIGNMENT

203.2.1 HORIZONTAL ALIGNMENT

Main lines must be parallel or perpendicular to the street centerline wherever possible. The minimum radius for VCP main lines 8 to 12 inches in diameter must be 191 feet using 6-foot sections of pipe. Use a larger radius wherever practicable or where necessary to avoid joint deflection in excess of 75% of the pipe manufacturer's recommended maximum. For other pipe materials and VCP with diameters larger than 12 inches, avoid joint deflection in excess of 75% of the pipe manufacturer's recommended maximum. Only factory joints are allowed.

203.2.2 VERTICAL ALIGNMENT

Pipe segments must provide a constant slope between nodes.

203.3 LOCATION

203.3.1 MINOR AND PRIMARY STREETS

Generally, locate main lines 6 feet south or east of street centerlines. If a street loops 180 degrees or more, the main line does not need to cross to the other side of the street to meet this requirement.

203.3.2 LARGE STREETS

In streets with more than one lane of traffic in each direction, generally, locate main lines in the center of the first drive lane south or east of street centerlines.

203.3.3 DUAL MAIN LINES

If dual main lines are necessary, locate dual main lines centered in the first drive lane of the street centerline and the adjacent outside lane. Dual main lines may be needed to accommodate lateral connections where the main line in the first lane exceeds an invert

depth of 19 feet or is a trunk, to address utility conflicts and to avoid laterals crossing large streets to connect fronting parcels.

203.3.4 EXISTING STREETS

When installing in an existing street, consider factors such as curbs, gutters, sidewalks, traffic conditions, traffic lane conditions, pavement conditions, future street improvement plans, and existing utilities must all be considered. Obtain approval of all appropriate jurisdictional agency entities and SacSewer in every instance. Alignment must be parallel to the street centerline wherever possible.

203.3.5 RELOCATED MAIN LINES

Main lines installed to replace existing facilities in improved areas must generally follow existing alignments but may be realigned as necessary to achieve optimum flow conditions, reasonable access, and separation from existing utilities. Where possible, relocate existing main lines and lower laterals in easements to nearby streets. In general, make every effort to avoid the need to pump to provide sewer service on either relocated main lines or impacted lower laterals. If an adjacent main line is located in an open space, relocate the main line within the limits of the project where possible.

203.3.6 PROHIBITED LOCATIONS

Construction of main lines is prohibited in the following locations:

- Within 100-year flood areas
- Within wetlands
- ROW of major highways, freeways, or waterways (perpendicular crossings only).
- Railroad ROW, unless appropriate license, easement, or permit is acquired
- Areas inaccessible to SacSewer's vehicles and equipment
- Within 10 feet of any buildings or structures

203.3.7 SEPARATION DISTANCE FROM WATER MAINS

Main lines must meet the State of California, Department of Public Health, *California Regulations Related to Drinking Water*, and Title 22 of the California Code of Regulation, Section 64572, "Water Main Separation" requirements.

Locate potable water, reclaimed water, and sewer main lines at different depths below the ground surface in order of descending water quality. There must be a minimum vertical separation of 1 foot between the top and bottom surfaces of the pipes in the same street.

If the State of California Department of Public Health approves a separation of less than 12 inches, a Styrofoam block must be used as a cushion between the two pipes.

203.3.8 WATER WELL CLEARANCE

Do not place a public sewer collection system closer than 100 feet to water wells unless the well has been fully abandoned in accordance with the County of Sacramento Environmental Management Department standards or if the location of the sewer collection system is approved in writing by the appropriate health agencies. If clearance of less than 100 feet is approved, all pipes within that distance from the well must be of material approved by the District Engineer. At a minimum, a casing is required if the public sewer collection system is less than 50 feet from a water well.

203.3.9 CROSSINGS

SacSewer reserves the right to require redundancy in the sewer collection system where bypass pumping is precluded for a main line failure or stoppage. Examples include railroad and freeway crossings.

Utility Crossings

Alignment of all main lines and structures must provide a minimum of 12 inches of vertical clearance from all other utilities and improvements. At a minimum, install a Styrofoam block at all utility crossings with a vertical separation of 12 inches and less. The main line must be encased in areas where the main line will be crossing under a railroad.

Critical Crossings

At SacSewer's discretion, provide a casing with an empty carrier pipe with a capacity equal to or greater than the original pipe and parallel to the main line and the nodes on both sides of the obstruction. Encase the main line in areas where it crosses under a railroad.

203.3.10 DRAINAGE SWALES

Do not locate public sewer main lines within a drainage swale. The horizontal distance between the sewer main line and the top of the bank must be sufficient to maintain the integrity of the drainage swale and provide access for maintenance of the sewer collection system.

203.4 ACCESS ROADS

Provide access to each manhole (including CARV manholes) and flusher branch not located within public ROWs by 24-hour, all-weather access roads so that all main lines and manholes are accessible for SacSewer's maintenance and cleaning equipment (use H-20 loading). At a minimum, this all-weather access road must consist of 2 inches of asphalt concrete surface over 6 inches of compacted aggregate base across a minimum 12-foot wide drivable surface. Other all-weather surfacing may be used in place of asphalt concrete with SacSewer's approval. In situations where the main line is in a designated future roadway, and the access road is a temporary facility, the temporary access road may consist of 12 inches of compacted aggregate base placed over the geotechnical fabric.

Permanent easements will be required for all maintenance access roads and turnaround spaces. As illustrated in Section 502, Drawing P-07 of these Standards, the hammerhead turnaround and right turn maintenance access road detail will be reversed and used for left turn vehicular movements. Construct hammerhead or intermediate turnaround spaces at the end of all access roads exceeding 120 feet in length and at intermediate locations as determined by SacSewer.

The maximum access road grade must not exceed 10% and must be shown in the profile view. The access road must not block natural or artificial drainage and must conform to the requirements of the governing agencies.

Construct access roads to all SacSewer's cleanouts located in unimproved areas and other inaccessible locations as determined by SacSewer.

Access to the manholes requires turning radii of 30 feet inside and 55 feet outside and a vertical clearance of 14 feet. Rim elevations of all manholes located within the access road must be equal to the elevation of the surface of the access road.

204 PRESSURIZED COLLECTION SYSTEM

Design pressurized pipelines as flowing full and with no point located above the energy grade line.

204.1 PIPE MATERIALS

Pressurized pipelines (e.g., force mains) must be pressure-rated DIP, HDPE, or approved equal.

Pressurized pipelines within wet wells must be coated and lined DIP. Please refer to Section 308.19 "Ductile Iron Pipe and Ductile Iron Fittings" of these Standards for coating specifications.

For DIP pressurized pipelines outside of wet wells, please refer to Section 308.19 "Ductile Iron Pipe and Ductile Iron Fittings." of these Standards. Please refer to Section 308.20, "High-Density Polyethylene Pipe," of these Standards for HDPE pressurized pipelines outside of wet wells.

204.2 SIZE AND VELOCITY

Size force mains to produce a fluid velocity of no less than 3 feet per second and no more than 6 feet per second. Consider the potential for expansion of the collection system and pump station(s) when sizing pressurized collection systems.

204.3 HYDRAULIC C FACTOR

For determining the head loss, use the Hazen-Williams equation using a C factor of 130.

204.4 OPERATING AND SURGE ANALYSIS REPORT

Perform and submit an operating and surge analysis report with the design report, as required by SacSewer. At a minimum, include the following in the surge analysis report:

- Narrative description of any potential hydraulic transients. Assumptions made for transient analysis, including program input/output tables, graphs, figures, etc., as necessary
- Modulus of elasticity of the pipe material
- Normal operating pressure along the entire system (from the pump to force main discharge)
- Water hammer for normal operation and sudden pump failure or power outage
- Effects of water hammer and other pressure spikes on the entire system
- Effects of cyclic loading
- Analysis of the entire pipeline profile to determine the possibility of the water column separation
- Recommended type and location of surge control measures (e.g., check valves/gate valves, CARVs, etc.)Surge Analysis Report must be signed and sealed by a registered professional engineer

Use a safety factor of 1.5 when designing all pressurized system components with regard to withstanding system pressure.

204.5 HORIZONTAL LOCATION

Locate pressurized systems within the public ROW or in an appropriate easement and parallel to curbs, street centerlines, property lines, or easement lines. Dual force mains must be separated from each other by a minimum of 12 inches as measured from the outside of the pipes. Provide appropriate clearances between other utilities as specified by the governing agencies. Please refer to Section 204.9, "Separation Distance From Utilities," of these Standards.

204.6 PROFILE

The pressurized pipeline must have a minimum depth cover of 4 feet as measured from the final grade to the crown of the pipe. Whenever feasible, a continuous upward slope from the pump station(s) to the discharge point is required.

Install CARVs in accordance with the surge analysis report unless otherwise directed by SacSewer.

204.7 DUCTILE IRON PIPE LOADING

The design of DIP must be in accordance with the *AWWA C150*.

204.8 BEDDING AND INITIAL BACKFILL

For pressurized pipelines, bedding and initial backfill must be graded sand meeting the requirements of Section 50-13.02, "Graded Sand" in the *County Specifications*, latest edition.

204.9 SEPARATION DISTANCE FROM UTILITIES

204.9.1 WATER MAINS

Force mains must meet the State of California, Department of Public Health, *California Regulations Related to Drinking Water*, and Title 22 of the California Code of Regulation, Section 64572, "Water Main Separation" requirements.

204.9.2 OTHER UTILITIES

Force mains must have a minimum separation of 12 inches from all other utilities as measured from the outside of the force main and outside of the utility. If 12 inches of separation is not feasible, submit a Request for Deviation. At a minimum, include Styrofoam or approved equal between the crossing and CLSM placed around the crossing.

204.10 PRESSURIZED PIPELINE LOCATORS

204.10.1 GENERAL

To accurately locate and protect pressurized pipelines after installation, tracer wire, programmable locator balls, and locator ribbon are required over all pressurized sewer pipelines. Locator design requirements are provided below. Please refer to Section 502, Drawing FM-04, and Section 317, "Locating Markers" of these Standards for installation, testing, and other requirements.

204.10.2 TRACER WIRE

Provide electrically continuous tracer wire for all pressurized pipelines. Tracer wire must be #10 AWG THW copper wire. Use locating wire stations, CARV manholes, and pump stations as access points for tracer wire. Access points cannot exceed 600 feet separation. Please refer to Section 502, Drawing FM-04 of these Standards for locating wire station and wire connection details.

204.10.3 LOCATOR BALLS

Program and install locator balls for sewer (green) over the pressurized sewer pipeline and 3 feet below final grade at the start, middle, and end of all vertical and horizontal bends, including deflected sections fittings absent of a valve, and all utility crossings. On straight runs of pipe, install locator balls at least every 200 feet. If the final grade is unknown, place marker balls at every 3 feet of depth as appropriate.

Use Electronic Marker System Markers from 3M Electronic Marker or Omni Marker systems, or equivalent with prior SacSewer's approval. Locator balls must be RFID, programmable with a minimum memory size of 256 bits, and have a reading depth capability of 5 feet.

204.10.4 LOCATOR RIBBON

Place and center a pipe locator ribbon 18 to 24 inches above the force main. Locator ribbon must be heavy sewer plastic warning tape a minimum of 6 inches wide with a printed warning "Sewer Force Main" on tape. The tape must be ITT Blackburn, type YT or RT, Griffolyn, Terra Tape, or approved equal.

204.11 CATHODIC PROTECTION

The geotechnical report must provide a corrosivity analysis for all metallic structures (e.g., steel casing and DIP) along the alignment of the pipeline and make recommendations for the design of the cathodic protection system. Cathodic protection systems must be designed by a NACE certified Cathodic Protection Specialist or licensed Corrosion Engineer. The cathodic protection system must be such that the anode bed can sustain protection for a minimum of 50 years. Include a corrosion protection study with the plan and specification submittals for all DIP and all steel facilities that are being constructed. SacSewer will consider special coatings on a case-by-case basis.

Cathodic testing stations must be located in an area that allows appropriate protection from damage and easy access for maintenance.

204.12 COMBINATION AIR RELEASE VALVES

Minimize the use of CARVs when designing pressurized pipelines. Install CARVs so the air can be purged from the pressurized pipeline as recommended in the surge analysis or as directed by SacSewer. Install the first CARV as close as possible to the check valves. Place CARVs directly over the force main and within manholes as illustrated in Section 502, Drawing FM-02 of these Standards.

204.13 THRUST FORCES AND SHEARING

Supply and install thrust blocks or pipe restraining devices at all angles and tees on pipelines, including CARVs, in accordance with these Standards.

Submit calculations in the design report that address these forces and provide recommendations for mitigation in the onsite structures and the pressurized pipeline. Mitigate thrust forces in a pressurized pipeline through restrained or anchored joints to prevent movement and separation. To avoid shearing due to differential settlement, install a compression coupling on pipelines and non-electrical conduits between pump station structures (e.g. , wet wells) and vaults.

204.13.1 BENDS

For changes in direction, use 11.25 or 22.5 degree bends. Long radius 90-degree bends are permitted inside the wet wells. The minimum radius of curvature must be no more than 75% of the manufacturer's recommendation.

204.14 PRESSURIZED PIPELINE DISCHARGE

The pressurized pipeline must enter the transition manhole with its centerline perpendicular to the manhole wall and at an invert elevation matching the spring line of the gravity pipeline to ensure a smooth transition of flow to the gravity collection system as illustrated in Section 502, Drawing FM-01A or FM-01B of these Standards. SacSewer may allow a drop connection with a force line hood on a case-by-case basis if the invert elevation of the pressurized pipeline is a minimum of 3 feet above the flow line of the receiving manhole.

205 PUMP STATIONS

205.1 GENERAL

These Standards outline the requirements for new and replacement pump stations. Upgrades or modifications to existing pump stations must meet these Standards to the extent practicable.

205.1.1 SIZE

These Standards apply to sewage pump stations with design flows less than 10 mgd. Pump stations designed for 10 mgd or greater capacity must meet Regional San requirements.

205.1.2 PROPERTY RIGHTS

SacSewer must own all property rights to permanent pump stations, regardless of how the property was acquired (dedication, purchase, quitclaim, or transfer). All new pump station property must be granted in fee title to the "Sacramento Area Sewer District."

205.1.3 HAZARDOUS MATERIALS AND SAFETY PLAN REQUIREMENTS

Stations must include station signage, spill kits, fire extinguishers, pelican box, NFPA placards, and first aid kits as required by Hazardous Materials Plan requirements.

205.1.4 ACCEPTANCE PROCESS

The station is to be designed, constructed, and demonstrated as operational before SacSewer's acceptance. The demonstration process is controlled by the current version of SacSewer's *Pump Station Startup Checklist* available on SacSewer's website at www.sacsewer.com. The contractor is responsible for providing all equipment and materials necessary for this test.

205.1.5 Naming Convention

A numerical designation will be assigned by SacSewer, after the Design Report is submitted. As soon as the street address for the site is known, incorporate the street name into the station title. Establish the street address before plan and specification approval.

205.1.6 Abandonment

The process for abandoning existing facilities is discussed in Section 302.9, "Facilities Abandonment."

205.1.7 Applicable Regulations

Sewage pump stations must satisfy the regulations of all agencies having jurisdiction. Adhere to all other regulations, governing facilities, and construction, including but not limited to regulations published by the Cal OSHA, NFPA, UBC, NEC, UMC, NEMA, CCR, and others as applicable.

205.1.8 Drawings and Details

The basic drawings and details for pump station design and construction are contained in Section 502, "Standard Plans" of these Standards. Instrumentation plans are available upon request.

205.2 Site Criteria

Consider all factors in this section when selecting a pump station site.

205.2.1 Topography

Consider adjacent areas or sheds potentially served by the pump station. Site selection must be compatible with suitable site access and soil capability with respect to land grading, site development, and engineering considerations.

205.2.2 Access

All pump stations must be accessible by surface roads that accommodate H-20 design vehicles. Make provisions for entry into traffic nose first. Center medians may require modification for ease of access to pump stations from all directions. Driveway widths and lengths must accommodate SacSewer's vehicles. Please refer to Section 203.4, "Access Roads" of these Standards.

205.2.3 Flood Plain

Site pump stations to remain operational and permit access during a 100-year flood (according to the current *Federal Emergency Management Agency's National Flood Insurance Program Flood Insurance Rate Map*). The pump station top slab, wet well rims, and related vault lid elevations must conform to the County of Sacramento *Floodplain Management Ordinance* and be accessible to roadways with a minimum of 1 foot above the 100-year flood level. Please refer to Section 203.4, "Access Roads" of these Standards.

205.2.4 Land Use

Pump station sites must conform to land use regulations for which the property is zoned and adhere to the setbacks required under such zoning.

205.2.5 Aesthetics

Natural screening and remoteness of the site are primary elements of site selection wherever possible. Facilities architecture must blend into the local surroundings. Paint all above-ground pipes gun metal gray. All concrete surfaces will have a broom finish.

205.2.6 Noise

Where pump stations are sited near developed areas, minimize noise impact to neighboring properties. When designing a pump station, consider the noise levels of all equipment and meet the minimum noise ordinance for night operations. These issues must be fully disclosed in the environmental review document.

205.2.7 Odors

Assess odor effects on neighboring properties. Every effort must be made during the site selection to reduce potential odor pollution. Duration and odor intensity are important considerations and must be evaluated. SacSewer requires necessary components for the future installation of an odor control facility.

205.2.8 Overhead Clearance

Provide adequate overhead clearance for the entire sewage pump station site, so maintenance equipment does not interfere with overhead utilities or structures. Do not locate pump stations where existing overhead conflicts exist when possible.

205.2.9 PROTECTION FROM VEHICLE IMPACT

Pump station equipment susceptible to vehicle impacts must have impact mitigation devices.

205.2.10 CANOPY

Provide a shade canopy large enough to protect all systems and equipment that are susceptible to inclement weather. The structure must withstand wind and seismic loadings. The canopy must cover the entire cabinet layout and provide sun-shading panels on all non-entry sides unless otherwise stated in the contract documents. The shading is to be installed on the outside of the structure for ease of maintenance. SacSewer requires a registered engineer, currently licensed in the State of California, to stamp these designs. Please refer to Section 502, Drawing PS-01 of these Standards. At SacSewer's discretion, a fully enclosed structure may be required in place of a canopy for larger pump stations.

205.3 DESIGN CONSIDERATIONS

205.3.1 HYDRAULIC DESIGN

The design flow dictates the size of a pump station. Please refer to Table 205-1. The design flows for SacSewer's pump stations are determined in accordance with these Standards. Generally, stations with flows 10 mgd or greater are Regional San pump stations and must meet the Regional San design requirements.

Table 205-1: Station Classifications

Station Type	Design Flow
Small Stations	Less than 1 mgd
Medium Stations	Between 1 and 7 mgd
Large Station	From 7 to less than 10 mgd

205.3.2 PHASING

If the pump station is intended for a development of a project built in phases, consider the flows that will occur at different project phases. Base the pump station design on the ultimate capacity requirement and on the interim phase flows. The design report must clearly identify and outline the various flows and the corresponding triggers requiring the next level of expansion or upgrade. Summarize phasing on the project-specific plans.

205.4 CIVIL

205.4.1 SITE DESIGN

Pump station designs must ensure adequate access, security, drainage, and maintainability. Site design and layout must be coordinated with and approved by SacSewer during the design phase of any pump station project.

Site Layout

Generally, pump station sites must be at least 120 feet by 120 feet. Pump station site design must provide adequate space to facilitate service equipment access (including but not limited to trucks, cranes, and vacuum trucks).

Vehicular Access

Construct pump stations for access for maintenance vehicles and equipment. All surfaces, including temporary all-weather aggregate base roadways, asphalt concrete surfaces, concrete pads, vaults, and hatch covers, must have H-20 load ratings (defined by AASHTO as 32,000 lbs axle load). The driveway must be accessible during a 100-year flood, with a minimum elevation of 1 foot above the 100-year flood elevation. Temporary access roads must also conform to these Standards. Please refer to Section 203.4, "Access Roads," and Section 501 of these Standards for driveways.

205.4.2 PERIMETER FENCE

All pump stations must have an 8-foot high fence at a minimum, above ground level that prevents unauthorized access. SacSewer must approve fence material. Anti-graffiti coating is required on all fencing.

205.4.3 GATES

Provide a standard man-gate, not less than 3-foot wide, and two sets of 10-foot wide swinging gates (20 feet total) for access to the site. Twenty feet wide sliding or bifold gates may be allowed in lieu of swinging gates if circumstances warrant. All gates must achieve a fully open position with a single operator (starting force 50 pounds or less for opening and closing, rolling force of 40 pounds or less). All gates must have a locking mechanism or chain for multiple locks to suit a minimum of three padlocks. In addition, all gates must have drop-bolt type gate stops with receiver sleeves set in PCC installed in both the open and closed positions for both gates.

205.4.4 POTABLE WATER

Provide potable water service to the pump station in accordance with State and local standards.

Provide an RPPA from the most recent list of approved RPPAs by the State of California Department of Health Services and local water purveyor.

Provide a potable water hose bib near the wet well that is protected from vehicular traffic with removable bollards as illustrated in Section 502, Drawing PS-02 of these Standards. The hose bib must have a threaded spigot for a 1-inch-diameter hose. Space bollards 3 to 4 feet apart.

205.4.5 GRADING

Pump station site grading must prevent local ponding and provide positive drainage away from structures. Grade the site so a low point is not created in relation to the adjoining properties. Maintain a minimum slope of 1% for site drainage, with the maximum slope not to exceed 2%.

205.4.6 STORM WATER

Storm runoff from the pump station site must comply with the jurisdictional agency. Storm water must not drain into the wet well and wash pad. Permanent BMPs for permanent onsite storm water runoff must conform to the requirements of the jurisdictional agency.

205.4.7 LANDSCAPING

If a jurisdictional agency or the development community has land use requirements that must be fulfilled with regard to landscaping, a local HOA, landscaping district, or other similar entity must be in existence or set up and funded. This HOA, landscaping district, or similar entity will own any landscaping easement and bear all the costs for construction and maintenance of said landscaping. If the entity responsible for maintenance fails to maintain said landscaping, minimal weed abatement measures will be used by SacSewer, and the landscaping will most likely be replaced with weed fabric and gravel.

Landscaping requirements can be incorporated into the site design but must not diminish the overall finished size of the site as required by SacSewer. Landscape design must not impede access to the pump station or impair functionality of the station. Avoid invasive root species that can create damage.

205.4.8 Exterior Lighting

Provide exterior lights to light the equipment area adequately. Shield the lights to prevent spillage on the neighboring properties or in a skyward direction. Provide manual exterior light switching with photocell override for daylight shut-off. Timer or motion control of exterior lights is not allowed. Provide galvanized steel light poles. All poles must be circular and conform to the latest edition of the *County Specifications*.

205.4.9 Approach Manhole and Pipe

The approach manhole is the first manhole upstream of the wet well. The approach pipe is the segment of pipe connecting the approach manhole to the wet well and is the inlet to the wet well.

The approach manhole must be Armorock or approved equal. The approach pipe type must be pressure class 350 lined DIP and laid at a 2% slope to the point of discharge into the wet well. The approach pipe invert elevation must be the same as the lead-pump-on elevation. Pipe penetrations into the manhole and the wet well must be bored by the pre-cast manufacturer or blocked out for boring in the field for penetration 8-inch or less in diameter. Seal penetrations with Link-Seal or an approved equal sealing system. The approach pipe is considered part of the wet well and not part of the collector system.

205.4.10 Wet Well

A civil or structural engineer currently licensed in the State of California must design all pump station wet wells, and the design must consider the following:

- Wet wells will be accessible for necessary maintenance, and all materials and equipment used in wet wells must be corrosion-resistant.
- Do not install junction boxes in the wet well.
- Do not use dry well or dry pit pump stations.
- Construct wet wells of precast reinforced polymer concrete. Wet wells must be circular for all pump stations, as illustrated in the mechanical drawings.
- Wet well size and depth must accommodate the influent sewage to prevent excessive pump cycling of pumps. For the maximum number of pump starts per hour, please refer to Section 205.5.1, “Pump Selection.”
- Design wet wells that are installed below groundwater to prevent flotation and water infiltration.

- The wet well must have a flat bottom and a 6-inch fillet along the inside perimeter edge of the wet well. Construct the fillet with a material that is resistant to corrosion and will adhere adequately to the bottom and sides of the wet well.

205.4.11 ACCESS HATCH

Integrally cast the access hatch into the wet well roof. The top of the access hatch must be smooth with the concrete deck at ground level. The manufacturer will preassemble the access hatch.

Use aluminum access hatch covers and frames. Use ANSI 316 stainless steel components and hardware and equip each hatch with hardware, so it locks with a padlock. Locate the padlock in a recessed lock box with an independently hinged cover over the padlock. Provide each cover leaf with a lift handle that remains flush with the cover when not in use. Equip each cover leaf with stainless steel hinges, hydraulic spring assist hold-open arms, watertight gasket, and recessed padlock hasps.

The frame must have weep holes to drain any water collected in it. Install H-20 rated access hatch(es) as approved by SacSewer. Show the hatch opening direction on the project-specific plans. Size the access hatch appropriately for all phases of pump station operation.

Contact SacSewer for current requirement provisions to allow crews to access the wet well pit .

205.4.12 SAFETY GRATE

Design the wet well hatch for fall-through protection when covers are open. Provide aluminum safety grates painted safety orange beneath the hatch covers. The grates must have a permanent hinging system that locks the grates in a 90-degree position once opened and prevents the grates from falling into the wet well. The safety grate must be 6061 T6 Aluminum. Grating panels must support the weight of the pumps.

Each safety grating panel must have a red vinyl grip handle, that allows the opening of the grate while providing the grate as a barrier between the operator and the wet well. Paint the grate with Cal OSHA-type safety orange paint.

Consider vehicle access, personnel safety, and access to the wet well when deciding on which side the safety grate hinges will be placed. If possible, place the safety grate hinges opposite the discharge pipe. Construct components and hardware out of ANSI 316 stainless steel.

205.4.13 Size Criteria of Wet Well

Calculate the required operational wet well volume to optimize pump operation to meet peak hour design flows, minimum hour flows, and the maximum pump start frequency. Every effort must be made to design a system that prevents conditions that allows sewage to become septic. Size the wet well based on the equation below:

$V = Q * t / (4 * N)$ Where V is the Wet Well operational volume in gallons, where:

Q: PWWF flow in gpm

T: interval between pump starts in minutes

N: number of pumps

Use submersible, centrifugal, constant speed pumps in the design. Other types of pumps require a more in-depth SacSewer review before approving the design report.

Design the wet well for the following parameters and as illustrated in Section 502, Drawing M-05 of these Standards:

- The low-level water alarm must meet the pump manufacturer's minimum recommended safety limits.
- The pump operational band (between pump on and pump off) must begin a minimum of 6 inches above the low water alarm or greater if recommended by the pump manufacturer. The pump start set point must provide for a minimum submergence at the pump suction inlet to prevent free-surface air core vortices as per pump the manufacturer-provided guidelines. If there are no submergence charts available, use the following U.S. Hydraulic Institute guideline:

  $S = D + [(0.574 \times Q) / D^{1.5}]$, where:

  S: Minimum submergence to prevent vortexing, in inches

  D: Pump suction inlet diameter, in inches

  Q: Pump design flow rate at BEP, in gpm

- The operational band must be large enough to accommodate SacSewer's maximum number of pump starts allowed for the installed pump.
- The inside diameter of the wet well must be a minimum of 6 feet; however, retention time, pump configuration, and access may require a larger structure.

- The pump operational band will be below the incoming gravity pipe invert. No part of the incoming gravity pipe will be used under non-emergency operating conditions.

205.4.14 VAULTS

Concrete used for manufactured vaults must have a minimum 4,000 psi compressive strength. Vaults containing equipment with the potential for off-gassing must be Armorock or approved equal or have an approved epoxy interior coating (walls, ceiling, and floor). When high groundwater is anticipated, install exterior waterproofing and ensure that vaults resist uplift forces by using a factor of safety of 1.5. Slope the floor of the vault within the pump station site to the drain. The floor of the vault must have a non-skid finish. Size the vault based on the number of pumps and future phasing of the station. Provide adequate space within the vaults for SacSewer's maintenance activities.

All vaults must be H-20 rated with aluminum single leaf doors with stainless steel hinges, spring assist hold-open arms, anti-slam gasket, and recessed pad-lockable hasps and fitted with a safety grate system. Size vaults to provide 2 feet overall clearance (for the top, bottom, and sides), between walls of the vaults, and internal components for accessibility and routine maintenance. Vaults within the pump station site must have a 3-inch ABS drain pipeline that discharges to the wet well as illustrated in Section 502, Drawing M-02 of these Standards.

Pressurized pipeline penetrations must be core drilled and grouted in place and level with the surface on both sides of the wall. Pressurized pipelines within the vaults must have flange support or saddle support as approved by SacSewer.

205.4.15 FALL PROTECTION

For all hatches except the wet well, that requires a safety grate, install guard rails to provide fall protection at pump stations. If guard rails cannot be installed, safety nets may be used instead. Provide safety netting that is UV resistant and corrosion resistant. All guardrails must comply with Cal OSHA 3209 requirements.

205.4.16 ODOR CONTROL

Provide an appropriately sized concrete pad and PVC intake pipe stubbed out and capped for future use for an odor control unit. Set the depth of the intake pipe in the wet well to avoid sewage entry into the pipe during the periods of high water level. Provide an electrical connection for the air scrubber and drain pipeline as illustrated in Section 502, Drawing M-04 of these Standards.

205.4.17 Wash Pad

Provide a square concrete pad, 8 feet by 8 feet, adjacent to the wet well with a 2% slope towards the floor drain for cleaning of equipment. Grade the site around the wash pad to slope away from the wet well and wash pad, so storm water does not have a natural path into the wet well from the pad.

205.4.18 Flow Monitoring

A flow monitoring system that includes an in-line electromagnetic flow meter on each force main, along with any ancillary equipment, vaults, conduits, etc., must be installed in all pump stations to measure pump discharge rate accurately. The flow monitoring system must be designed according to vendor specifications and approved by SacSewer during the design phase.

205.4.19 Emergency Storage

Calculate the required emergency storage capacity using 2 hours of PWWF. At critical sites, provide 4 hours of emergency storage at PWWF as determined by SacSewer.

Critical sites are defined but not limited to the following items:

- Pump stations or the low manhole that are adjacent to a creek, stream, or river
- Where a station sewage overflow or a sewage overflow from the low manhole would flow into a nearby waterway
- Pump stations that have a pump station discharging into it
- Pump stations with a long (at least 2,500 feet) force main
- Other sites, as determined by SacSewer

Storage can be provided either inline or offline. Emergency storage is not required if an overflow is provided, as described in Section 205.4.20, “Bypass Provisions.”

Inline storage consists of additional capacity in the upstream collection system that feeds the pump station, up to and including the wet well. The design engineer may oversize pipes in the local collection system to gain additional storage. Minimum pipe slopes will not change due to the upsized pipes.

For storage purposes, 100% of the volume in the collection system to 3 feet below the rim elevation of the lowest manhole, and the entire wet well from the invert of the incoming pipe to 3 feet below the rim elevation of the lowest node may be counted. The design

report must include an exhibit of the pipes used for calculating emergency storage and identification of the controlling node with its elevation. Building pads or laterals that connect at an elevation lower than the controlling elevation must include a note that a backflow prevention valve is required.

Offline storage is a storage tank or pipe (onsite or offsite) that is designed for this purpose. Preferably, this system would operate with a gravity flow design and flow directly into the wet well so that it remains in an empty condition when not used for emergency storage.

This emergency storage time allows SacSewer at least 2 hours to respond to a station failure alarm, a shut off all pumps, and to perform emergency repairs to correct a failure condition.

205.4.20 Bypass Provisions

Pump stations with a discharge manhole within the station fence must have an overflow pipe installed between the wet well or approach manhole and the discharge manhole. The overflow pipe crown elevations must be below the invert elevation of the air scrubber intake and low manhole.

All other pump stations must have a bypass vault with isolation gate valves and bypass pumping assembly located inside the bypass vault between the wet well and the discharge manhole.

205.4.21 Bypass Pumping Plan

Outline the bypass pumping plan in the Design Report and Maintenance and Operations Manual. A plan sheet dedicated specifically to the emergency bypass plan must contain the minimum information such that SacSewer's staff has information necessary to evaluate and prioritize a response to emergency conditions. The minimum information must include the design flows into the pump station, emergency storage capacity and time, basic equipment information, and piping layout.

The following scenarios require information in the bypass plan:

- The wet well is not operational.
- The pressurized pipeline is not operational.
- There is an electrical power outage at the pump station.
- Other scenario(s) as required by SacSewer.

Correct or add any information that is unavailable at plan approval or modified during construction to the as-built or record drawings before SacSewer accepts the pump station.

205.4.22 Bypass Plan and Profile Sheets

Show the pump station site in both plan and profile views on one sheet. Show plan and profile of the wet well. Include an emergency bypass plan that shows the layout of the sewer collection system with all facilities used for emergency storage. Include the lowest two nodes, all branches in the system leading into the pump station, and the pressurized pipeline to the outfall into the gravity system.

Provide the low manhole rim elevations for the upstream collection system of the pump station. Show the location of all significant structures (e.g., CARVs). This requirement may require several details at different scales and more than one sheet. Show the layout of the most likely location for bypass piping, emergency storage system, the upstream collection system, and the pressurized pipeline at a minimum.

205.4.23 Bypass Piping Layout

Show and dimension the most likely route for bypass piping for at least the three scenarios identified in Section 205.4.21, "Bypass Pumping Plan" of these Standards. Maintain emergency bypass plan protocols for each station. The plan must be laminated and located onsite.

205.4.24 Emergency Storage System Layout

Include a detail of the layout and basic information for the emergency storage system. Show all pertinent information for all parts of the gravity system, onsite structures and tanks, wet wells, wet well diameters, rim elevations, and depths that are used for emergency storage. Include the lengths, diameter, and invert elevations of nodes. If known, show the diameter, rim elevation, depth, and SacSewer's node numbering. Clearly label the location, rim elevation, and depth of the lowest node. Identify and provide how many hours of available downtime there is at peak wet weather flow.

205.4.25 Pressurized Pipeline Layout

Include a detail of the pressurized pipeline layout from the bypass valve to the outfall manhole into the downstream gravity system. Include all pertinent structures such as CARVs. Label the pipe diameter and lengths between structures. Label the rim elevation, depth, invert of the pressurized pipeline, all other entry pipes, and the exit pipe on the outfall manhole.

205.4.26 DATA TABLE

Show the basic design information as outlined above in tabular form. Show the design flows for the PDWF and the PWWF, along with the emergency storage capacity and time for the entire system. Incorporate the specific storage information for the wet well, upstream system, and all onsite storage structures included in the design. The basic pump information required includes the number, makes and models designed, the capacity, type of pump, type of drive, and the dynamic head for each pump, both individually and combined.

205.5 MECHANICAL STANDARDS

205.5.1 PUMP SELECTION

Sewage pumps must be submersible, centrifugal non-clog solids handling pumps specifically designed for handling raw, unscreened sewage. Pump motors must operate on 480-volt, 3 phase, and 60 Hertz electrical service, or as specified by the utility provider, and at a speed no higher than 1,800 rotations per minute. The pump motor horsepower selected must be sufficient to prevent motor overload over the entire range of the pump performance curve. Sewage pumps must be suitable for continuous duty. Pumps that are 100-horsepower or smaller can have no more than eight starts per hour. Larger than 100-horsepower submersible pumps must be designed to maintain six starts per hour.

The design engineer must submit an analysis to support pump selection that includes number of starts per hour, flow, volume, duty pump, standby pump, and pump rotation for SacSewer's review.

205.5.2 PUMP DESIGN

Include calculations and pump efficiency curves that conform to the industry standard conventions as part of the design report to verify all the criteria are met for the pressurized pipeline and the pump station system(s) to provide the best pump selection. System curves must include static head and friction losses or the TDH.

The pump station design must consider the following parameters:

- Use a duplex pump configuration configured with identical pumps; each pump should be capable of handling peak wet weather flow.
- The pump must have a head capacity curve that rises continuously from its BEP to shutoff.

- Avoid pumps with flat pump curves (e.g. , where a small change in TDH will result in a large change in pump flow).
- The pump must pass solids equivalent to a sphere a minimum of 3 inches in diameter.
- The NPSHA at the lowest wet well operating level must exceed the NPSHR by a margin of at least 35% at the maximum flow condition.
- Pump efficiency and "wire to water" efficiency must be identified at the typical operating points.
- The low-level water alarm must meet the pump manufacturer's minimum recommended safety limits.
- The pump operational band (between pump on and pump off) must begin a minimum of 6 inches above the low water alarm or as recommended by the pump manufacturer.
- The operational band must be large enough to accommodate SacSewer's maximum number of pump starts allowed.
- Do not set pumps to start or stop at alarm points.
- Set the high water alarm at the level that is calculated in the event of a 2-hour pump station outage or as specified by SacSewer.
- Set the high water alarm at the spring line of the approach pipe at the wet well.
- Do not set the high-high water level alarm higher than 3 feet below the elevation of the lowest node in the upstream system.

205.5.3 KNIFE GATES

Limit use to isolated applications where the total potential hydraulic head is less than 20 feet and space is restricted. Knife gates must be of resilient seated design with 316 stainless steel construction where in use.

205.5.4 GATE VALVES

Gate valves must be manually operated isolation valves in horizontal pipelines with valve stems oriented vertically upwards. Various types of corrosive environment gate valves are described next:

- Resilient Seat Gate Valves – 3 to 12 inches in diameter: use an outside screw and yolk (OS&Y), non-rising stem (NRS), full port, cast iron valve body, and gate with SBR resilient seats in sizes 3 to 12 inches. The gate valve must comply with AWWA C509. Fusion bonded epoxy is required on interior and exterior surfaces.

- Resilient Seat Gate Valves – 14 to 30 inches in diameter: use an NRS, full port, ductile iron valve with bonded SBR ductile iron gate, and Buna N stem seals in sizes 14 to 30 inches. Valves must comply with AWWA C500, "Standard for Metal-Seated Gate Valves for Water Supply Service," and AWWA C509, "Resilient-Seated Gate Valves for Water Supply Service." Fusion bonded epoxy coating is required on both interior and exterior surfaces.
- Rotating Double Disc Gate Valves – 14 to 60 inches diameter: full port, rotating, double disc valves, complying with AWWA C500, "Standard for Metal-Seated Gate Valves for Water Supply Service." Ductile iron body, bonnet, and wedges, and low zinc body seat rings can be used for diameters of 14 to 60 inches as an alternative to resilient seated gate valves. The valve must permit replacement of discs without removal of the valve body from the pipeline. A 6-inch flushing port, 2-inch blow-off port, and optional bypass valve port must be cast into the body of the valve. The valve design must allow complete replacement of the stem packing under pressure when the valve is either fully open or fully closed.
- Swing Check Valves: provide a counterbalanced swing check valve. Use either cast iron or stainless steel valves with replaceable bronze or Buna N seat ring. Mount swing check valves on horizontal piping only. Mount check valves outside the wet well.

205.5.5 PLUG VALVES

All plug valves must be Type EP 125, ANSI Class 125. Valves, $2\text{-}^{1}/_{2}$ to 12 inches and rated 175 psi gauge for bi-directional bubbletight shutoff. Valves 14 to 36 inches must be rated 150 psi gauge for bi-directional bubbletight shutoff. Plug valves require SacSewer's approval.

205.5.6 VALVE ACCESS

All valves must be easily accessible, with adequate clearances on both sides, above and below, as illustrated in Section 502, Drawings M-02 and M-03 of these Standards.

205.5.7 PIPING SYSTEM MATERIALS SELECTION

In selecting pipe system materials, the design engineer must use the piping materials shown SacSewer in **Table 205-2**. Larger diameter materials are listed if materials are needed in the design for the additional storage capacity or other incidental uses.

Table 205-2: Ancillary Pump Station Piping Materials

Service	Material	Allowable Sizes
Potable Water	Copper Tubing, Type L (Exposed) Hard Temper	3 inches and less
Potable Water	Copper Tubing Type K (Buried) Soft Temper	3 inches and less
Foul Air	Schedule 80 PVC	6 inches and larger
Drain Pipelines	ABS, PVC, Sch. 40, or SDR	3 inches and larger

205.5.8 Additional Piping Design Guidelines

Other piping system design guidelines include the following:

- All piping consisting of similar metallic materials must have bonding for continuity and must be grounded as required by code.
- Protect all above-ground piping and equipment from freezing as appropriate.
- Install nylon insulation bushings between all dissimilar metals in piping (e.g., brass fittings connected to manifolds), between pumps and inlet, pipes and valves, and discharge piping to insulate from the inductance current caused by motors.
- Install insulation couplings and flanges to isolate piping and building if it applies.
- Do not use short 90-degree elbows, except for potable water.
- Plug all piping that penetrates the wet well as required by SacSewer to prevent the escape of hydrogen sulfide gas.
- Coat all exposed material that is susceptible to damage by UV rays with compatible material that will inhibit this action as required by SacSewer.
- All joined dissimilar metals require a connection that eliminates electrical conductivity.
- Braze all buried copper pipe connections.

205.5.9 Pressure Gauges and Transmitters

Pressure gauges must be glycerin-filled sealed diaphragm direct reading 4-inch dial with a $^1/_4$ inch connection. Pressure gauges are made of type 316 stainless steel. Provide all gauges with isolation valves, including oil isolation of the gauge from sewage. Include gauge connection ports on all pump discharge mains. The connection ports must include a coated service saddle or welded thread-o-let for the tapping of the main. Provide type 316 stainless steel nipples. Pressure transmitters may be required at SacSewer's discretion.

205.6 ELECTRICAL

205.6.1 NOMINAL VOLTAGE SELECTION

Provide a 480-volt, 4-wire, 3-phase, and 60-Hertz electrical service.

205.6.2 ELECTRICAL FACILITIES CONFIGURATIONS

Typical electrical facilities configurations are illustrated in Section 502, "Standard Plans" of these Standards. Alternative configurations may be considered or allowed by SacSewer. Show cable penetrations opposite the guide rails.

205.6.3 EQUIPMENT SELECTION AND CONTROL CRITERIA

Electrical equipment must meet the process demands of the pump station. All equipment must meet the most recent applicable standard limits for vibration, audible noise, harmonic voltage and current, electrical surge immunity, and thermal limitations.

205.6.4 CONTROL

Equipment must have a minimum level of manual control in addition to automatic operation, as addressed later in this chapter.

205.6.5 ENCLOSURES

Locate house electrical equipment outdoors in an enclosure suitable for the location. The enclosure must provide complete access for all onsite maintenance and repair needs without requiring disassembly or removal of the enclosure. Motor junction boxes must be rated NEMA 4X.

Main switchboards, motor control centers, automatic transfer switches, and similar equipment, when installed outdoors, must be supplied in NEMA 3R non-walk-in, weatherproof enclosures with dead-front, weatherproof, pad-lockable outer doors providing complete access to interior mounted equipment and their components. The NEMA 3R enclosure vestibule must provide LED lighting behind the dead front/control panels and be sized to allow full opening of equipment interior doors.

Wherever outdoor equipment is front and rear accessible, provide weatherproof, dead front, pad-lockable outer doors on both the front and rear of the equipment that allows full access to all interior mounted equipment components and terminations. Provide thermostatically controlled element heaters, top cabinet ventilation fans, and filter-protected lower air intakes in all sections of interior mounted equipment.

The internal temperature of the enclosure must not exceed the recommended operating range set by the manufacturer for all components within it.

Label all switches, breakers, and controls to indicate their function.

When additional cooling equipment is required, integrate the equipment with the overall equipment enclosure.

The emergency generator connection enclosure must be rated NEMA 3R.

Other outdoor electrical enclosures must be NEMA 3R, except for motor junction and transducer termination boxes, in a corrosive environment, or underground structures must be NEMA 4X stainless steel as illustrated in Section 502, Drawing E-03 of these Standards.

205.6.6 Audible Noise Criteria

Equipment placement can mitigate audible noise concerns depending on placement relative to adjacent properties. Locate pump station equipment and large transformers based on generating minimum audible noise to adjacent properties.

205.6.7 Noise Limits

Design and verify, at the property line, compliance with audible noise limits imposed for nighttime requirements by local ordinance, under all pump station design-operating conditions.

205.6.8 Noise Attenuation

Review the type of noise attenuation employed with SacSewer, assuming compliance with all audible noise limits required by Cal OSHA and local ordinances at the site.

205.6.9 Harmonic Voltage and Current Limit and Monitoring Criteria

All new pump station facilities and pump station refurbishment projects must meet *IEEE 519* standard requirements (latest edition) at the point of common coupling with the utility. Final verification must be confirmed by an SacSewer-approved representative during a field test under actual operating load conditions, with all additional measures to be designed, installed, and retested to verify compliance with *IEEE 519* (latest edition).

205.6.10 Surge Protection Application at the Main Service

Install distribution class, metal oxide varistor surge arresters at the main service for 480-volt pump stations. The required location is at the load side terminal of the 480-volt main breaker.

205.6.11 Surge Monitoring on Normal and Emergency Power Services

Large stations must have individual surge monitors on both normal and emergency power sources. This surge monitoring must be a function of the power monitoring system. The power monitoring system must provide a capture of sags, swells, and spikes on the monitored service.

205.6.12 Minimum Equipment Manual Controls

Apply Hand-off-Auto switches for all main pump controls at all pump stations. The “hand” switch position must not bypass any overloads relays, and the controlled pump must be operable with only those interlocks that are determined to be critical in the circuit.

205.6.13 Pump Motor Breakers

Provide a motor circuit protector. Pump motor breakers must have lockable handles.

205.6.14 Motor Starters

All motor starters must have adjustable electronic overloads and comply with NEMA standards. The motor starters must include the following items:

- Provide a reduced voltage non-reversing starter (soft starter or VFD) for pump motors larger than 30 horsepower.
- Provide a full voltage non-reversing starter for less than 30 horsepower unless the design engineer demonstrates the need for a reduced voltage non-reversing starter.
- Provide a circuit breaker equipped with an adjustable magnetic trip breaker motor circuit protector for combination motor starters.

205.6.15 Conduits

Exposed conduits and buried conduits must meet the following requirements:

- Install rigid galvanized steel conduits for all exposed conduits, as illustrated in Section 502, “Standard Plans” of these Standards.

- Install Schedule 40 PVC conduits for all buried conduits, as illustrated in Section 502, "Standard Plans" of these Standards.
- Install PVC-coated rigid galvanized steel conduits in all underground and hazardous locations.
- Show the conduit runs on the project-specific plans and specifications.
- Conduits will meet the requirements specified in Section 322.2, "Raceway, Boxes, Conduits, and Fittings" of these Standards.

205.7 SCADA, CONTROLS, AND INSTRUMENTATIONS

205.7.1 REMOTE TERMINAL UNIT LAYOUT DETAILS AND CONTROL POWER DISTRIBUTION

Typical RTU layout and diagrams for control power distribution can be provided upon request to SacSewer.

205.7.2 PROCESS AND INSTRUMENTATION DIAGRAM

The Process and Instrumentation Diagram identifies major pieces of equipment, associated instrumentation, and PLC RTU input-output points for all systems interfaced with the Pump station SCADA System.

205.7.3 INSTRUMENTATION STANDARDIZATION AND CONTROL COMPONENTS

Standardization of instrumentation and control components and implementation significantly facilitates both operation and maintenance of the stations. With a standardized instrumentation and control interface, operators (both locally and via SCADA) can quickly adapt to each station with minimum effort or risk.

For consultant reference, SacSewer may consider changes or upgrades to the standardized instrumentation and control components in the future, as chosen models become obsolete or new technology offers significant advantages. At this time, SacSewer allows only Modbus, HART, or foundation field bus protocol. SCADA communications must use the DNP3.

205.7.4 ENCLOSURES

Control and instrumentation equipment located outdoors must be in NEMA 3R enclosures suitable for the location. The enclosures must provide complete access for all onsite maintenance and repair needs without requiring disassembly or removal of the enclosure. For corrosive environments, provide NEMA 4X stainless steel enclosure.

- Where electronic equipment, PLCs, personal computers, power supplies, instrumentation, displays, or other heat-sensitive control equipment are located in an outdoor enclosure, group the equipment together in a control panel or control section of the enclosure. Please refer to Section 205.6.5, "Enclosures" of these Standards for additional design requirements.

205.7.5 Level Instrumentation

SacSewer requires a submersible level transducer system. The submersible level transducer senses the level of fluid in the wet well and transmits that datum to the PLC via a 4 to 20-milliampere signal. The transducer kit consists of a level transducer with a weatherproof cable, protective sleeve, hanger, a sink weight, a termination box with remote electronics, and a moisture protective bellows assembly.

The transducer sits in a 6-inch stainless steel stilling well that holds it 6 inches from the bottom of the wet well. The terminations between the transducer and the RTU cabinet are to be made in a NEMA4X stainless steel junction box mounted next to and constructed similarly to the motor junction box as illustrated in Section 502, Drawing E-03 of these Standards.

Refer to SacSewer's *Pump Station Standard Equipment and Requirements List* available on SacSewer's website at www.sacsewer.com for pre-approved devices.

Use a reactive air type wet well high-high alarm, with the reactive air bell located at the appropriate elevation for flood risk warning and in a location convenient for testing with a bucket of water.

205.7.6 Power Instrumentation Guidelines

RS-485 Standardization of electric power instrumentation is required. Please refer to SacSewer's *Pump Station Standard Equipment and Requirements List* available on SacSewer's website at www.sacsewer.com. Apply all pump station power metering on utility service feeders. Provide power metering with harmonic analysis capability for each pump. Use RS-485 communications to transfer the data from the power meters to the RTU PLC.

205.7.7 Hazardous Gas Instrumentation

Chlorine leak detection is required wherever chlorine gas or sodium hypochlorite is stored or handled. Furnish redundant sensors at stations where large quantities of chlorine or hypochlorite are stored.

SacSewer does not have a standard for permanently installed hazardous gas monitoring of excess hydrogen sulfide or methane (combustible gas) or lack of oxygen. If hydrogen sulfide or methane gas could exist, or there could be a lack of oxygen, an air sampler pump and tubing system are required to test air quality.

205.7.8 Instrumentation Power Supply

Instrumentation and control systems must be powered with a 24-volt direct current power supply with battery backup. Batteries must be sealed valve regulated lead acid type for optimal safety and minimal risk of acid spillage. Verify battery AH capacity against actual station equipment in order to provide the 12 hours backup.

Stations without onsite emergency generators must have enough backup battery capacity to support the PLC and SCADA communications equipment for 12 hours.

Where essential instruments are not available for 24-volt direct current operation, supply a 120-volt AC UPS, sized for a minimum of 2-hour operation.

205.7.9 Programmable Logic Controller

Each pump station is controlled and monitored by a PLC. Please refer to SacSewer's *RTU Bill of Materials* for pre-approved devices available on SacSewer's website at www.sacsewer.com. SacSewer will provide the program.

205.7.10 Operator Interface Panel

The OIP is used to access the pump station status and alarms. Provide the OIP, power, and communications cabling needed for proper OIP operation. SacSewer will provide the programming for the OIP. Please refer to SacSewer's *RTU Bill of Materials* for SacSewer's pre-approved devices available on SacSewer's website at www.sacsewer.com.

205.7.11 SCADA Communication

Provide pump stations with standard components for SCADA communications. Contact SacSewer to determine cellular communication availability at the proposed site. If cellular communication is available, provide the pump station with cellular communication with a spare conduit for telephone dial-up communication backup. Provide critical stations as requested by SacSewer with cellular and radio communication with a spare conduit for telephone dial-up communication.

205.7.12 CONTROL STRATEGIES

SacSewer will program the PLC, OIP, and SCADA. Detailed strategies for primary pump station services are not required during station design. An outline of the intended control strategy for the station, along with a narrative of all hydraulic limitations, is required.

205.7.13 SPARE CONDUIT

Install a spare conduit between the RTU cabinet and the Transducer Termination Box for ease of installing future instrumentation into the wet well.

205.7.14 OVER CURRENT PROTECTION

Apply fusing to segregate loads. Fuse holders should be the blown-fuse-indicating type to facilitate further troubleshooting.

Apply standard terminal block arrangements.

205.8 PRIVATE PUMP STATIONS

Do not locate private pump stations (serving more than one lot) in the public ROW.

If in the future the pump station might be transferred to SacSewer, determine pump station design capacity for private pump stations in the same manner as for public pump stations. Also, prepare a design report meeting the same criteria as for a public pump station for the proposed station and submit it to SacSewer for review and approval.

Private pump stations require separate structural, mechanical, and electrical permits from the governing jurisdiction. As such, it is the responsibility of the design engineer to ensure that all private pump stations are adequately sized, have sufficient redundant measures, and comply with all applicable local, State, and Federal regulations that may apply. The design engineer is responsible for providing an adequate design for any potential failures that could occur during the service life of the pump station. Record a Private Sewer Maintenance Agreement on lots serve by the pump station.

206 PUMP STATION STANDARD EQUIPMENT AND REQUIREMENTS LIST

All equipment must meet the requirements listed on SacSewer's *Pump Station Standard Equipment and Requirements List* available on SacSewer's website at www.sacsewer.com.

SECTION 300:CONSTRUCTION

This section outlines the SacSewer construction requirements for SacSewer's facilities, including new construction and rehabilitation.

300 GENERAL

300.1 ENCROACHMENT PERMITS

Before performing work, SacSewer must possess a signed copy of all necessary encroachment permits from the jurisdictional agency, the railroad company, Caltrans, or any other property or easement holder in the area.

300.2 OTHER AGENCY NOTIFICATIONS

All necessary approvals or permits from governmental or municipal agencies must be obtained before construction starts if any of their facilities are involved. All work must comply with these permits.

300.3 APPROVED PLANS

If new construction or rehabilitation of public sewer facilities within SacSewer's service area require that plans be prepared, such plans must meet SacSewer's requirements in Section 200, "Design" of these Standards. SacSewer may order anyone to cease work on any project if they do not have properly approved plans in their possession at the job site.

300.3.1 CONSTRUCTION INITIATION

SacSewer's projects require a Notice to Proceed before construction may begin. Developer projects may begin construction once the plans are approved and a pre-construction meeting attended by SacSewer's representative is held. Initiate construction and make substantial progress in constructing the sewer collection system within one year of the date of plan approval. If in SacSewer's judgment, projects or portions of projects have not been initiated or substantial progress has not been made within one year, the plan approval will be voided. Resubmit plans older than one year for re-approval. The resubmitted plans must be in accordance with SacSewer's current procedures and comply with the current version of SacSewer's Standards.

Construct the sewer collection system in accordance with the approved plans. No change or deviation from the approved plans will be permitted except for revisions approved in writing by SacSewer.

Upon completion of construction, submit the following items to SacSewer:

- One bound paper set of the original plans showing all changes made during construction and labeled “As-built Plans” or “Record Drawings,” signed by the Engineer of Record.
- One electronic copy, in a format acceptable to SacSewer, of the labeled “As-built Plans” or “Record Drawings.”

Turn over the completed public sewer collection system to SacSewer in a complete condition, ready for operation.

For capital improvements projects, SacSewer’s inspector submits a letter of substantial completion to the Board for approval to signify the facilities are complete and ready to be accepted.. SacSewer

For development projects, an SacSewer inspector will submit a letter of acceptance to SacSewer; the Board of Directors' approval is not required.

300.3.2 REVISIONS DURING CONSTRUCTION

If design changes become necessary during construction, first obtain the consent of SacSewer and then resubmit the title sheet and any other sheets affected for approval. Minor changes that do not affect the basic design or contract may be made in the as-built plans or record drawings upon SacSewer’s authorization. SacSewer may order changes in the plans to complete the necessary facilities.

Obtain SacSewer’s approval by submitting revised drawings and specifications to SacSewer for review in a timely fashion. Identify the number and content of the revision. A signature in the standard revision signature block will indicate SacSewer’s revision approval. Provide this block on each revised plan sheet. Specification-only changes will be approved by letter by SacSewer.

Make changes to the plans in the following manner:

- Do not eradicate the original drawings and text. Line out items from the plans.
- In the event that eradicating the original proposal is necessary to maintain clarity of the plans, entire sheets may be replaced. Designate the replacement sheets using

alphabetically ordered letters after each replaced sheet number and identify it on the title sheet as superseding the original sheet.

- Show the changes clearly on the plans with the changes and approval noted on a revision signature block.

Identify the changes by a revision number in a triangle on the plans adjacent to the change and on the revision signature block.

300.4 MOBILIZATION AND DEMOBILIZATION

No quantity measurement will be made for any work required to complete this item. Payment will be 50% for mobilization and 50% for demobilization.

The lump sum price for this item includes, but is not limited to, transporting all facilities, equipment, and labor necessary to complete the work in accordance with these Standards.

300.5 TRAFFIC CONTROL

Traffic control is typically required to perform work in developed areas. Follow the traffic control standards of the jurisdiction where the work is located (e.g., Sacramento County, City of Sacramento, Citrus Heights, Elk Grove, Rancho Cordova, Folsom) at all times. This requirement includes following *California Manual on Uniform Traffic Control Devices, Standards, and Requirements*.

Submit all traffic control plans to the jurisdictional agency with sufficient time for review and approval.

No quantity measurement will be made for any work required to complete this item. Payment will be based on the completion of the work in accordance with these Standards.

The lump sum price for this item includes, but is not limited to, transporting all equipment, materials, and labor necessary to complete the work in accordance with these Standards.

Construction area traffic controls and devices must provide for safe public traffic and pedestrian passage through the construction site in accordance with the jurisdictional agency's requirements. Submit traffic control plans to the jurisdictional agency where the work is taking place for review and approval.

Full compensation for traffic control must meet the latest edition of the *County Specifications*. SacSewer will not pay additional compensation for repairing damage to traffic control equipment.

300.6 STOP WORK

Any representative of SacSewer can call a temporary stop to a project if the representative perceives a potential hazard immediately dangerous to life or health (IDLH) or an issue that may cause damage to property.

300.7 MEASUREMENT AND PAYMENT

Measurement of pay items will be made by SacSewer, or as specified in a reimbursement agreement. The measurement of all items is based on their satisfactory installation and completion based on the plans and specifications. Measurement and payment will not be made for those items that did not receive SacSewer's approval before placement. The following items are classified as incidental work and will not be measured for separate payment unless otherwise specified in the plans and specifications. Include the cost of these items in the lump sum or unit prices bid for the other items of work:

- Noise control
- Flow control
- Topsoil or gravel shoulder replacement or repair
- Miscellaneous replacement or repair required of sidewalks, curb and gutter, driveways, drainage pipe, or similar items
- General site preparation; clearing and grubbing, disposal of vegetation; and disposal of sewer pipe, manholes, cleanouts, or other similar material removed during the performance of the work
- Trench and excavation dewatering
- Sheeting, shoring and bracing
- General earthwork (e.g., stripping of topsoil, excavation and backfilling, site restoration, fertilizing, seeding)
- Erosion, sediment control, and all other activities to comply with the project's SWPPP, including material and labor
- Bedding material used for installation of sewer facilities
- Root removal and disposal
- Excavation and disposal of unsuitable material
- Temporary utilities
- Restoration of property
- Landscaping

- Construction site cleanup and housekeeping

301 PRECONSTRUCTION VISUAL DOCUMENTATION

301.1 GENERAL

Preconstruction photographs or videos will only be required in developed areas or when specified in the project's Special Provisions.

301.2 PRECONSTRUCTION DOCUMENTATION

Take preconstruction photographs at 100-foot intervals along the work route before any construction begins. The view in each photograph must include a sign showing the date, name of the project, lateral or street, and applicable station designation. The sign must not block the critical areas of the view and must be legible in a $3\text{-}^{1}/_{2}$ inch by 5-inch print. Take each photograph from a point between 4 and 8 feet above the ground. All photographs must show good details in both shadow and sunlit areas. Submit digital photograph files. Photographs must be TIF or uncompressed JPEG raster files with a minimum resolution of 6 megapixels.

The views in preconstruction photographs must include the entire construction zone and, in particular, show the interface between the ROWs and construction zone and abutting property features such as, but not limited to, condition of existing streets, sidewalks, driveways, fences, landscaping, irrigation, buildings abutting work site, and existing surface utility facilities on and close to the work.

Show all essential features of the project area accurately. If SacSewer determines that all essential features on the original submitted photograph are not accurately or adequately shown, SacSewer may order additional photographs showing additional features or orientations.

A color digital video may be submitted in lieu of photographs. Provide an AVI or raw Quick Time file. The contractor is responsible for ensuring the file format is compatible with SacSewer's software. The digital video must have a minimum resolution of 720p. If SacSewer determines that all essential features on the originally submitted digital video are not accurately or adequately shown, SacSewer may require additional digital videos showing additional features or orientations. If the video is of a long work site, the work site will be recorded at a maximum of 30 feet per minute.

301.3 Measurement and Payment

Include all costs incurred for preconstruction photographs or videos with various work items; do not include preconstruction photographs as a separate line item for payment. SacSewer will authorize the final acceptance of photos or videos.

302 Existing Facilities

302.1 General

This work must conform to the current version of Section 15, "Existing Highway Facilities," *State Specifications*.

Facilities subject to these Standards include existing facilities that interfere with the work shown in the plans. The utility owner is responsible for removing existing utilities.

Maintain existing facilities service at all times. Devise acceptable methods for maintaining continuity of service equal to what existed before construction.

Connect pipes to existing manholes so that the finished work conforms as closely as possible to the standards for new manholes.

Protect existing and temporary facilities that do not interfere with the work and are within the ROWs and construction areas from damage. Please refer to Section 13-1.01 "Preservation of Property" of the *County Specifications*, latest edition.

Pothole two weeks prior to construction to identify the location of all existing utilities. Submit field notes to SacSewer to confirm the location of potholed utilities within two working days of confirmation.

302.2 Sewage Bypass Pumping and Flow Control

In some cases, nighttime work may be required to have flow levels low enough to perform the work. If sufficiently low flow levels cannot be obtained even at night, plugging, bypass pumping, storage tanks, or all may be required. For all plugging and bypass pumping, submit an Access Permit package to SacSewer for review and approval. Please refer to SacSewer's website at www.sacsewer.com for an Access Permit form and procedure for submittal.

302.2.1 Bypass and Flow Requirements

Size the pumping system to handle the existing PWWF and all additional flows that may occur. SacSewer may allow the pumping system to handle PDWF and all additional flows

that may occur depending on the duration and time of year the pumping operations will occur.

For successful joint testing, or sealing operations, the depth of flow at the upstream manhole must be within the recommended limits for pipe sizes given below:

- 6-inch to 10-inch pipe: 0% to 20% of pipe diameter
- 12-inch to 24-inch pipe: 0% to 25% of pipe diameter
- 27-inch and up pipe: 0% to 30% of pipe diameter

When depth of flow is greater than recommended above, the flow must be reduced by plugging or by pumping and bypassing the flow.

302.2.2 EQUIPMENT

When pumping is required, furnish pumps, conduits, and other related equipment to facilitate sewage conveyance as needed for the work. The pump must be continuously manned while running, including after hours. Equipment not operating continuously must be tested weekly. SacSewer's staff must approve the bypass pumping plan.

In addition to the primary equipment, backup or standby equipment must be available on-site should the primary system fail. All equipment must be in good working order, must not leak, and must be approved by SacSewer.

Provide the labor and supervision to set up, operate, maintain, and monitor the pumping system. Select pumping equipment that meets the jurisdictional agency's noise requirements.

302.2.3 SUBMITTALS

Prepare and submit a bypass pumping plan to SacSewer for approval as part of the Access Permit package. The access permit, including the bypass plan, must be approved before implementing the bypass plan. The bypass plan must contain the minimum information required, such that SacSewer's staff has the information necessary to evaluate and prioritize a response to emergency conditions. The minimum information includes but is not limited to the following:

- A map with the exact location of manholes to be plugged
- A map with the exact location of bypass suction and discharge
- A map identifying the two lowest manholes and two points most likely to overflow
- Valve type, identified on bypass map
- Bypass pumping plan, including a contingency plan
- Identify how the bypass pumps will be monitored and controlled
- Equipment: pump type, pump capacity, pipe type, pipe diameter, pipe length
- Sewer Spill and Sewer Overflow Response Plan
- Hydrograph, estimated hours of non-operation possible from SacSewer's Business Planning, Hydraulic Management Group
- A process for alarming for issues that may occur (i.e., auto-dialer, SCADA)
- A detailed list of responders being notified after hours and weekends, with estimated response times
- Monitoring and log details

302.2.4 EXECUTION OF WORK

Discharge

When temporarily discharging bypass flow into SacSewer's system, an Access Permit is necessary in accordance with the *SacSewer Sewer Ordinance*. Please refer to Section 307.4, "Disposal of Water" of these Standards. Flows must be diverted, trucked, or otherwise handled to prevent flows from interfering with the work to be performed.

Discharge bypassed flows to the sewer collection system in accordance with the Access Permit, an appropriate watertight vehicle, or an appropriate watertight container.

Main Line Plugging

The main line may be plugged upstream of the section being repaired with prior written approval from SacSewer. After the work has been completed, restore sewage flow to normal. Install plugs in the upstream (incoming) pipe of a manhole. SacSewer may require double plugs. Equip the plug with an air hose to permit deflation from above ground. Attach and properly secure a strong rope above ground to quickly pull the plug out of the manhole. All plugs must be inflatable. Mechanical plugs are not allowed. Do not allow the plug to be pushed into the outgoing pipe when the sewage backup is released.

Existing SacSewer Sewer Cleanouts

When performing rehabilitation operations, locate and uncover all existing SacSewer cleanouts before starting construction. If a cleanout cannot be located, locate the lower lateral and install a cleanout as illustrated in the lower lateral drawings in Section 501, "Standards Plans" of these Standards, before proceeding with sewage bypass or flow control measures.

Precautions

When the flow in a pipeline is reduced, plugged, or bypassed, precautions must be taken to ensure that operations do not cause flooding or damage to public or private property. The contractor assumes the responsibility for all damage resulting from flow control operations.

Closely monitor a minimum of the two lowest manholes in the connecting collection system and be alert for situations such as residential flooding that would be likely to occur.

Sewage Overflow

If any sewage, liquid, or solid matter is spilled, discharged, leaked, or otherwise deposited to the open environment due to bypassing or flow control operations, ***immediately*** notify SacSewer at (916) 875-6730 and perform required cleanup operations at no additional cost to SacSewer. Comply with all local, State, and Federal regulatory requirements regarding overflows. When setting up bypass pumping, every pump used must have an SacSewer-approved spill containment berm.

Improper disposal of sewage or solids removed from the sewer collection system may result in fines imposed by regulatory entities. In addition, there are civil and criminal penalties for improper disposal of removed materials under Federal, State, regional, and local laws and the *SacSewer Sewer Ordinance*. The contractor will be responsible for all costs associated with improper disposal of sewage or solids.

302.3 COORDINATION WITH EXISTING OPERATIONS

Contractors must plan and execute work without interfering with or interrupting SacSewer's personnel or system operations while maintaining the reliability of SacSewer's sewer collection system at all times.

SacSewer will stop or restrict all activities that have or could result in an unauthorized discharge or permit violation. The contractor is responsible for all costs incurred for unauthorized discharges or permit violations, including fines.

Access to SacSewer's assets is allowed only when approved by SacSewer. To obtain access, submit an Access Permit package, available online at www.sacsewer.com, to SacSewer at least 10 days before starting work for review and approval before entering or connecting to the existing SacSewer's sewer collection system.

302.4 CONFINED SPACES

Only authorized personnel may remove existing SacSewer's manhole covers because potentially explosive and/or lethal, poisonous gases may be present. If access to any existing SacSewer manhole is necessary for design or construction purposes, submit an Access Permit package to SacSewer for review and approval. SacSewer's Access Permit is located on SacSewer's website at www.sacsewer.com.

All manholes and specific structures in the SacSewer's sewer collection system are designated as confined spaces. They require special procedures and personnel to open, "break the plane" of the opening, or enter according to the *California Code of Regulations*, *Title 8*. Identify pipeline inspections that require confined space entry before starting fieldwork. Only individuals certified for confined space entry are allowed to open or enter these manholes or structures.

Perform continuous atmospheric testing to prevent personnel from being overcome by noxious gasses. Do not open or enter a facility if the gas detector alarm sounds. If the alarm sounds, follow all procedures in your confined space policies or procedures.

Submit a plan for confined space entry to SacSewer, in accordance with the Access Permit submittal requirements, before entering a manhole. Follow the latest edition of the *County Specifications* for all manhole entries.

302.5 ODOR MITIGATION

When working in SacSewer's existing facilities, exercise caution and comply with Cal OSHA requirements when working in the presence of hydrogen sulfide and other offensive odors.

To minimize the dispersal of odors above ground:

- Seal all open manholes or access openings in the pipelines when operations have been suspended for a period of 2 hours or more.
- Vent and filter hydrogen sulfide gases upstream of the openings in the pipeline during construction operations when open manholes or access openings cannot be sealed.

- Ensure that the hydrogen sulfide gas level does not exceed 5 parts per million (by volume) at the outside wall of any habitable structure or at any point within 25 feet of the opening.

302.6 LOWER LATERAL CONNECTION TO EXISTING MAIN LINE

SacSewer will make all lower lateral taps to existing collectors. Submit a plan for the lower lateral to SacSewer for review and approval before starting construction. Submit an application to SacSewer and pay the required fees for all taps at least 10 working days before the date the tap is needed. The contractor is responsible for all materials, traffic control, excavation, sheeting, shoring, bracing, backfilling, and compacting, and all curb, gutter, sidewalk, and pavement restoration. All aforementioned items must be in conformance with all Cal OSHA, other applicable safety standards, and jurisdiction requirements. All shoring, bracing, and the lower lateral must be in place before SacSewer's personnel installs the tap.

Fees charged for the construction of the main line tap in accordance with the *SacSewer Sewer Ordinance* are based on a single visit to the site. If access to the main line is not to SacSewer's satisfaction, the contractor will compensate SacSewer for the extra time and materials necessary to complete the tap installation.

If there is an existing lower lateral stub, a State of California licensed plumbing contractor will perform a TVI after connecting to an existing lower lateral stub. The TVI verifies that the lateral is in good working condition and free of all debris. If the stub found is damaged, notify SacSewer, and SacSewer will make all repairs to the existing lateral stub at SacSewer's expense.

SacSewer is not responsible for locating lower lateral stubs or main line taps.

302.7 LOWER LATERAL CONNECTION TO EXISTING MANHOLE

SacSewer will make all lower lateral taps to existing manholes. Submit a plan for the lower lateral to SacSewer for review and approval before starting construction. Submit an application to SacSewer and pay the required fees for all taps at least 10 working days before the date the tap is needed. The contractor is responsible for all materials, traffic control, excavation, sheeting, shoring, bracing, backfilling, and compacting, and all curb, gutter, sidewalk, and pavement restoration. All aforementioned items must be in conformance with all Cal OSHA, other applicable safety standards, and jurisdiction requirements. All shoring, bracing, and the lower lateral must be in place before SacSewer installs the tap.

Fees charged for constructing the manhole tap in accordance with the *SacSewer Sewer Ordinance* are based on a single visit to the site. If access to the manhole is not to SacSewer's

satisfaction, the contractor will compensate SacSewer for the extra time and materials necessary to complete the tap installation.

SacSewer must have access to enter the manhole and surrounding area to set up the equipment necessary to enter the manhole. The contractor must preserve an area extending at least 3 feet beyond the edge of the manhole for setting up the equipment necessary to enter the manhole.

Excavation depth at the manhole must be a minimum of 1 foot below the desired flow elevation to allow SacSewer's staff room to core the hole for the pipe connection. If there is an existing lower lateral stub, a State of California licensed plumbing contractor will perform a TVI after connecting to an existing lower lateral stub. The TVI verifies that the lateral is in good working condition and free of all debris. If the stub found is damaged, notify SacSewer. SacSewer will make all repairs to the existing lateral at SacSewer's expense.

302.8 MODIFICATION OF STRUCTURES

Penetrate existing structures by coring only. Jack hammering is not allowed.

302.9 FACILITIES ABANDONMENT

302.9.1 GENERAL

Obtain all necessary permitting and properly dispose of all removed material, including soils. Submit the certification of proper disposal. An abandonment plan may be required at SacSewer's discretion.

Perform a hazard assessment of the site to detect the presence of soil contamination. An environmental assessment may need to be performed before the property can be surplused and sold. Remove all contaminated soil discovered by the hazard assessment from the site. Meet all Federal, State, and local hazardous material handling requirements.

Fill voids resulting from abandoned or removed structures with import borrow material, in accordance with these Standards, and compact to a relative minimum compaction of 90% or in accordance with jurisdictional agency's requirements, whatever is higher. If the voids are in surfaced areas otherwise to remain undisturbed, backfill the voids with materials equal to or better in quality, and to the same thicknesses as the surrounding materials, as directed by the jurisdictional agency.

302.9.2 PIPES

When abandoning a pipe within specified limits, also abandon all structures and appurtenances within said limits.

Remove and dispose of all abandoned pipes within 2 feet below subgrade. Pipes that are lower than 2 feet below the roadway subgrade or finished grade will be either removed or the ends plugged with Class B-2 concrete.

At SacSewer's discretion, fill large diameter pipes or pipes located under major roads or freeways, railroads, drainage channels, or sensitive structures with CLSM.

Lower laterals shown on SacSewer's maps but not encountered during regular construction operations do not need to be abandoned based on the requirements of this section.

302.9.3 MANHOLES

Unpaved Surface

- Remove the upper portion to a depth of at least 5 feet below the proposed grade, or as required by the jurisdictional agency, whichever is greater.
- Fill the abandoned manhole with CLSM to a minimum of 1 foot above the crown elevation of the highest pipe, to the top of the manhole barrel.
- Fill remaining void with native soil or aggregate base with relative compaction of 90% or, as required by the jurisdictional agency, whatever is higher.

Paved Surface

- Remove the upper portion to a minimum depth at or below the bottom of roadway or pavement structural section, or as required by the jurisdictional agency, whichever is greater.
- Fill the entire manhole that remains in place with CLSM.

Seal and abandon the pipes connected to the structure as described in Section 302.9.2, "Pipes" of these Standards.

302.9.4 PUMP STATIONS AND FACILITIES

General Site Abandonments

Contact SacSewer at least 60 days before beginning abandonment procedures for pump stations. Take all necessary precautions to prevent damaging any existing utilities. Review and amend the latest edition of the SWPPP or WPCP as necessary and have it approved by SacSewer 30 days before beginning the abandonment process.

Schedule a site visit with SacSewer within 30 days of beginning construction so SacSewer can identify and remove all salvageable electrical and mechanical equipment; subsequently, remove and discard the remaining unsalvageable equipment.

Drain and dispose of all diesel tanks in a safe and legal manner. The contractor must also remove all buildings, pads, radio towers, power poles, and fences from the site.

Wet Wells

Remove the top of the wet well to 5 feet below the final grade. Backfill the wet well with CLSM to 5 feet below the site grade, and backfill the remaining 5 feet below the site grade with native soil or aggregate base with a 90% relative compaction or as required by the jurisdictional agency, whatever is higher.

Valve Vaults

Remove and dispose of valve vaults. Fill the void with native soil or aggregate base with 90% compaction or, as required by the jurisdictional agency, whatever is higher.

Force Mains

Remove the remaining sewage in the pressurized pipeline in a safe, non-hazardous manner. Rinse the pressurized pipeline with water and remove the rinse water. Remove the force main on-site to the property line. Fill pressurized pipelines located under freeways, drainage channels, or sensitive structures with CLSM. Apply concrete caps to both ends of the abandoned force main.

Underground Utilities

Remove all underground utilities from the site to the property line. Complete abandonment of the remaining utilities in accordance with the utility company's standards.

302.9.5 SITE RESTORATION

After completing all of the steps necessary to abandon the pump station, restore the site as follows:

- Remove all remaining concrete and asphalt from the site.
- Backfill the site to the original ground level with 8 inches of topsoil.
- Slope the site to drain appropriately.
- Landscape the site.
- Address all post-construction storm water requirements of the State Water Resources Control Board.

302.9.6 FENCES

Carefully remove all fence material and gates to be relocated or reset to prevent damage to the material. Remove all adhering concrete footings from fence posts and braces that are to be relocated or reset.

Relocated or reset fences must provide 2 feet minimum clearance from fire hydrants or as required in accordance with the jurisdictional agency.

Furnish and erect temporary chain link fencing to replace existing fencing to secure or contain the property as directed by the jurisdictional agency.

Materials removed from existing fences that will not be reused become the contractor's property and will be disposed of at the contractor's expense.

302.9.7 CONCRETE

If the concrete structure is in the public ROW, follow the jurisdictional agency's requirements for concrete removal. All concrete that is not to remain in place must be disposed of at the contractor's expense.

302.10 MEASUREMENT AND PAYMENT

Include all costs to protect existing facilities in various work items; do not include a separate line item for protecting existing facilities.

Payment for removing, resetting, relocating, adjusting, or working on existing facilities, including disposal and salvaging, is based on prices for the work items in the contract documents.

The contract price for relocating or resetting the existing fence includes the following:

- Supplying all labor, materials, tools, equipment, and incidentals
- All work involved in removing materials, PCC fence footings, and gates
- Clearing fence lines and disposing of the resulting material
- Excavating high points in the existing ground between posts
- Excavating hole
- Disposing of surplus excavated material
- Supplying and placing PCC footings
- Connecting the fences to structures and existing cross fences
- Constructing temporary fences

Relocating or resetting existing fencing is paid per linear foot.

If the contract documents do not have a line item for relocating or resetting fences, SacSewer understands that payment for these services is included in the various items of work involved, and no separate payment will be made.

Removing traffic stripes, traffic reflectors, and pavement markings are measured by the linear foot of 4-inch traffic stripes. To determine quantities, convert stripes of widths other than 4 inches to an equivalent length of a 4-inch stripe. Only measure traffic stripes with gaps or skipped striping portions with traffic striping. Do not measure gaps without striping. Traffic stripe is paint, thermoplastic, or other approved equal striping material. The unit price bid for stripe removal includes all material, tools, labor, and equipment to remove the traffic stripes and pavement markings, all debris from the roadway, and disposal of all waste.

303 DUST CONTROL

303.1 GENERAL

Dust control consists of applying water or dust palliative to alleviate or prevent dust nuisance resulting from the work, either within or outside the work ROW. All dust control activities must comply with the jurisdictional agency's requirements.

Perform dust control any time dust resulting from work becomes a nuisance or visual impediment or as directed by the jurisdictional agency. Failure to control dust adequately will be cause for the jurisdictional agency to suspend work or for the jurisdictional agency to perform such activity with all costs to be borne by the contractor.

The contractor, for the contractor's convenience, may perform the application of water for dust control. Apply water as directed by the jurisdictional agency's requirements.

The contractor must adhere to the latest edition of the SWPPP or WPCP requirements and approved work amendments.

303.2 DUST PALLIATIVE

Apply dust palliative when in the jurisdictional agency's opinion this type of dust control is required. Dust palliative must meet the most current versions of the jurisdictional agency, WPCP, SWPPP, and California Air Resources Board standards.

304 CLEARING AND GRUBBING

304.1 GENERAL

Clearing and grubbing consist of removing all objectionable material and material designated for removal within the work site or other designated areas directed by SacSewer.

For restoration requirements, please refer to Section 327, "Surface Restoration," of these Standards.

Clearing and grubbing operations must not cause more than minimal damage to public and private property, including existing improvements such as trees, irrigation and drainage systems, or shrubbery.

304.1.1 VEGETATION AND DEBRIS

The contractor must remove and dispose of designated vegetation, such as weeds, grass, shrubbery, roots, stumps, and debris, such as broken concrete and trash, from the ROWs or construction areas. Protect remaining vegetation in place.

304.1.2 TREES, SHRUBS, AND GROUND COVER

Removal of existing trees includes removing tree stumps and tree roots 2 inches or larger in diameter to a minimum depth of twelve inches below the grading plane. Removed trees, stumps, and roots become the property of the contractor, and must be removed from the project site. Promptly remove all debris resulting from tree removal, including broken branches, fallen leaves, wood chips, and sawdust produced from stump and root removal work from the work site. If the tree to be removed is within the drip line of any other tree that is to remain, the tree removal work must be done under the direction of a certified arborist. Backfill the holes resulting from a tree stump and tree root removal activities.

For these Standards, trees, shrubs, and ground cover are defined as follows:

- Trees: A trunk diameter of 3 inches and greater measured at the height of 4-$^1/_2$ feet above the ground
- Shrubs: A single or multi-stem individual plant, not of tree size
- Ground cover: A multiple spreading and matting plant material of a density to cover bare ground, including turf lawn

Only dispose and remove plant material as shown on the plans. Before clearing and grubbing operations on a particular property or portion of the work site, the jurisdictional agency will mark and designate the trees, shrubs, and ground cover areas to be removed and disposed of.

Trees, shrubs, and ground cover that are not to be removed must be protected from injury or damage in accordance with all requirements of the jurisdictional agency.

Comply with the jurisdictional agency's requirements and the plans for trees, shrubs, and ground cover designated to be relocated.

The contractor to obtain a certified arborist and submit the name to the jurisdictional agency in writing a minimum of 10 working days before starting clearing and grubbing operations.

Please refer to Section 327, "Surface Restoration," of these Standards for restoration requirements.

304.1.3 TREE TRIMMING

Trim trees in accordance with jurisdictional agency's requirements. Limit tree trimming to tree limbs requiring removal to allow for the minimum required vehicular clearance.

Trim tree branches or portions of shrubs that extend over a roadway to provide a minimum clearance of 14 feet above the shoulder point of the roadbed unless specifically permitted otherwise in writing by the jurisdictional agency. The tree or shrub branches to be removed must be removed by a tree trimmer certified by the International Society of Arboriculture at the Contractor's cost.

Limit tree root cutting to what is required for earthwork operations to minimize the impact on surrounding existing trees. All roots of trees designated for removal $^1/_2$ inch in diameter or greater will be cut cleanly and sealed as directed by the certified arborist or by the certified arborist's staff.

Any root cutting on trees to remain that, in the opinion of the certified arborist, will jeopardize the health or stability of the tree must be brought to the attention of the jurisdictional agency for specific instructions before cutting the roots.

The Contractor must not cut or remove any roots that are 2 inches in diameter or greater without consulting SacSewer. SacSewer may require evaluation by a certified arborist to identify the impacts of root removal. If the Contractor removes tree roots 2 inches and greater without consulting SacSewer, the Contractor is responsible for all costs related to any damage done to the tree, including but not limited to arborist evaluation, removal, disposal, and compensation for loss of value and use of the tree.

304.1.4 Disposal and Salvage

All materials removed will become the property of the contractor and must be disposed of in the appropriate landfill or recycling facility unless otherwise directed by SacSewer. Existing public or private improvements that are designated in the plans to be salvaged must be carefully removed, stockpiled, and protected in the ROW or easement for later removal by the jurisdictional agency or the adjacent property owner.

304.1.5 Silt Control

Comply with the jurisdictional agency's requirements for erosion, sediment, and water pollution control during all clearing and grubbing operations. Comply with the latest edition of the SWPPP, WPCP, and the current State Water Resources Control Board *Construction General Permit*.

304.2 Measurement and Payment

All work associated with tree removal is paid per tree based on the various categories of trees and the specified ranges of trunk diameters listed in the proposal. Measure the diameter of the tree trunks to be removed at a height of $4\text{-}^{1}/_{2}$ feet above the ground surface.

Payment for tree removal includes the following:

- All labor, tools, and equipment used to remove and dispose of the tree, stump, roots, and all debris
- All required services of a certified arborist
- Backfilling of all tree removals
- Repair and replanting of all disturbed landscaping, including all incidentals

If there are no line items for tree removal services, SacSewer understands that all work, including removals, disposals, required services of a certified arborist, earthwork, and landscaping, is included in the lump sum price paid for clearing and grubbing and will not pay additional costs for tree removal services.

Clearing and grubbing includes the following:

- Supplying all labor, materials, tools, equipment, and incidentals necessary to perform the work.
- Protecting existing trees as shown or specified in the plans or as directed by the jurisdictional agency, including the removal and disposal of all the resulting material.

Clearing and grubbing is paid at a lump sum price. Include removal of all concrete and existing storm drain facilities as shown in the plans or as otherwise directed by the jurisdictional agency in the price paid for clearing and grubbing. SacSewer will not pay additional costs associated with concrete or storm drain removal.

If there is no line item for clearing and grubbing, SacSewer understands that clearing and grubbing is included in the prices paid for the individual items of work requiring clearing and grubbing and will not pay additional costs for clearing and grubbing.

305 Water Used In Construction

305.1 General

Water used in construction must conform to the current version of Section 10-6, "Watering," of the *State Specifications* and the jurisdictional agency water purveyor's standards.

Obtain all the necessary permits from the local water agency and comply with the requirements of the local water agency during the construction period.

The contractor must not use the customer's water services without securing permission first. If the Contractor uses a customer's water without permission, the Contractor may be required to compensate the homeowner for the cost of water use.

Excavated areas may be watered before excavation. Excess water is the responsibility of the contractor.

Make arrangements for obtaining water for use in construction. Proof of such arrangement, including method of payment, will be subject to review and approval by the jurisdictional agency.

Adhere to all storm water pollution control requirements, including those in the latest edition of the *County Specifications*. The contractor must also comply with the latest edition of the SWPPP and the current State Water Resources Control Board *Construction General Permit* to prevent sediment from entering waterways and the storm drain system.

305.2 Measurement and Payment

Include all costs incurred for water used in construction with various work items involving the use of water; do not include water use as a separate line item for payment.

306 Earthwork

306.1 General

Earthwork must conform to the latest edition of the *State Specifications*. All references to the "roadway prism," "roadway facilities," "roadway," and "SacSewer's facilities" means the applicable project features shown on the plans.

The method and rate of applying water for earthwork and dust control must conform to State and jurisdictional agency's requirements.

All earthwork must conform to State and jurisdictional agency's requirements for sedimentation and erosion control.

306.2 Subgrade Preparation

Strip all organic materials that exist within facilities from the ground surface before grading. Stripping should extend a minimum of 2 to 3 inches below the existing surface. Organic materials stripped from the ground become the property of the contractor and must be removed from the job site. After removing stripped material, areas receiving fill material or new structural sections must be scarified to a depth of at least 8 inches, moisture conditioned, and re-compacted to a relative compaction of not less than 90% in unpaved areas and a relative compaction of 95% in paved areas, unless exceeded by the jurisdictional agency. Site soils will not be considered unsuitable solely because the soils are above optimum moisture content.

306.2.1 Relative Compaction

Whenever relative compaction is specified, the relative compaction will be determined by *California Test Method 231,* with the exception that an individual test result may not be reported as a representative test result.

306.2.2 Measurement and Payment

Measurement and payment for facilities excavation must conform to the latest edition of the *State Specifications,* with the exception that the contract price paid per cubic yard for facilities excavation also includes all the following work:

- Compaction of the natural and original ground
- Subgrade preparation
- All haul and off-haul
- Excavation
- Placement of earth embankment as shown on the plans and as directed by SacSewer
- Supply of all water necessary for the compaction of the material and subgrade preparation.
- Shape and trim of slopes to solid material and to the lines and elevations shown on the plans.

No additional compensation will be allowed for proof rolling subgrade as directed by SacSewer, removing unsuitable material from the work site, or placing unsuitable material in the facilities' access road embankment.

Payment for Class 2 aggregate base used as backfill in place of unacceptable material encountered during facilities excavation is paid for as detailed in Section 311, "Trench Excavation, Bedding, and Backfill" of these Standards.

306.3 Imported Borrow

306.3.1 General

Obtain imported borrow from sources listed in the plans. If no sources are listed, provide sources to SacSewer for approval before starting construction. Imported borrow must be free of roots, organic matter, and other unsatisfactory material and readily bind to form a firm and stable base when compacted.

The imported borrow material must have a sand equivalent of not less than the average sand equivalent of the native material that is adjacent to the existing roadbed and an R-value of not less than 20. The contractor must test all imported fill before transporting it to the project site.

If no item for imported borrow appears in the contract, the earthwork will be considered balanced with no imported material required. If SacSewer deems it necessary to place imported borrow due to field conditions, shrinkage, or swell factors experienced, the imported material must be furnished and placed as extra work, as provided in the latest edition of the *County Specifications*.

306.3.2 AGREEMENTS

The contractor must enter into an agreement with the property owner of all privately owned material sites to hold the property owners harmless from all claims for injury to persons or damage to property resulting from operations on the property. The agreement must contain provisions to relieve SacSewer of all obligations to the property owner and/or claims for injury or damage to persons or property. Provide a copy of the agreement to SacSewer a minimum of two working days before starting operations at the material site. Please refer to Section 6-1.03, "Local Materials," of the *State Specifications*, the latest edition, regarding local materials and their sources.

306.3.3 PLACEMENT

Place and compact imported borrow material in accordance with Section 311, "Trench Excavation, Bedding, and Backfill" of these Standards.

306.4 SURPLUS MATERIALS

Surplus excavated materials will become the property of the contractor and must be disposed of appropriately.

306.4.1 GENERAL

Surplus materials resulting from excavations that are not required for backfill become the property of the contractor. The contractor must dispose of the surplus materials off the ROWs and easements unless permitted by SacSewer to dispose of the material on the work site.

306.4.2 AGREEMENT

When materials are disposed of outside the ROWs or easements, obtain written permission from the property owner upon whose property the disposal is to be made. Also, enter into an agreement with the property owner to hold the property owner harmless from all claims for injury to persons or damage to the property resulting from the operations on the property. The agreement must contain provisions to relieve SacSewer of all obligations to

the property owner for all injuries or damages to persons or property. The agreement must also include a sketch showing the location where the material will be deposited.

Provide a copy of the permission obtained from the property owner and the agreement to SacSewer a minimum of 2 working days before starting disposal operations. Do not deposit excess materials in any location that will block or restrict a natural or artificial drain. Do not deposit material within the drip line of certain ornamental, landmark, and native oak trees, as specified in the latest edition of the *County Specifications*.

306.4.3 PERMITS

If copies of all required permits are not provided to SacSewer immediately upon request, the work may be stopped, in accordance with the latest edition of the *County Specifications*, until such copies of permits are provided to SacSewer.

The contractor or property owner where excess material will be deposited is responsible for obtaining all required permits from all agencies that may have jurisdiction over the proposed disposal site. Provide copies of all required permits to SacSewer. No permits will be required if disposal sites are shown on the plans.

When disposing of materials outside the ROWs or easements that would affect any waterway as set forth in *Ordinance No. 1* of the County of Sacramento Water Agency, obtain a permit from that agency, in addition to the property owner agreement as set forth in the preceding section.

In addition to permits required by the County of Sacramento Water Agency, disposed of material must conform to the jurisdictional agency grading ordinances. The contractor or the owner of property on which material is to be disposed of must obtain a grading permit, if required, prior to disposal of any excess excavated material.

Before placing any material within the 100-year floodplain of any of the thirteen natural streams as adopted by the Board of Supervisors, the contractor or property owner must first obtain a Use Permit from the appropriate jurisdictional agency.

306.4.4 MEASUREMENT AND PAYMENT

No separate payment will be made for the disposal of surplus material; all compensation is included in the payment for other earthwork items.

307 DEWATERING

307.1 GENERAL

Furnish a dewatering system and appurtenances to be used during construction, including those for installing, maintaining, and operating for control of water within the project.

If water is encountered during excavation, dewatering must be commenced and must proceed in advance of or concurrently with further excavation.

The excavation must be free of water at the time facilities are placed. Water control must continue as necessary to prevent damage to work, as stated in the latest edition of the *County Specifications*.

Submit a dewatering plan to SacSewer for review and approval before starting excavation.

307.2 REQUIREMENTS

Comply with all Federal, State, and local laws and regulations concerning environmental pollution arising from construction activities. Dewatering procedures must conform to the rules of the State Regional Water Quality Control Board and the *Clean Water Act*. Obtain all required permits.

Provide system redundancy as required to keep excavations free of water in the event of pump failure or failure of other components.

The design must acknowledge the type of excavation and support system proposed for the project. The depth of the dewatering system provisions must be in accordance with the recommendation specified in the geotechnical report.

Dewater a minimum of 3 feet below the bottom of the excavation or, as required by the geotechnical report, whatever is higher.

Dewater all trenches and all other parts of the construction site and keep them free of standing water, run-off, rain, perched, drainage, and muddy conditions as necessary for the proper execution of the work. Groundwater control must be such that softening of the bottom of excavations or formation of quick conditions or boils does not occur.

307.3 EROSION AND POLLUTION CONTROL

Remove water from the construction site and borrow areas in a manner that minimizes erosion and the transporting of sediment and other pollutants.

Dewatering systems must prevent the removal of natural soils. Dewatering must allow the required compaction of the subgrade to the values specified in the plans. Do not allow water to enter the bottom of the excavation or drained excavations until the pipeline or other facilities are backfilled or restrained to prevent flotation.

307.4 DISPOSAL OF WATER

Dispose of water resulting from dewatering operations in a suitable manner without damage to the adjacent property. Comply with all conditions described in the dewatering discharge permit obtained by the contractor from Regional Water Quality Control Board, the jurisdictional agency's requirements, and as outlined in the SWPPP, WPCP, and the State Water Resources Control Board *Construction General Permit* most current standards versions.

307.5 MEASURE AND PAYMENT

Payment for all activities necessary for dewatering is included in either excavation or the item of work requiring the excavation when the excavation is not paid for separately. SacSewer will not pay for dewatering as a separate line item on contracts.

308 CONSTRUCTION MATERIALS

This section indicates the requirements for various classes and types of materials used in construction. Describe and specify any materials not included in this section in the plans.

308.1 APPROVED EQUAL

The words "approved equal" mean any material deemed by SacSewer to be acceptable as compared to products of specified manufacturers. Submit all necessary documentation for materials that are not specifically named as an approved equal. Submit deviations to the Standards according to the requirements shown in the Request for Deviation form available on SacSewer's website at www.sacsewer.com. Allow 20 working days review time for material deviation requests.

308.2 PORTLAND CEMENT

Please refer to Section 50-1, "Portland Cement" of the *County Specifications*, latest edition.

308.3 CONCRETE AGGREGATES

Concrete aggregates must conform to *ASTM C33*, except that grading requirements will be as specified in Section 90-1.01, "Aggregate Gradation," of the *State Specifications*, latest edition.

308.4 WATER FOR CONCRETE

Please refer to Section 50-3, "Water for Concrete" of the *County Specifications*, latest edition.

308.5 PRE-MOLDED EXPANSION JOINT FILLER

Pre-molded expansion joint filler material must conform to *ASTM D1751*.

308.6 PORTLAND CEMENT CONCRETE

Please refer to Section 50-5, "Portland Cement Concrete" of the *County Specifications*, latest edition.

308.7 CURING COMPOUNDS FOR CONCRETE

The compounds must meet the most current requirements of the *State Specifications*.

308.8 AGGREGATE BASES

Aggregate bases must conform to the most current requirements of the *State Specifications*. The combined aggregate must conform to the gradation requirements specified for the $^{3}/_{4}$ inch maximum aggregate for the Class 2 aggregate base.

308.9 COBBLES

Clean, naturally occurring water-rounded particles of rock passing a 12-inch square opening and retained on a 3-inch sieve.

308.10 GEOTEXTILE FABRIC

Label each roll of fabric used in accordance with *ASTM D4873*. Geotextile fabric sampling and testing must conform to the requirements of *ASTM D4354*. Specification conformance for geotextile fabric must conform to the requirements of *ASTM D4759*. Storage and handling of the geotextile fabric must conform to the requirements of *ASTM D4873*. Handle and place geotextile fabric in accordance with the manufacturer's recommendations.

308.10.1 NONWOVEN GEOTEXTILE FABRIC

Use nonwoven geotextile fabric consisting of long-chain polymeric fibers composed of polypropylene, polyethylene, or polyamide. The fibers must be oriented into a random web and stabilized to retain the relative position of the fibers. The geotextile must be free of all chemical treatments and coatings and be inert to chemicals commonly found in soil.

The geotextile must conform to the physical property requirements listed in Table 308-1.

Table 308-1: Nonwoven Geotextile Properties

Physical Property	Test Method	Acceptable Minimum Test Results
Tensile strength (lb)	ASTM D4632	200
Elongation (%)	ASTM D4632	50
Permittivity (sec-1)	ASTM D4491	1.5
Puncture strength (lb)	ASTM D4833	120
Mullen burst strength (psi)	ASTM D3786	380

Note: Use tension testing machine with ring clamp, steel ball replaced with a $^{5}/_{16}$ inch diameter solid steel cylinder, with a flat tip and beveled edges, centered within the ring clamp.

Propex 4553, as manufactured by Propex Fabrics Inc., meets these specifications.

308.10.2 WOVEN GEOTEXTILE FABRIC

Use a high modulus woven fabric consisting of long-chain polymeric monofilaments, slit film tapes, or multifilament tape and nonwoven yarn of polypropylene, polyester, or nylon, inert to commonly encountered chemicals, rot proof, and resistant to UV light exposures, insects, and rodents. The fabric must be woven into a stable network, and the edges of the fabric must be selvaged or surged so that the fabric will not unravel or fray during installation or usage.

The geotextile must conform to the physical property requirements listed in Table 308-2.

Table 308-2: Woven Geotextile Properties

Physical Property	Test Method	Acceptable Minimum Test Results
Tensile strength (lb)	ASTM D4632	200
Weight (oz/cy)	ASTM D5261	6.0
Equivalent Opening Size (US Standard Sieve)	USACE CW-02215	50
Permittivity (sec-1)	ASTM D4491	0.05
Mullen burst strength (psi)	ASTM D3786	400

Note: Tension testing machine with ring clamp, steel ball replaced with a $^{5}/_{16}$ inch diameter solid steel cylinder, with a flat tip and beveled edges, centered within the ring clamp.

Geotextile fabric must be Mirafi 600X or approved equal.

308.11 Cement Treated Bases

Transit-mixed and plant-mixed cement treated base must comply with the most latest edition of the *State Specifications*.

308.12 Lime Treated Bases

Please refer to Section 50-12, "Lime Treated Bases," of the *County Specifications*, latest edition.

308.13 Sand

Please refer to Section 50-13, "Sand," of the *County Specifications*, latest edition.

308.14 Controlled Low Strength Materials

All CLSM must conform to *ACI 229R* and have a 28-day unconfined compressive strength of 50 to 125 psi. The cement must be Type I or Type II Portland cement conforming to *ASTM C150*. Blended hydraulic cement conforming to *ASTM C595* may be used with SacSewer's written approval after submitting test results. Fly ash must be in accordance with *ASTM C618*. Air entraining admixtures and foaming agents are permitted.

Water quality must conform to *ASTM C94*.

Aggregates must comply with *ASTM C33*. Aggregates will be sand with no more than 10% passing a #200 sieve. If fly ash is not used in the mix design, the amount passing the #200 sieve

can be increased to 20%. Do not use soils with clay fines. If requested, submit a mix design and test results to SacSewer for approval before starting excavation.

308.14.1 PROPERTIES

The CLSM must have a high flow ability with greater than 8 inches and not greater than 10 inches slump, as measured using *ASTM C143*. The separation of constituents in the mixture during fluid movement is not permitted.

308.14.2 MIXING, TRANSPORTING, AND PLACING

Mix, transport, and place CLSM in accordance with the methods and procedures given in *ACI 304R* and *ACI 304.6R*.

Before placing the CLSM:

- The trench must be free of loose soil.
- The trench bottom must be stable and non-yielding.
- There must be no excess moisture present.
- The pipe bells must be supported so there is at least 3 inches of separation from the bedding material.
- All bedding material must be removed from the pipe haunches.

Place the CLSM along the full width and length of the trench, and covering the top of the pipe bell. Place the CLSM on both sides of the pipe simultaneously to minimize the potential for lateral displacement of the pipeline.

The pipe sections may need to be secured against floating during CLSM placement. The CLSM may be placed in lifts to reduce the potential for flotation to occur.

308.14.3 BACKFILL

Backfill above the CLSM may commence only when placement and compaction of the backfill will not cause deformation of the CLSM or at SacSewer's direction.

308.14.4 QUALITY CONTROL

Sample in accordance with *ASTM D5971*. Test CLSM cylinder in accordance with *ASTM D4832*.

Protect the area where the CLSM has been placed. The liquid CLSM will have characteristics similar to quick sand until solidification occurs.

308.15 CRUSHED ROCK

Please refer to Section 50-16, "Clean Crushed Rock," of the *County Specifications*, latest edition.

308.16 ASPHALT

Asphalt means asphalts as specified in the latest edition of the *State Specifications*.

308.17 VITRIFIED CLAY PIPE

Vitrified clay bell and spigot pipe and fittings must meet the minimum 3-edge bearing strength requirements of *ASTM C700 Extra Strength*. In some applications, a higher strength may be required. In these cases, a letter from the manufacturer must be submitted to SacSewer stating the pipe meets the minimum 3-edge bearing strength requirements of *SSPWC "Green Book" Extra Strength* or *SSPWC "Green Book" High Strength.* Provide a Certificate of Compliance from the pipe manufacturer.

Joints must be factory applied resilient type, polyurethane, mechanical compression joints conforming to *ASTM C425* unless SacSewer approves other joint types.

Vitrified clay microtunneling pipe must be manufactured in accordance with *ASTM C1208*. The pipe must not deviate from straight by more than 0.5 inch per linear foot when the maximum offset is measured from the concave side of the pipe. Take measurements by placing a straight edge along the concave side of the full length of the pipe barrel, excluding the joint, and measuring the maximum distance between the straight edge and concave side of the pipe. The ends of the pipe must be perpendicular to the theoretical longitudinal axis within 0.004-inch per inch of the outside diameter.

The sleeve is an element that bridges between the pipe sections and must be made of noncorrosive materials in conjunction with the sealing elements. Stainless steel sleeves must be ANSI Type 316. The compression disk is a flat disk that forms a continuous ring of contact with the ends of the pipe and functions to distribute the jacking forces that develop during pipeline installation. The width of the compression disk must not exceed the maximum wall thickness of the pipe, not extend into the flow, nor inhibit the installation of the sleeve onto the joint of the pipe.

Imperfections in pipes and fittings containing blisters, cracks, and chips in excess of the limits will be rejected.

- Blisters: SacSewer will not accept any pipe containing blisters
- Cracks: SacSewer will not accept any pipes with cracks
- Chips: Chips must not exceed 2 inches long, 1 inch wide, and $^1/_4$ of the barrel thickness deep (but not to exceed $^1/_4$ inch deep). A single pipe must not contain more than two chips.

Before installation, retest all joints older than 180 days from the manufacture date to ensure compliance with these Standards. SacSewer will not accept any joint that is more than two years old, based on the manufacture date of the pipe, or any pipe missing manufacturer documentation.

Field repair of vitrified clay pipe segments, joints, and fittings is limited to removal and replacement of the unacceptable portions of the pipeline.

308.18 SUBSURFACE DRAINS

Subsurface drains must comply with the latest edition of the *State Specifications*.

308.19 DUCTILE IRON PIPE AND DUCTILE IRON FITTINGS

The pipe and gaskets must come from the same manufacturer. Remove all damaged pipe; field repairs are not permitted. All materials and craftsmanship must comply with *AWWA M41*.

308.19.1 PIPE

Coat non-buried pipe and piping in wet wells with a ceramic epoxy as specified in these Standards. An optional coating system for piping within vaults (excluding wet well) may consist of a field coating over bare or standard compatible coating with 10 mils minimum DFT of a 100% solids epoxy as approved by SacSewer. The coating contractor must be certified by the National Association of Coating Engineers.

Use bell and spigot ductile iron pipe for gravity collection systems that conform to *ANSI/AWWA C151/A21.51* with a minimum thickness class of PC250. The pipe class must be in accordance with Table 5 of *ANSI/AWWA C151/A21.51* for the project depth of bury and the laying condition specified.

Ductile iron pipe for pressurized pipelines must conform to *ANSI/AWWA C151/A21.51* for a minimum rated working pressure of 250 psi. The pipe class must be in accordance with

Table 5 of *ANSI/AWWA C151/A21.51* for the project depth of bury and the laying condition specified.

Clearly mark each section of pipe with the nominal pipe size, class, weight, and casting period. The manufacturer's mark, the year the pipe was produced, and the lettering "DI" or "DUCTILE" must be cast or stamped on the pipe.

Line the interior of the pipe with a minimum thickness of 6 mils of Protecto 401 from the bell gasket seat to within 6 inches of the spigot end. Refer to Section 308.19.2, "Protecto 401 Supplemental Specification" of these Standards.

Coat the exterior of the pipe with a bituminous material. All ductile iron pipe and ductile iron fittings must be asphaltic coated at the factory, approximately 1 mil, in accordance with *ANSI/AWWA C153/A21.53*. Top-coat any epoxy-coated pipe exposed to UV with a compatible paint, two coats minimum. A conversion primer may be required for proper adhesion.

All joints for DIP and ductile iron fittings must conform to *ANSI/AWWA C111/A21.11* with standard SBR gaskets. Restrained joints for DIP and ductile iron fittings must be externally restrained mechanical joints (e.g., EBBA Megalug, Sigma One-Lok), manufacturer's push on restrained joints (e.g., American FlexRing, American Field FlexRing), or mechanical rodding. All restrained joints must have a minimum rated working pressure of 250 psi. Use the DIPRA method for restrained joint design. Test the approved restrained joints to withstand the thrust of a blind end assembly at the rated working pressure of either the pipeline or the fitting on which the restrained joint is used with not less than a 2.0 safety factor. Do not use wedging gaskets, such as American FastGrip.

Ductile iron fittings must conform to *ANSI/AWWA C110/A21.10* or *ANSI/AWWA C153/A21.53*. Fittings must have push-on, push-on restrained, mechanical joint, or flanged ends. Ductile iron fittings must have a minimum rated working pressure of 250 psi.

The factory-produced welded-on outlets, both lateral and tangential, are allowed in lieu of tee and wye fittings. Welded-on outlets must be fabricated by the pipe manufacturer at the same facility where the pipe is produced. The pipe manufacturer must have a minimum of five years of experience in the fabrication and testing of outlets of similar size and configuration.

308.19.2 PROTECTO 401 SUPPLEMENTAL SPECIFICATION

The Protecto 401 material must be an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. Request for substitution must be accompanied by a

successful history of lining pipe and fittings for service, a test report verifying the following properties, and a certification of the test results:

- A permeability rating of 0.00 when tested according to Method A of *ASTM E96*, Procedure A, with a test duration of 30 days.
- An abrasion resistance of no more than 3 mils (0.075 millimeters) loss after 1 million cycles using British Standards Institution *EN 598* Section 7.8, "Abrasion Resistance."

Run the following tests on coupons from factory-lined DIP:

- *ASTM B117* Salt Spray (scribed panel): Results to equal 0.0 undercutting after two years
- *ASTM G95* Cathodic Disbondment 1.5 volts at 77 degrees Fahrenheit. Results to equal no more than 0.5 millimeters undercutting after 30 days
- Immersion Testing rated using *ASTM D714*
- 20% Sulfuric Acid: No effect after two years
- 140 degrees Fahrenheit 25% Sodium Hydroxide: No effect after two years
- 160 degrees Fahrenheit Distilled Water: No effect after two years
- 120 degrees Fahrenheit Tap Water (scribed panel): 0.0 undercutting after two years with no effect

308.19.3 SURFACE PREPARATION

Before abrasive blasting, inspect the entire area receiving the protective compound for oil, grease, and other deleterious substances. Solvent clean areas with oil, grease, or substances that can be removed by solvent to remove those substances. After the surface has been made free of grease, oil, or other substances, abrasive blast all areas receiving the protective compounds using sand or grit abrasive media. Strike the entire lined surface with the blast media so that all rust, loose oxides, and other deleterious materials are removed from the surface. Only slight stains and the tightly adhering oxide may be left on the surface. Reblast all areas where rust reappears before lining.

Capture and properly dispose of all abrasive media and all material removed from the pipe surface.

Deliver all ductile pipe and fittings to the application facility without asphalt, cement lining, or any other lining on the interior surface. Because removal of old linings may not be possible, the intent of this specification is that the entire interior of the DIP and fittings are

not lined with any substance before the application of the specified lining material, and no coating is applied to the first 6 inches of the exterior of the spigot ends.

308.19.4 APPLICATION

A competent firm with a successful history of applying Protecto 401 or similar linings to the interior of DIP and fittings must apply all pipe lining.

After surface preparation and within 8 hours of surface preparation, line the interior of the pipe with 40 mils DFT of Protecto 401. No lining will occur when the substrate or ambient temperature is below 40 degrees Fahrenheit. The surface must be dry and dust free. If flange pipe or fittings are included in the project, do not use lining on the face of the flange.

Coat the gasket area and spigot end to 6 inches back from the end of the spigot end with 6 mils nominal, 10 mils maximum using Protecto Joint Compound. Apply joint compound by brush to ensure coverage. The joint compound must be smooth without excess buildup in the gasket seat or on the spigot ends. Coat the gasket seat, and the spigot ends after applying the lining.

Apply the manufacturer's recommended number of coats of lining material to the pipe. Do not apply this material above the dry thickness in accordance with each coat recommended by the lining manufacturer in printed literature. The maximum or minimum time between coats must comply with the time recommended by the lining material manufacturer. To prevent delamination between coats, do not use any material that is not indefinitely recoatable with itself without roughening the surface for the lining.

308.19.5 WASHING

High pressure washing to clean the inside diameter of Protecto 401 Ceramic Epoxy lined DIP and/or fittings may result in damage to the lining. The aggressiveness of the pressure washing is dependent on water pressure, travel speed, water jets, water jet angle to the lining, the distance of the water jets from the lining, the diameter of the pipe, the shape of cleaning heads or other apparatus contacting the pipe lining, and cleaning head or apparatus material. All attempts to pressure wash are done at the sole risk of the pressure cleaning operator.

308.20 HIGH-DENSITY POLYETHYLENE PIPE

The pipe must comply with *ASTM D2239*, *ASTM D2737*, *ASTM D3035*, and *ASTM F714* and use PE4710 resin material. For non-pressure applications, the pipe must have a minimum wall

thickness of DR 17. Use butt-fusion joint connections whenever possible. The joint assembly must be in accordance with the pipe manufacturer's recommendations for the specific application.

The pipe manufacturer must clearly mark all pipe, fittings, and couplings at intervals not to exceed 5 feet as follows:

- Nominal pipe diameter
- Company, plant, shift, ASTM, DR, and date designation
- Service designation or legend

Install all service connections with electro-fusion wye fittings or other approved tapping devices.

308.20.1 High-Density Polyethylene Pressurized Pipelines

HDPE pressurized pipelines and drainage pipes must have a minimum wall thickness of DR 11 (minimum pressure Class 200). Supply pipe in minimum standard lengths of 20 feet.

308.21 Polyvinyl Chloride Pipe

The pipe must comply with *ASTM D3034* or *ASTM F679.* For non-pressure applications, the pipe must have a minimum wall thickness of SDR 26 (pipe stiffness of 115 psi).

The pipe manufacturer must clearly mark all pipe, fittings, and couplings at intervals not to exceed 5 feet as follows:

- Nominal pipe diameter
- PVC cell classification
- Company, plant, shift, ASTM, SDR, and date designation
- Service designation or legend

Use PVC plastic pipe with a cell classification of 12454 or 13364, as defined in *ASTM D1784*. Use PVC plastic fittings with a cell classification of 12454, 13343. PVC compounds of other cell classifications must conform to *Greenbook 207-17.5*. Additives and fillers, including but not limited to stabilizers, antioxidants, lubricants, and colorants, must not exceed 10 parts per 100 (by weight) of PVC resin in the compound.

Pipe, fittings, and couplings must meet the requirements of the section titled "Requirements" of *ASTM D3034* or *ASTM F679*. During pipe production, the manufacturer must perform the

specified tests for each pipe marking. Deliver a manufacturer's certification indicating compliance with specification requirements with the pipe.

PVC gravity pipe and fittings must be SDR 26 with elastomeric gasket joints providing a watertight seal. Minimum pipe stiffness at maximum allowable deflection must be 115 psi according to *ASTM D2412*.

Use integral wall bell and spigot end joints. Install all service connections with wye fittings, gasketed wye saddles with stainless steel bands, or other approved tapping devices. Solvent welded wye saddles are not approved.

All rubber rings must conform to *ASTM F679*.

308.22 REINFORCING STEEL

Reinforcing steel must conform to *State Specifications*. Use deformed Grade 60 bar reinforcement conforming to *ASTM A615*.

Epoxy coat reinforced steel on all non-submerged field installed structures within pump station wet wells. Welded steel wire fabric for concrete reinforcement must conform to *ASTM A185*. Specify the gauge of the wire and the dimensions of the mesh.

308.23 VALVES

Valves provided must open to the left (counterclockwise) and be equipped with flange, mechanical, or push-on joint. Valves must show the registered AWWA certification mark.

All installed valves must operate smoothly with no more than 25 foot-pounds torque. Valves operating at torques greater than 25 foot pounds require SacSewer's approval.

All valves with an operating nut deeper than 4 feet below grade must include an extension stem with an operating nut and centering disk.

308.23.1 GATE VALVES

Gate valves must be able to withstand a working pressure of 200 psi, with non-rising stems of the type and size shown on the plans.

Gate valves must be double disk conforming to *AWWA C500* or resilient seat conforming to *AWWA C509*.

Valves must be manufactured by American Rotating Disc, 50 Line Series, or approved equal. Equip the valve with a bonnet 2-inch operating nut and flanged ends in conformance with *ANSI B16.1*, Class 125. The bolt pattern must straddle the centerline. Install the valve in accordance with manufacturer recommendations.

Coat all interior ferrous surfaces in accordance with *AWWA C550* and coat external surfaces in accordance with the manufacturer's standards, using a high solids epoxy no less than 16 mils DFT.

The valve must consist of the materials listed in Table 308-3.

Table 308-3: Gate Valve Materials

Item	Material Specifications
Body, Bonnet, and Disk	ASTM A536 Ductile Iron
Stem and Stem Nut	Bronze or Stainless Steel
Hardware	ASTM A276 Stainless Steel (304)

308.23.2 Combined Air Release and Vacuum Valves

CARVs are required at locations on long stretches of pipe, on all the high points, and as shown on the plans. CARVs must be fully automatic and automatically release accumulated air from the sewer collection system while in operation and under pressure. The CARV must automatically allow air to re-enter the pipeline when the internal pressure of the pipeline becomes negative due to draining of the pipeline, a power outage, or other situations.

CARVs must be able to withstand a 200 psi working pressure. CARVs must be set plumb and properly fitted to the high points on the pressurized pipeline.

CARVs located outside the pump station site must be installed as illustrated in Section 502, Drawing FM-02 of these Standards. All CARVs located outside the pump station site must be Nylon type 2," as manufactured by ARI D-025-10, or approved equal.

CARVs within the pump station must be 2-inch ARI D-020 with a stainless steel body or approved equal and installed as illustrated in Section 502, Drawing M-02 of these Standards.

Flange connections must conform to *ANSI B16.1*, Class 125. Flanged ends must be supplied with the proper bolt pattern for alignment to the specified standard. Include all nuts, washers, and jointing gaskets.

308.23.3 SWING CHECK VALVE

Swing check valves must be able to withstand a pressure of 200 psi, as shown on the plans. Check valves must conform to the requirements of *AWWA C508* full waterway design and feature an outside weight and lever.

Check valves must be APCO Valve and Primer Corporation Series 6000CLS, Crispin Valve Series SWL, or approved equal. Each valve must have a minimum of one counterweight assembly in accordance with each valve size.

Equip valves with flanged ends in conformance with *ANSI B16.1*, Class 125. All interior/exterior ferrous surfaces must be fusion epoxy coated in accordance with *AWWA C213* no less than 15 mils DFT.

Valves must consist of the material listed in Table 308-4.

Table 308-4: Swing Check Valve Materials

Item	Material Specifications
Body and Disk	ASTM A126 Grade B Cast Iron
Seat	Bronze/Buna-N
Hardware	ASTM A276 Stainless Steel (304)

308.23.4 PLUG VALVE

Use of plug valves is at SacSewer's discretion. If allowed, plug valves 2-$^1/_2$ inches and smaller must be rated at 150 psi and be lever operated, eccentric plug threaded, or flanged where shown on the plans.

Plug valves 2-$^1/_2$ inches to 10 inches must be rated at 175 psi for bidirectional bubbletight shutoff. The flow way must be round, 100% area, full port design.

Plug valves 12 to 36 inches must be rated at 150 psi for bidirectional bubbletight shutoff. The flow way must be round or rectangular, 100% area, full port design.

Use Milliken Millcentric, DEZURIK, Keystone, or approved equal type EP 125, ANSI Class 125 plug valves.

Construct the body of the *ANSI B16.1* Class 125 plug valve from *ASTM A126*, Class B cast iron. End connections must be flanges, integrally cast with the body, and conform to *ANSI B16.1*. Construct the plug from *ASTM A536*, Grade 65-45-12 ductile iron. The plug must be

one-piece construction and encapsulated with an elastomer. The elastomer must be Viton for grit service and Buna-N for all other services.

The plug must provide full bidirectional shutoff capability. The closed position travel stop for the plug must be externally adjustable. The seat must be 90% nickel alloy, welded into the body. The seat thickness must be a minimum of $^1/_8$ inch thick. Screwed or sprayed seats are not acceptable. The bearings must be replaceable sleeve type, constructed from sintered, oil impregnated *ASTM A351,* Grade CF8M, Type 316 stainless steel. Bearings must be permanently lubricated.

A grit seal consisting of a PTFE flat compression washer must be provided at the top and bottom of the plug to prevent grit from entering the bearing area. O-ring style grit seals are not acceptable.

308.24 WATER SERVICE CONNECTION

Water services, connection material, and meters must conform to the jurisdictional agency's requirements.

308.25 MANHOLE JOINTS

Joint materials for precast reinforced concrete manhole sections must conform to one of the following:

- Non-shrink grout as specified in these Standards. Retempering is not permitted.
- Preformed plastic sealing compound must conform to Type 1 Rope Form, 1-$^1/_2$ inches diameter, Federal Specification *SS-S-210A*, "Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints"
- Pre-extruded concrete joint sealant in accordance with *ASTM C990*, RAM-NEK by KT Snyder, QUIKSEAL (Associated Concrete Products), or approved equal
- Rubber Gaskets (O-Ring), *ASTM C443*

308.26 PAINT

Paint must conform to the most current *State Specifications*. Specify paint colors in the plans.

308.27 LIQUID ASPHALT

Liquid asphalt must conform to the most current *State Specifications*.

308.28 ASPHALTIC EMULSION

Please refer to Section 50-17, "Asphalt, Liquid Asphalt, and Asphaltic Emulsion" of the *County Specifications*, latest edition.

308.29 EPOXY

Epoxy for protecting concrete surfaces must be 100% solids and resistant to wastewater immersion and sulfuric acid. Epoxy must be Sherwin Williams Dura-Plate 6100 High-Performance Epoxy or approved equal.

308.30 NONSHRINK GROUT

Use prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based nonshrink grout requiring only the addition of water. Brush a bonding agent, such as acrylic concrete type 2 or equal conforming to *ASTM C1059* onto the surface to be grouted. Place grout immediately after the agent is brushed on.

Nonshrink grout must have the following characteristics:

- Minimum compressive strength of 2,000 psi at 28 days (*ASTM C109*), gaining 85% of its compressive strength within seven days
- No shrinkage
- Maximum 4.9 expansion in the plastic state when tested in accordance with *ASTM C827*; and No Shrinkage and a maximum of 0.2% expansion in the hardened state when tested in accordance with *USACE CRD C621*

309 TRENCHLESS OPERATIONS

309.1 GENERAL

All trenchless operations with a diameter greater than or equal to 30 inches must comply with Cal OSHA *California Code of Regulations, Title 8* "Tunnel Safety Orders."

Provide a trenchless operations plan to SacSewer before beginning trenchless operations. The trenchless plan must describe the equipment, method, and construction sequence for trenchless operations. The plan must identify the location of all potential conflicting public and private utilities and address all conflicts with these utility systems. The plan must also identify the location of nearby trees and address all conflicts with their root systems.

Do not begin work associated with trenchless operations until SacSewer has approved the trenchless operations plan.

Shoring and bracing for the boring and receiving pits must conform to Section 311.2.4, "Shoring and Bracing" of these Standards.

Backfill of the area excavated for the boring operation must conform to Section 310, "Structure Excavation and Backfill," of these Standards.

Either use vitrified clay microtunneling pipe, ductile iron pipe, or other SacSewer's approved pipe material in conductor pipe. If surface obstructions exist, the pipeline will be placed in a conductor.

If a specific method is not stated in the plans, the intended method must be approved by SacSewer before implementation.

Microtunnel in all areas where tunneling operations may occur below the groundwater table.

Establish and adhere to a settlement-monitoring plan for all trenchless work.

309.2 EQUIPMENT

309.2.1 MICROTUNNELING

For microtunneling, the equipment must consist of an MTBM. The MTBM must be mechanically articulated to enable steering of the shield and must be incrementally adjustable to maintain face stability for the soil conditions encountered. Provide a remotely controlled steering mechanism that allows the system to operate without personnel entering the tunnel.

Measure and balance earth and groundwater pressure using a slurry system. The MTBM cutter face must support the full-excavated area without the ground stabilization and must measure the earth pressure at the face and set a calculated earth balancing pressure. The MTBM must be advanced by jacks mounted in a jacking frame and located in the drive shaft. The MTBM must be moved forward by the jacks advancing a successive string of connected pipes toward a receiving shaft.

The control equipment must integrate the method of excavation and removal of soil and its simultaneous replacement by a pipe. Control line and grade by a guidance system that relates the actual position of the MTBM to a design reference (e.g., by a laser beam transmitted from the drive shaft along the centerline of the pipe to a target mounted in the shield). As each pipe section is jacked forward, the control system must synchronize spoils

removal, excavation, and jacking speeds. The MTBM display equipment must continuously show and automatically record the position of the shield with respect to the project design line and grade.

309.2.2 PILOT TUBE

The pilot tube equipment must consist of a remotely guided tube and a soil removal system. Use a laser or electronic theodolite guidance method with a camera and electronic target that can continuously monitor line and grade to ensure accuracy is maintained within the tolerances specified. The head must not need dewatering except what is required to control groundwater inflows at jacking and receiving pits.

Employ pipe insertion methods using pilot tube equipment to directly install new pipe in a 2-phase operation (1 - pilot tube, 2 - pipe) or 3-phase operations (1 - pilot tube, 2 - casings with augers, 3 - pipe) at each of the locations indicated.

309.2.3 AUGER BORE AND JACK

The equipment must consist of a rotating cutting head and auger internal to a steel casing that is being advanced hydraulically. The internal auger turns to remove soils to the entrance pit while the hydraulics advance the casing.

309.3 PIPE TYPES

VCP and DIP are both accepted. SacSewer will consider other pipe materials on a case-by-case basis. VCP must comply with *ASTM C1208* and British Standards Institution *EN 295-7*. The DIP must be Fastite Joint Push-Bar Pipe, MT Push Pipe, or GS Push Pipe by American Ductile Iron Pipe Company or an approved equal.

309.4 MAIN LINE TO MANHOLE CONNECTIONS

The main line to the manhole connection must consist of a 1 foot and 2-foot section of pipe outside the manhole. Cast a bell of the main line pipe material into the manhole to receive the 1 foot section of pipe. A sanded manhole adapter manufactured by IPEX USA, LLC or approved equal with clamp on waterstop grout ring must be used for PVC. SacSewer may allow the use of a mechanical link seal at the manhole connection for non-rigid pipe materials instead of a bell.

309.5 CONDUCTOR PIPE

The diameter of the bored hole must be not more than 0.1-foot greater than the outside diameter of the conductor pipe. Accurately set guide rails to line and grade to ensure the installation of the conductor pipe within permitted tolerances. The conductor pipe diameter must be sufficient to allow adjustment of line and grade of the carrier pipe to meet allowable tolerances, to allow material or fill to be placed between the conductor pipe and the carrier pipe and to allow future upsizing of the carrier pipe if necessary.

Conductor pipe sizes must be as shown or specified in the plans and comply with Section 202.13.2, "Conductor Casing" of these Standards. Conductor pipe must be a new, smooth wall, carbon steel casing. At SacSewer's discretion, the use of non-ferrous conductor pipe material may be allowed.

Corrugated steel pipes are not allowed for use as conductor pipes.

309.6 CARRIER PIPE INSIDE CONDUCTOR PIPE

Fit the carrier pipe having any part of a joint larger in diameter than the barrel of the pipe with two 24-inch long polyurethane skids. Attach polyurethane skids to the carrier pipe as recommended by the manufacturer. Locate the polyurethane skids near the center of each carrier pipe section. Skids must be large enough to prevent all parts of a joint from bearing on the conductor pipe. Pipe installation in conductor casing is illustrated in Section 502, Drawing P-04 of these Standards.

Carrier pipe with joints smaller than the pipe barrel must be slid into place on two polyurethane skids that have been securely fastened to the barrel of the carrier pipe as specified above.

Join carrier pipe sections outside the conductor pipe and then slide them into place. Completely fill the space between the carrier pipe and the conductor pipe with clean, dry sand unless SacSewer specifies an alternate fill material. SacSewer must approve the method of placing sand. Make all necessary adjustments in grade by adjusting the height of the skids.

309.7 VOIDS

When material tends to cave in from outside the permitted diameter of the bored hole, use a shield ahead of the first section of the conductor pipe, or do not extend the face of excavation beyond the end of the pipe more than 1-$^{1}/_{2}$ feet. The shield must cover the upper two-thirds of the conductor pipe and project not more than $^{1}/_{2}$ inch beyond the conductor pipe's outer surface. Excavation must not project beyond the shield.

Fill voids larger than those permitted by these Standards with sand or mortar, as approved by SacSewer.

To assist in the detection of voids, establish a settlement-monitoring grid. A minimum number of monitoring points will be quarter stations along the centerline of the pipe alignment plus wing points 25 feet on either side of the centerline points. Record the elevations of these monitoring points before either the boring or receiving pit is constructed.

Monitor the elevations each day that material is removed from the excavation. Record a final set of elevations two weeks after filling the conductor pipe and placing the bulkheads. Provide a copy of the elevation records to SacSewer at the end of each day. Correct settlement over $^1/_4$ inch to the satisfaction of and at no additional expense to SacSewer.

309.8 TOLERANCES

The maximum allowable deviation from line and grade will be 1 inch, and the rate of deviation must be 1 inch or less in 25 feet. For auger bore and jack operations, verify the proper line and grade a minimum of once every 10 feet.

309.9 DRY BORING OF LOWER LATERALS

Portions of main lines and lower laterals that pass beneath curbs, gutters, sidewalks, and other obstructions may be installed by dry boring. For such locations, begin the bore at the edge of the street pavement, or as directed by SacSewer, and continue to 6 inches beyond the property line. For lower laterals, cap or plug the end of the pipe and then push the pipe into the bored hole. To determine the final line and grade for a lower lateral and to install the cleanout, expose the end of the bore at the property line.

For VCP, the pipe must have plain ends connected with compression-type couplings. Make the bore just large enough to pass the couplings; backfilling is not required. Limit the maximum length of bore to 15 feet.

Do not use boring on laterals where the required slope is such that probable deviation of the bore from the intended line and grade would result in a final slope of less than 2%.

309.10 WET BORING OF LOWER LATERALS

When specified in the plans, pipelines that are 6 inches and smaller may be installed by wet boring. The pipe must be DIP, PVC C900 pressure class 300, or other pipe material approved equal by SacSewer.

If the diameter of the boring hole is 0.1-foot greater than the outside diameter of the pipe to be installed, fill the void with sand, CLSM, or other material as directed by SacSewer.

309.11 Abandonment of Instruments

309.11.1 Surface Control Points

All surface control points on public property must remain in place at the completion of the work. Remove all surface control points on private property during the cleanup and restoration work or as required by SacSewer.

309.11.2 Subsurface monitoring points

Subsurface monitoring points must remain in place. Properly abandon all monitoring point boreholes by grouting drilled holes with cement-bentonite grout.

309.11.3 Structural Monitoring Points

Remove structural monitoring points after completing adjacent work and as allowed by the engineer. Restore the sites to the conditions existing before installation of the structural monitoring points.

309.12 Measurement and Payment

The unit price paid for trenchless operations for each location is based on size and type of pipe. Payment for trenchless operations includes the following:

- All labor, materials (including conductor pipe when specified), tools, equipment, incidentals, and
- All work involved in trenchless operations, including excavation and backfill, as shown, specified in the plans, or directed by SacSewer

310 Structure Excavation and Backfill

310.1 General

Structure excavation consists of excavation for the construction of manholes, wet wells, flusher branches, vaults, and footings. Structure excavation and backfill must conform to the most current *State Specifications*. Structure excavation and backfill include all necessary excavation, structure backfill, and pervious backfill within limits in the plans.

Jetting of structure backfill is not permitted.

310.2 UNSUITABLE MATERIALS

310.2.1 GENERAL

Unsuitable material is that material determined by SacSewer to be unsuitable in its natural location and condition for the structural foundation.

The method of excavating unsuitable material must not undermine the existing base material. If, in SacSewer's opinion, the excavation method is increasing the amount of unsuitable material required to be excavated, SacSewer will require correction to the condition at no additional expense to SacSewer.

310.2.2 BACKFILL FOR UNSUITABLE MATERIALS

Backfill to replace unsuitable materials must be either imported aggregate base, CLSM, clean crushed rock or gravel, or clean native soil (engineered fill) upon SacSewer's approval. The imported aggregate base has to meet the requirements of Section 50-7, "Aggregate Bases" in the *County Specifications*, latest edition.

310.2.3 GEOTEXTILE FABRIC

The need for this item is contingent upon the need to stabilize unsuitable basement material encountered during construction and may be extended or deleted at the discretion of SacSewer. The fabric must be woven geotextile fabric specified in Section 308.10, "Geotextile Fabric" of these Standards.

Geotextile fabric at the overlap must be either lapped a minimum of 18 inches, sewn, or glued. If lapped, place the fabric so that the preceding roll overlaps the following roll in the direction the fill material is being spread. If sewn or glued, the seam strength must not be less than 90% of the required tensile strength of the unaged fabric.

Prepare the surface receiving the fabric so it is smooth and free of obstructions and debris that may damage the fabric during installation. Deliver the geotextile fabric in a protective wrapping that protects the fabrics from UV radiation and abrasion from shipping and handling. The geotextile fabric must be covered with the fill material within two calendar days of its placement. If the fabric is damaged during construction, repair the torn or punctured section by placing a piece of fabric that is large enough to cover the damaged area and meets the overlap requirement.

310.3 BACKFILL FOR STRUCTURES

Around and adjacent to structures, backfill must be native soil free of deleterious materials. Place backfill in 6-inch lifts, each lift being compacted to 90% relative compaction or, as specified by the geotechnical engineer of record, whatever is higher.

CLSM may be used as an alternative to native soil to backfill around and adjacent to structures.

Do not place backfill against the structural wall until all connecting structural members are in place. The contractor must provide adequate protection to all structures during backfilling operations and use every precaution to avoid damaging or defacing any structures.

310.4 CONTROLLED LOW STRENGTH MATERIALS

CLSM backfill will only be permitted when specified in the contract documents or as directed by SacSewer. Where permitted, CLSM backfill must conform to Section 308.14, "Controlled Low Strength Materials" of these Standards.

310.5 MEASUREMENT AND PAYMENT

Measurement and payment for structure excavation and backfill must conform to the latest edition of the *State Specifications*. The contract price per cubic yard for structure excavation includes all necessary excavation and structure backfill within the limits set forth in the contract documents. When removing an existing structure that will be replaced with a new structure, no payment will be made under this item for the area occupied by the existing structure.

Excavations greater than required for preparation of the original ground or subgrade will be paid for at the contract unit price per cubic yard for the various types of excavation involved. Unsuitable material excavated more than 2 feet below subgrade will be paid for as extra work as provided in the latest edition of the *County Specifications* if no item for unsuitable material excavation appears in the contract documents.

Backfill of unsuitable material, when made with material excavated from the work site, will be paid for at the same contract unit price paid for facilities excavation. The pay quantity will be the same as that quantity computed for unsuitable material excavated.

Imported borrow, crushed rock, CLSM, and the placing of such materials, will be paid for as extra work as provided in the latest edition of the *County Specifications*.

The quantity of geotextile fabric to be paid for will be measured by the square yard of the area covered, not including additional fabric for overlap. The contract price paid per square yard for the geotextile includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals. The price per yard also includes doing all work involved in placing the geotextile, complete in place, as directed by the SacSewer.

311 TRENCH EXCAVATION, BEDDING, AND BACKFILL

311.1 GENERAL

Remove all materials or obstructions and control water as necessary to construct the work as shown or specified in the contract documents. Excavation will be by open cut.

Control water according to the requirements in the latest editions of the *County Specifications* and the SWPPP.

Obtain an encroachment permit from the jurisdictional agency before any exploratory excavation within road ROWs or other public easements.

Work must conform to the jurisdictional agency's requirements for sedimentation and erosion control.

Do not allow surface water to enter any pipe trench or the existing downstream sewer collection system.

Treat excess material from trench excavations as directed in Section 306.4, "Surplus Materials" of these Standards.

311.2 EXCAVATION METHOD

Methods used in excavation must not cause damage to surrounding property or damage remaining pavement and other existing improvements that are to remain. Fit outriggers for excavation equipment, and other heavy equipment, with street pads to prevent pavement damage.

311.2.1 TRENCH WIDTH

Minimum and maximum trench widths along the barrel of the pipe are illustrated in the pipeline plans in Section 502, "Standard Plans" of these Standards. If maximum trench widths at the top of the pipe are exceeded by any amount, the contractor must provide stronger pipe or improved bedding and backfill conditions, as approved by SacSewer, to

meet the load requirements. The stronger pipe or improved bedding and backfill must be provided at no additional expense to SacSewer.

311.2.2 Pavement Cutting

When the trench is in an existing paved area, on public property, or within a public ROW, remove and replace the pavement in accordance with the jurisdictional agency's requirements. Please refer to Section 327.5.1, "Concrete on Public Property and within Public Rights-of-way" of these Standards for restoration requirements.

When the trench is in an existing paved area that is on private property, please refer to Section 327.5.2, "Concrete on Private Property" of these Standards.

Do not cut pavement until the respective utility companies have marked the location of their underground facilities.

311.2.3 Maximum Length of Open Trench

No more than 400 feet of the trench is allowed to remain open unless the jurisdictional agency requires a shorter length. This requirement includes excavation, pipe laying, appurtenant construction, and backfill that has not been temporarily resurfaced but excludes manhole excavations. Backfill and compact the remainder of the trench and, when in the streets, open the streets to traffic as soon as possible. Failure by the contractor to comply with the limitations may result in a temporary suspension of work in accordance with the latest edition of the *County Specifications*.

311.2.4 Shoring and Bracing

The contractor must supply and install sufficient shoring and bracing to ensure the safety of personnel and the public, protect the work, and protect adjacent improvements. The contractor must comply with all of the requirements of the latest edition of the *County Specifications* and Cal OSHA.

A registered professional engineer must design shoring and bracing for excavations greater than 20 feet deep.

During drilling and driving operations, the contractor must prevent damage to the existing surface and subsurface improvements, both public and private.

Lift shoring along with the compaction lifts. Remove all sheeting, timbering, lagging, and bracing during backfilling to prevent ground movement or damage to the pipe or to other

structures. If sheet piling, lagging, and bracing are specified to be left in place, such materials must be cut off where designated and removed.

Avoid disturbing the pipe location, jointing, or embedment when using movable trench supports.

311.2.5 UNSUITABLE FOUNDATION SOILS

Whenever the bottom of the trench is soft, spongy, unstable, rocky, or otherwise unsuitable in SacSewer's opinion as a foundation for pipe bedding, remove the unsuitable material to a minimum depth of 12 inches or to a depth designated by the geotechnical engineer, and replace it with compacted crushed rock, gravel, or sand as directed by SacSewer.

When the bottom of the trench is cobbled or of any material that might, in SacSewer's opinion, allow loss of sand backfill, the backfill material must be crushed rock or gravel graded to 100% passing a $^{3}/_{4}$ inch sieve and not more than 15% passing a #8 sieve. Crushed rock or gravel must conform to Section 50-16, "Clean Crushed Rock," of the *County Specifications*, latest edition. Sand backfill, when permitted by SacSewer, must conform to Section 50-13, "Sand," of the *County Specifications*, latest edition. Compact this backfill material to a non-yielding condition. Jetting is not permitted.

As an alternative to the bedding materials specified above, SacSewer may direct the contractor to furnish and place geotextile fabric below the bedding materials. The geotextile material must be a woven fabric in accordance with these Standards. Furnishing and placing of geotextile fabric will be paid for as extra work as provided in the latest edition of the *County Specifications*.

If material more than 12 inches below the typical trench bottom is ordered removed by SacSewer, the excavation below that point and the imported material required to backfill the trench to that elevation will be paid as extra work as provided in the latest edition of the *County Specifications*.

Before pipe trench excavation in fill areas or roadway embankments, complete the fill area or embankment to a height above the pipe invert grade line of not less than twice the internal pipe diameter or to final fill or embankment subgrade, whatever is lower, but in no case less than 12 inches above the top of the pipe. Compact this embankment to a minimum relative compaction of 90% for a distance on each side of the pipe equal to at least two pipe diameters. Compact the remainder of the embankment in accordance with the jurisdictional agency's requirements.

311.3 PIPE BEDDING

Place the pipe on a firm layer of bedding material, and bed uniformly throughout its length. Pipe bedding is illustrated in Section 502, Drawing P-01 of these Standards.

311.4 TRENCH BACKFILL

311.4.1 INITIAL BACKFILL

Initial backfill is illustrated in Section 502, Drawing P-01 of these Standards. Initial backfill is the material between the top of the bedding material and 12 inches above the top of the pipe. Shovel slice the initial backfill material in the pipe haunch area to fill the voids and consolidate the material, thus providing uniform and consistent support for the pipe. Shovel slice along the pipe barrel, not adjacent to the bell hole or couplers. Shovel slice when the initial backfill is no higher than about one-fourth of the pipe diameter. The maximum lift must not exceed a thickness of 8 inches.

311.4.2 TRENCH BACKFILL

Trench backfill consists of material placed between the initial backfill and subgrade in paved areas or to the top of the trench in unpaved areas. Trench backfill must conform to the jurisdictional agency's requirements.

Document the use of Type III bedding in the record drawings.

311.5 MEASURE AND PAYMENT

The unit price paid for trench backfill is paid per linear foot based on sizes, grades, and types of pipes listed in the contract documents.

Actual excavation quantities are calculated based on the maximum width of the trench shown on the contract documents and measured at the top of the pipe.

Actual trench resurfacing quantities are calculated based upon the maximum width of the trench specified in the plans.

Trench excavation includes all the following items:

- All equipment labor and materials
- Control of water
- Shoring and bracing

- Other safety measures required

If additional bedding material is required to control groundwater, the contractor bears the expense of the additional excavation and material.

312 GRAVITY PIPELINE

312.1 GENERAL

The contractor will supply and install the materials shown or specified in the contract documents. Where alternate pipe materials are listed in the bid, the contractor will bid only one of the alternates shown. Substitution of alternate pipe material after the bid is not permitted.

312.2 MATERIALS

Use VCP or the type, class, and size as specified in the contract documents. All pipes must conform to Section 308, "Construction Materials," of these Standards.

Use standard bell and spigot unless circumstances require higher axial strength, then a jacking pipe with push fit joints may be used.

Use flexible manufactured connections to accommodate all expected ground settling, including, but not limited to, pipe connections outside manholes, outside of the encased pipe, and changes from jacking pipe to bell and spigot.

Use manufactured 1 foot pipe connections followed by a manufactured 2-foot pipe, at which point the standard pipe lengths may then be used again. Use manufactured bells for pipe connections into manholes. Use shielded flexible couplings when bell and spigot connections cannot be used.

312.3 EXCAVATION AND BEDDING

Trench excavation and bedding for all pipeline construction must conform to Section 311, "Trench Excavation, Bedding, and Backfill," of these Standards.

The contractor will expose the end of the existing pipe to be extended and verify the alignment and elevation before trenching any affected pipes.

312.4 LAYING PIPE

312.4.1 PLACEMENT

Start laying pipe after excavating the trench to the proper depth, the foundation soils are found to be firm and non-yielding, and bedding has been placed and compacted to a non-yielding condition. Start laying pipe upgrade with the bell end of the pipe placed upstream. Lay each section of pipe to plan line and grade, with a uniform bearing under the full length of the barrel of the pipe.

Make excavation suitable to receive the bell that must not rest on the subgrade or bedding. The pipe that is not in true alignment or shows any undue settlement after laying must be taken up and re-laid at the contractor's expense. Lay and join pipe sections so that the offset of the inside of the pipe at all joints will be held to a minimum at the invert.

The maximum offset must meet the requirements of Table 312-1.

Table 312-1: Allowable Offset Joints

Pipe Diameter	Allowable Offset Joint
Less than 12-inch	$^{3}/_{8}$ inch
12-inch to 18-inch	$^{1}/_{2}$ inch
Larger than 18-inch	$^{5}/_{8}$ inch

For polyurethane compression joints, clean and lubricate the mating surfaces with a lubricant recommended by the pipe manufacturer. Join the pipe spigot into the bell.

Clear the interior of the pipe of all dirt and debris as the work progresses. Do not lay the pipe when, in SacSewer's opinion, the trench condition or the weather is unsuitable. Dewater the trench in accordance with Section 307, "Dewatering" of these Standards. Close all open ends of pipe and fittings whenever discontinuing work. For remedial maintenance or improvement projects in established areas, the contractor must coordinate the work so that the sewer collection system is fully operational at the end of each working day. Do not allow runoff to flow uncontained through any trenches or excavations.

312.4.2 LINES AND GRADES

Lay all pipes in strict conformity to the prescribed line and grade with grade bars set, and each pipe length checked to the top grade line. Use three consecutive points on the same grade of slope at all times to detect any variations from a straight grade. If a discrepancy exists, stop work and immediately report the discrepancy to SacSewer. In addition, when

requested by SacSewer, use a string line in the bottom of the trench to ensure a straight grade and alignment of the pipe.

The contractor may elect to furnish a laser beam system for grade and alignment control. The laser beam must have a minimum accuracy of plus or minus 0.01-foot per 100 feet online and a minimum visible range of 1,000 feet and comply with Cal OSHA requirements. The laser system must have good visibility when used with suitable target material. Use a self-leveling laser system so that the laser beam is automatically compensated for small grade disturbances. The laser system must also have an early warning system that warns when the laser is off grade.

312.4.3 Depth

All collectors and trunks must meet minimum depths outlined in Section 202.2, "Gravity Collection System – Depth" of these Standards.

312.4.4 Grade Tolerance

Grade tolerance of the flow line of gravity pipelines less than 36-inch diameter must not exceed plus or minus 0.05-foot, and there must not be any deviation in a 12-foot section greater than 0.05-foot.

Grade and total variation tolerance for 36-inch diameter pipe or greater must meet the requirements outlined in the contract documents.

312.4.5 Sag Tolerance

The allowable sag tolerance, the total variation (plus or minus) from flow line grade, must not exceed the following:

- $^{1}/_{4}$ inch for 4-inch or smaller pipe
- $^{3}/_{4}$ inch for 6 through 12-inch pipe
- 1 inch for 15 through 36-inch pipe

312.4.6 Backfilling Pipe Trenches

Pipeline backfill must conform to Section 311.4, "Trench Backfill," of these Standards.

312.5 TESTING

After pipe installation, backfilling, and compacting of the trench and before placing the roadway aggregate base:

- Clean the pipe system in accordance with Section 329, "Pipe Cleaning" of these Standards
- Test for obstructions and leakage in accordance with this section
- Perform the television inspection in accordance with SacSewer's *Television Inspection Manual* available on SacSewer's website at www.sacsewer.com

SacSewer may require pipes to be retested within the warranty period at no additional cost to SacSewer.

Each new gravity main line segment must pass either the low-pressure air test or the hydrostatic exfiltration test for leakage. Alternatively, use the water infiltration test when the measured groundwater is 5 feet or greater above the pipe barrel at the midpoint of the test section.

312.5.1 LOW PRESSURE AIR TEST

The air test for main lines will be in accordance with *ASTM C828*.

The contractor will furnish all necessary equipment and is responsible for conducting all low-pressure air tests. The contractor will repair all pipeline segments that do not pass any of the tests at no additional cost to SacSewer. SacSewer's inspector will witness all testing for acceptance.

312.5.2 EQUIPMENT

Either mechanical or pneumatic plugs may be used. The contractor will restrain or brace the plugs as a safety precaution throughout the test. Before air pressure testing, check all pipe plugs with a soap solution to detect air leakage. If leaks are found, release the air pressure, eliminate the leaks, and resume the test procedure. No one is allowed in the manhole adjoining a pipeline being tested when the pipeline is pressurized.

To facilitate test verification by SacSewer, all air used must pass through a single, above-ground control panel. The above-ground air control equipment must include a shut-off valve, pressure regulating valve, pressure relief valve, input pressure gauge, and a continuous monitoring pressure gauge having a pressure range from 0 to a maximum of 15 psi. The continuous monitoring gauge must be no less than 4 inches in diameter with

minimum divisions of 0.10 psi and an accuracy of plus or minus 0.04 psi within the operating range of the gauge.

Use two separate hoses: (1) to connect the control panel to the sealed pipeline for introducing low-pressure air, and (2) a separate hose connection for constant monitoring of air pressure build up in the pipeline. If pneumatic plugs are used, a separate hose will also be required to inflate the pneumatic plugs from the above ground control panel.

All pressurizing equipment used for low pressure air testing will include a regulator or relief valve set no higher than 7 psi to avoid over-pressurizing and displacing temporary or permanent plugs.

Main Line Preparation

All laterals, stubs, and fittings within the test section will be properly capped or plugged to prevent air loss that could cause an erroneous air test result.

Plug Installation and Testing

After a manhole-to-manhole reach of pipe has been backfilled to subgrade and prepared for testing, place the plugs in the pipeline at each manhole and secure them.

Plug the upstream end of the pipeline first to prevent upstream water from collecting in the test pipeline.

Main Line Pressurization

Slowly introduce air into the plugged pipeline. The internal air pressure must not exceed 4 psi for areas without groundwater above the crown of the pipe. In areas with groundwater above the crown of the pipe, add 0.43 psi for each foot of groundwater above the crown of the pipe up to a maximum of 6.2 psi. When groundwater is greater than 5 feet above the crown of the pipe, perform a water infiltration test in accordance with *ASTM C1091* Standard Test Method for Hydrostatic Infiltration Testing of Vitrified Clay Pipe Lines.

The requirements of this section only apply where groundwater is known or expected to exist above the pipes to be tested.

During manhole installation, install a $^1/_2$ inch diameter threaded pipe nipple with a cap through the manhole wall directly on top of the pipe to be tested. Not every manhole needs to have a pipe nipple. A few key manhole locations should be sufficient to establish a groundwater profile for the test area. SacSewer will assist the contractor in selecting appropriate manholes for pipe nipple installation.

Immediately before air testing, determine the groundwater level by removing the threaded cap from the nipple nearest the section to be tested, blowing air through the pipe nipple to remove any obstructions, and connecting a clear plastic tube to the pipe nipple. Hold each plastic tube vertically to allow groundwater to rise in it. After the water level in the tube has stopped rising, take a measurement of water over the invert of the pipe. If the section to be tested is not immediately adjacent to an installed pipe nipple, estimate the groundwater height based upon nearby height readings and the pipe's invert elevation. Remove the pipe nipple and plug the hole in the manhole with hydraulic cement or equal after the groundwater measurement.

Pressure Stabilization

The air supply may be throttled to maintain internal pressure until the temperature stabilizes.

Timing Pressure Loss

When temperatures have equalized, and the pressure stabilized to 3.5 psi gauge for no groundwater above the crown of the pipe and up to 5.7 psi depending on groundwater conditions (0.43 psi per foot of groundwater above the crown of the pipe), shut off or disconnect the air hose from the control panel to the air supply and start the timer.

Determination of Line Acceptance

If the time shown in *ASTM C828* for the designated pipe size and length elapses before the air pressure drops 1 psi gauge, the test section has passed. Should the section of the pipeline include more than one pipe size, determine the minimum test time for each size and add the test times to arrive at the total test time for the section.

Pipeline Repair or Replacement

If the section fails to meet the requirements of *ASTM C828*, the contractor must, at his own expense, determine the source(s) of leakage and repair or replace all defective materials and workmanship to SacSewer's satisfaction. The extent and type of repair that may be allowed and results are subject to SacSewer's approval. The completed pipe installation must be retested and required to meet the requirements of this test.

312.5.3 HYDROSTATIC TEST

If, in SacSewer's opinion, excessive groundwater is encountered in the construction section of the sewer, do not use the hydrostatic test for leakage. In this case, please refer to Section 312.5.4, "Water Infiltration Test" of these Standards.

Prepare a section of pipe for testing by plugging the upper side of the downstream manhole and all openings in the upstream manhole except the downstream opening. Avoid interrupting service to existing laterals when installing plugs. Where grades are slight, two or more sections between manholes may be tested at once. Where grades are steep and excessive heads would result by testing from one manhole to another, install test tees the same size as the main at intermediate points, so the maximum head on all sections tested does not exceed 12 feet.

Test a section of pipeline prepared as above by filling with water to an elevation 5 feet above the top of the pipe at the upstream end of the test section, or 5 feet above the existing groundwater elevation, whatever is greater. Introduce the water into the test section 4 hours before the test period to allow the pipe and joint material to become saturated with water. The water level should then again be brought to the 5-foot mark. At the beginning of the test, measure the elevation of the water in the upper manhole from a point on the manhole rim or test tee. After 4 hours or less with SacSewer's approval, measure the water elevation from the same point on the manhole rim and calculate the loss of water during the test period. If this calculation is difficult, measure enough water into the upper manhole to restore the water to the level existing at the beginning of the test, and the amount added taken as the total leakage.

Determination of Line Acceptance

The allowable leakage in the test section must not exceed 50 gallons per mile per day per inch diameter of pipe tested at the 5-foot test head. If it is necessary or desirable to increase the test head above 5 feet, the allowable leakage will be increased at the daily rate of 50 gallons for each foot of increase in the head.

Do not allow water to enter the existing collection system without prior SacSewer's approval.

Main Line Repair or Replacement

If the section fails to meet the requirements of the hydrostatic test, determine the source(s) of leakage and repair or replace all defective materials and workmanship to SacSewer's satisfaction at no additional cost to SacSewer. The extent and type of repair that may be allowed and results are subject to SacSewer's approval. Retest the completed pipe installation to ensure they meet all test requirements at no additional cost to SacSewer.

312.5.4 WATER INFILTRATION TEST

Plug the upstream end of the pipeline to be tested to prevent the entrance of water. Discontinue pumping groundwater for at least three days before testing the section for infiltration. The infiltration into each individual reach of pipeline between adjoining manholes must not exceed the following formula:

$$E = 0.00002*L*D*(H)^{½}$$

Where:

L: Length of the pipeline (ft)

E: Allowable leakage in gpm of pipeline tested

D: Internal diameter of the pipe (in)

H: Difference in elevation (ft) between the water surface in the upper manhole and the invert of the pipe at the lower manhole; or, if groundwater is present above the invert of the pipe in the lower manhole, the difference in elevation between the water surface in the upper manhole and the groundwater at the lower manhole.

Perform all tests in the presence of SacSewer's inspector.

312.5.5 FAILED TESTS

When any of the tests fail as specified, locate the problem and make necessary repairs or replacements at no additional cost to SacSewer. Repair all individually detectable leaks, regardless of the test results.

312.6 MEASUREMENT AND PAYMENT

For construction purposes, the pipeline measurement is based on the linear feet of sizes, grades, and types of pipes designated by the contract documents. Pipe length is measured along the centerline of the pipe from manhole to manhole and includes the straight run of all wyes and tees where used. Length is measured from the inside face of the structures and does not include the inside diameter of manholes or other structures.

The prices paid per linear foot for pipe construction listed in the contract include the following:

- All labor, materials, tools, equipment, and incidentals

- Supply all water, materials, and labor for required infiltration tests
- All work involved in sewer collection system construction, including:
  - Supplying pipe
  - Excavation and backfill
  - Removing obstructions
  - Removing and replacing utilities
  - Bedding
  - Placing and jointing the pipe
  - Testing pipelines
  - Connecting to existing manholes or pipes as shown or specified in the contract documents and as directed by SacSewer

Wye fittings in main lines in connection with lower laterals are included in the price per linear foot for the main line. SacSewer will not pay additional costs for these items.

313 LOWER LATERALS

313.1 GENERAL

The contractor must supply and install lower laterals of the materials shown or specified in the contract documents. Lower lateral connections to existing facilities operated and maintained by SacSewer must conform to Section 302.6, “Lower Lateral Connection to Existing Main Line,” of these Standards.

313.2 INSTALLATION

Install cleanouts for all lower laterals that do not require a manhole at the property or easement line, as specified in the *SacSewer Sewer Ordinance*. Install lower laterals as illustrated in the lower lateral plans in Section 502, “Standard Plans,” at the locations shown on the contract documents in accordance with Section 202.11, "Lower Lateral Design," of these Standards.

In residential use, only the following exceptions are allowed.

Use a manufactured wye fitting of the same materials as the main line inclined upwards at a minimum angle of 25° and a maximum of 45° from the horizontal. For new construction, securely seal the ends of all lower laterals with a solvent-cemented or jointed watertight cap.

The maximum allowable offset joint must be in accordance with Table 312-1 in Section 312.4.1, "Placement," of these Standards.

The depth of cover of the lower lateral at the easement or ROW must be a minimum of 4 feet below the finished grade or edge of the adjacent roadway.

Where installing water mains, the lower lateral invert must be a minimum of 1 foot below the water main invert. In such cases, as illustrated in Section 502, Drawing LL-01A of these Standards, extend the lateral to the back of the easement or a minimum of 10 feet. The cleanout, however, must remain a maximum of 3 feet beyond the ROW or easement. Install a second cleanout at the end of the extension.

All elevations given must be a maximum allowable elevation, and the minimum slope of the service is 2%. If the lower laterals are to be bored, the tolerance of the operation must be within these limits.

Lower laterals having less than 3 feet of cover as measured from the top of the finished subgrade to the crown of the pipe must be constructed pressure class 300 PVC (DR 14) pipe conforming to the requirements of *AWWA C900*. The invert of the lower laterals entering a manhole must conform to Section 314.2.4, "Connections to Manholes," of these Standards.

313.2.1 Reinstatement of Lower Lateral Connections

The contractor must reinstate all lower laterals that are provide service to SacSewer's sewer system. Notify SacSewer before connecting lower laterals that serve vacant lots. The contractor is responsible for restoring and correcting all missed or faulty reconnections and all damage caused to property owners for not reconnecting the services soon enough or not giving adequate notice of temporary service disruption to the owners.

Show all reconnected services on the as-built drawings with the exact distance from the nearest downstream manhole and offset distances to SacSewer's cleanout. Replace all active lower laterals from the main line to the public ROWs pipeline. Locate and replace or install SacSewer's cleanouts according to these Standards.

The contractor must ensure that all reinstated lower lateral connections are fully reestablished and that there are no obstructions that may impede flow. Reinstated lateral connections that are not fully reestablished will be considered defective and must be re-cut to meet SacSewer's approval.

The contractor must seal the connection between all reinstated lower laterals and pipelines in accordance with the manufacturer's recommendations. The seal must be

watertight and support a minimum groundwater head equal to 2 feet below the ground surface. The seal must not impede the flow in the reinstated lateral or pipeline.

313.2.2 MARKINGS

Where curb and gutter exist or will be constructed, an "S" must be inscribed on the curb. The "S" must be 2 inches in height and located perpendicular to the street centerline and directly in line with the SacSewer cleanout.

In new subdivisions, when the lower laterals and cleanout are installed, the contractor must record the exact location of each SacSewer cleanout as measured from the property lines and record this information on the record drawings.

313.3 CLEANOUT

Construct the cleanout to the finished grade.

Install the cleanout a maximum of 3 feet from the back of ROW if a public utility easement exists; at the ROW line if no public utility easement exists;, or at the sewer easement line. Set a concrete or PVC box to the finish grade of the property.

Where cleanouts are located in concrete or traveled ways, install a round, concrete, H-20 rated valve box with a cast iron cover. Mark each cover "SEWER." The cleanout and lateral must be of like material and diameter and be installed as illustrated in Section 502, "Standard Plans," of these Standards as required for the particular situation.

All cleanouts damaged because of grading or other construction activities must be repaired or replaced at the contractor's expense.

313.3.1 SEWER RELIEF VALVES

The contractor will install a sewer relief valve on every SacSewer's rehabilitated 4-inch lower lateral or cleanout or any other time a cleanout is accessed. Install the sewer relief valve in accordance with Section 502, Drawing LL-02 of these Standards.

313.4 MEASUREMENT AND PAYMENT

Lower lateral connections are paid per linear foot. SacSewer's cleanouts are paid per each installation. Removal of existing SacSewer cleanout is paid per each unit removed, but only when the existing SacSewer cleanout is not replaced with a new cleanout.

The bid price includes the following items:

- The cost of removing and disposing of the existing pipe or cleanouts
- Disposing of surplus or unsuitable material
- Providing and installing new pipe or cleanouts, appurtenances, plugs, or caps
- Bypass pumping and water control
- Dewatering
- Excavating
- Temporary sheeting and bracing
- Testing
- Backfilling
- Compacting
- Inspection
- Other site restoration and cleanup

The bid price for cleanout includes the following:

- Providing and installing the wye riser pipe cleanout relief valve and cleanout cover
- Bedding
- Dewatering
- Excavating
- Backfilling with suitable material
- Compacting
- Removal and disposal of existing cleanouts
- Disposing of surplus or unsuitable material
- Other restoration and cleanup.

314 STRUCTURES

314.1 GENERAL

This section applies to the construction of manholes, wet wells, flusher branches, and vaults.

314.2 PRECAST CONCRETE MANHOLES

Precast manhole barrels, risers, cones, flat tops, and grade rings must conform to *ASTM C478* with the additional requirement that Type II cement is used . Manufacture manhole sections without the provision for ladders or steps. For easement areas outside of roadways and vehicle traffic, Cretex Pro-Ring grade rings may be used in lieu of concrete grade rings.

Only manholes approved by SacSewer are allowed Please refer to SacSewer's website at www.sacsewer.com for a list of *SacSewer's Approved Manhole Manufacturers*. .

314.2.1 MANHOLE BASE

Use precast manhole bases. Place manhole bases on a minimum of 10 inches of $^{3}/_{4}$ inch crushed rock. Bells must be cast into the manhole base and must be of the same material and diameter as the pipe to which they will be connected too. Nonshrink grout and a bonding agent must be used to fill the annular space between the bell and core hole.

The surface finish must conform with the latest edition of Section 51-1.18A, "Ordinary Surface Finish," of the *State Specifications*. TV channels conforming to Section 502, Drawings MH-04 and MH-05 of these Standards are required for all 8-inch and 10-inch collector pipelines.

Field modifications to manhole bases must comply with these Standards, and SacSewer must approve them before starting work.

314.2.2 CONCENTRIC CONES AND FLAT TOPS

Use standard concentric cones or flat tops conforming to *ASTM C478* on all manholes shown on the contract documents.

Construct flat slab tops of Class A concrete conforming to the latest edition of the *County Specifications*.

Design manholes, so that pipe flexing does not result in infiltration or exfiltration at the interface between the manhole and the pipe.

Seal joints in precast manhole sections in accordance with all the requirements of *ASTM C990*. If a leak occurs, seal the sections by buttering with a non-metallic, nonshrink grout in accordance with Section 308.30, "Nonshrink Grout" of these Standards during vacuum testing or with preformed plastic sealing compound conforming to *ASTM C990* and installed as recommended by the manufacturer. Thoroughly clean all joint surfaces before placing the sealing compound. Plaster the inside and outside of sealed joints with non-

metallic, nonshrink grout in accordance with Section 308.30, “Nonshrink Grout” of these Standards, and the inside brushed to a smooth finish with a wet brush. Fill the entire joint space with grout, so it is watertight.

314.2.3 Manhole Frames and Covers

Use manhole frames and covers of the type and size shown on the plans. Use the SacSewer’s logo covers on all SacSewer’s manholes. Seal the joint between the manhole frame and the cone, flat top, or grade ring by buttering the joint space with non-metallic, nonshrink grout in accordance with Section 308.30, “Nonshrink Grout” of these Standards.

All castings for manhole frames, covers, and other purposes must be tough gray iron or ductile iron free from cracks, holes, swells, and voids, or casting imperfections. The cast iron must conform to *ASTM A48*, Class 35B; the ductile iron must conform to *ASTM A536*.

Manufacture all castings true to pattern and with a satisfactory fit of all component parts. Round frames and covers must have machined bearing surfaces. All manhole covers that do not fit neatly and bear firmly in the ring will be rejected. Coat all manhole frames and covers with bituminous material. Hang manhole frames; do not shim.

314.2.4 Connections to Manholes

Lower lateral connections to existing facilities must conform to Section 302.7, “Lower Lateral Connection to Existing Manhole,” of these Standards. Internal drop connections must have a minimum length of 3 feet and be installed using a drop bowl as illustrated in Section 502, Drawing MH-09 of these Standards.

314.2.5 Drop Connection Inside Manhole

Inside-drop connections must comply with Section 202.9, "Drop Connection Criteria," and Section 502, Drawing MH-07 of these Standards. SacSewer does not allow outside drop connections.

314.2.6 Saddle Manholes

In general, saddle manholes are not allowed. SacSewer may allow the use of saddle manholes over trunk facilities on a case-by-case basis.

314.2.7 Manhole Testing

Test all manholes to ensure they meet of *ASTM C1244* requirements before acceptance.

Test manholes after manhole assembly and installation of the pipe entering or exiting the manhole but prior to backfill. Repair and retest the manhole at no additional cost to SacSewer if the manhole fails the test. Repeat this procedure until the manhole passes the required test. SacSewer may also require a manhole to be tested using this method after backfilling if there is reason to suspect that the manhole has been disturbed during the backfilling operation or at other times during construction.

Prepare the manhole by plugging all lift holes with nonshrink grout per Section 308.30, "Nonshrink Grout" of these Standards, and plugging the incoming and outgoing pipes past the first flex joint located outside of the manhole base.

The following is the test procedure:

1. Place the test head at the top of the manhole in accordance with the manufacturer's recommendations.
2. Draw a vacuum of 10" of mercury on the manhole, close the valve on the vacuum line of the test head, and shut off the vacuum pump. Measure the time for the vacuum to drop to nine inches of mercury.
3. The manhole passes the test if the time for the vacuum to drop from 10 inches to nine inches of mercury meets or exceeds the values shown in Table 314-1. In addition to the minimum time, nine inches of mercury must be held for at least one minute.

The contractor must supply a 4-inch diameter vacuum gauge for this test with maximum scale divisions of 0.1 psi and an accuracy of 0.04 psi. Accuracy and calibration of the gauge must be certified by a reliable testing firm at 6-month intervals or when requested by SacSewer. In addition, SacSewer may compare the contractor's gauge with an SacSewer-owned gauge at any time. During testing, locate the vacuum gauge, so it is readily visible.

Table 314-1: Minimum Manhole Vacuum Test Times

Depth (ft)	Diameter (in)		
	48	60	72
	Time in Seconds		
8	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	67
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121

Spark test lined manholes, in accordance with the manufacturer's recommendations. All welders must be approved and certified by the manufacturer.

314.2.8 CONNECTIONS TO THE INTERCEPTOR SYSTEM

Connections to the interceptor system must comply with Section 202.8.10, "Connections to the Interceptor System," and illustrated in Section 502, Drawing P-03 of these Standards.

314.3 FLUSHER BRANCHES

Construct a flusher branch or manhole at the end of all pipelines in accordance with Section 202.10, "Flusher Branch Criteria" of these Standards. Pipeline stubs are not permitted. Do not locate flusher branches in between manholes. Use flusher branches at the end of pipelines that will be extended with future development. Lower laterals into the flusher branch are not allowed. Flusher branches are illustrated in Section 502, Drawings MH-02A and MH-02B of these Standards.

314.4 PRECAST CONCRETE VAULTS

The contractor will furnish and install all precast vaults, complete with blockouts, hatches, coatings, lining, and other appurtenances, in accordance with the approved contract documents and Section 205.4.14, "Vaults" of these Standards.

314.5 WET WELL

Construct wet wells of precast reinforced concrete in accordance with Section 205.4.10, "Wet Well" of these Standards.

A wet well can be alternatively constructed of reinforced concrete pipe sections in accordance with *ASTM C76* or reinforced manhole sections in accordance with *ASTM C478*, as long as it meets all requirements of these Standards and SacSewer has approved the changes.

Armorock or an approved lining precast into the concrete wall of the wet well at the plant. Lifting holes, pipe protrusions, and damaged lining must be sealed and repaired in accordance with the liner manufacturer's recommendations. Spark test lining in accordance with the manufacturer's recommendations. All welders must be approved and certified by the liner manufacturer.

All repairs to the liner must use a mechanical method to ensure adherence of the repair to the concrete wall, in accordance with the liner manufacturer's recommendation.

314.5.1 WET WELL INSTALLATION

Lines and grades of the vertical and horizontal construction tolerances must be maintained at within plus or minus $^1/_4$ inch per 10 feet.

Do not drag the spigot on the ground or allow it to be damaged by contact with gravel, crushed stone, or other hard objects.

Clean joint mating surfaces immediately before applying joint lubricant and jointing.

Use flush bell concrete joints and spigot ends with a contained O-ring neoprene gasket(s). Use single rubber gasket-type joints that meet the requirements of these Standards.

314.5.2 PIPE JOINTS

Provide flexible pipe joints in all pipes attached to the wet well as shown in the contract documents. Flexible pipe joints will be no more than 1 foot from the outside face of the wet well to the first joint. Limit the length of the subsequent pipe segment to 2 feet or twice the pipe diameter, whatever is greater.

Lay pipes entering wet well on compacted pipe bedding material as shown in the contract documents.

314.5.3 Access Hatch

The access hatch must comply with Section 205.4.11, "Access Hatch" of these Standards. Place the access hatch hinges on the opposite side of the guide rails. The safety hatch must allow for three sides of fall protection.

314.5.4 Safety Grate

Equip the wet well hatch with fall-through protection when covers are open. Fall protection must comply with Section 205.4.12 "Safety Grate" of these Standards.

314.5.5 Pressurized Pipeline Penetration

Core drill pressurized pipeline penetration in the wet well. Provide Mechanical Link Seal as illustrated in Section 502, Drawing M-05 of these Standards. Use nonshrink grout as necessary to seal the opening.

314.6 Testing

Testing for leaks will be performed before backfilling and after wet well assembly, grouting, and any joint lining welding. At SacSewer's discretion, a project specific phased backfill and leak test may be allowed. SacSewer may also require a wet well to be re-tested at no additional cost to SacSewer if there is reason to suspect that the wet well was disturbed during the backfilling operation or at other times during construction.

Prepare the wet well for testing by temporarily plugging all penetrations that are below the testing water level.

Introduce water into the wet well to a minimum of one foot above the bottom of the last barrel section at least one hour before the test period. The wet well passes the leak test if there are no visible leaks or weeping around the exterior of the wet well. Any leaks or weeping must be fixed and the wet well re-tested. The wet well has passed the test once there are no visible leaks or weeping.

The contractor is responsible for disposing of testing water.

314.6.1 Failed Tests

When any of the tests fail as specified, locate the problem and make necessary repairs or replacements at no additional cost to SacSewer. Repair all individually detectable leaks, regardless of the results of the tests.

314.7 MEASUREMENT AND PAYMENT

The unit price paid for each new manhole, flusher branch, vault, and wet well includes the following:

- All labor, materials, tools, equipment, incidentals, and
- All work in constructing the manhole, flusher branch, vault, or wet well, including:
    - Excavation and backfill
    - Manhole bases
    - Wet well bases
    - Mortar
    - Concrete
    - Reinforcement
    - Acceptance testing

The unit price paid for each reconstructed manhole, flusher branch, vault, and wet well includes the following:

- All labor, materials, tools, equipment, incidentals, and
- All work in reconstructing the manhole, flusher branch, vault, or wet well, including:
    - Excavation and backfill
    - Demolition
    - Disposal
    - Mortar
    - Concrete
    - Reinforcement

315 PRESSURIZED PIPELINES

315.1 GENERAL

The contractor must furnish and install piping systems as shown and as specified in the contract documents and in compliance with Section 204, "Pressurized Collection System" of these Standards.

The piping systems must be complete, including pipe, fittings, flanges, flexible couplings, and other appurtenances and accessories as required for a complete and operating system.

Use pressurized pipeline materials detailed in Section 204.1, "Pipe Materials" of these Standards.

Place pressurized pipelines along the alignment as shown on the contract documents.

315.1.1 EXCAVATION

Trench excavation for pressurized pipelines must be in accordance with Section 311, "Trench Excavation, Bedding, and Backfill," of these Standards.

315.1.2 DUCTILE IRON PIPE LAYING

Do not use blocking; the bedding must form a continuous, uniform bearing for the full length of the pipe. Excavate as needed to facilitate the removal of handling devices after laying the pipe. Form bell holes at the ends of the pipe to prevent point loading at the bells or couplings. Excavate as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for coating application on field joints.

Lay each section of pipe in the order and the position shown on the laying schedule. In laying the pipes, adjust supports to maintain vertical and horizontal alignments within approximately $^{1}/_{4}$ inch plus or minus from design lines and grades.

As pipe laying progresses, the contractor must keep the pipe interior free of all debris. The contractor must completely clean the interior of the pipe of all sand, dirt, mortar splatter, and all other debris following completion of laying the pipe, pointing of joints, and all necessary interior repairs before testing the completed pipeline.

315.1.3 HIGH-DENSITY POLYETHYLENE PIPE LAYING

Install pipe in accordance with *ASTM D2321* and the current *Performance Pipe Engineering Manual*.

Pipe bedding must form a continuous, uniform bearing for the full length of the pipe. Excavate as needed to facilitate the removal of handling devices after the pipe is laid.

Perform all laying, joining, and testing in the SacSewer inspector’s presence. Lay each section of the pipe in the order and the position shown on the laying schedule. In laying the pipe, adjust supports to maintain vertical and horizontal alignments within approximately

$^1/_2$ inch plus or minus from design lines and grades. The contractor must not exceed the manufacturer's allowable pipe deflection.

Cut all pipes in accordance with the manufacturer's recommendations. Do not drag HDPE pipe on the ground surface. Use wooden dunnage or rollers to protect the pipe when moving.

The contractor must use vertical and horizontal curves for all points of deflection shown on the contract documents with a minimum bend radius no less than 40 times the outside diameter of the pipe (in feet) and a curve length no greater than 10 feet. The minimum field-bending radius is 100 times the outside diameter of the pipe when a fitting, socket, saddle, or flange connection is present in the bend.

Join pipe and joints thermal fusion (butt fusion welding) in accordance with *AWWA C906*, *ASTM D3261*, and *ASTM F905* as applicable and in accordance with the manufacturer's requirements and instructions. The fused joints must be watertight and have tensile strength equal to or greater than the pipe.

315.2 VALVES

Please refer to Section 308.23, "Valves" of these Standards.

315.3 LOCATORS

Install tracer wire, locator ribbon, and programmable locator balls over all pressurized pipelines in accordance with Section 502, Drawing FM-04, and Section 317, "Locating Markers" of these Standards.

315.4 THRUST BLOCKS AND RESTRAINED JOINTS

Supply and install thrust blocks or pipe restraining devices at all locations specified in the plans in accordance with Section 502, Drawing FM-03 of these Standards. Do not start backfilling over thrust blocks until the concrete has adequately set up and can support the load of the soil and the pressures from the compaction effort.

315.5 DISCHARGE

The pressurized pipeline must enter the discharge manhole with its centerline horizontal and invert elevation matching the spring line of the outgoing gravity pipeline. Pressurized pipeline connections to manholes must be Link-Seal as illustrated in Section 502, Drawings FM-01A and FM-01B of these Standards. SacSewer may allow a drop connection, as illustrated in Section

502, Drawing FM-01B of these Standards. The discharge manhole and adjacent downstream manhole must be lined. In lieu of lining, Armorock or approved equal may be used.

315.6 TESTING

After finishing the installation, the contractor must test the force main system. The contractor must furnish all material, equipment, and labor for testing the piping systems. The contractor must use a 4-inch diameter gauge, 0-160 psi. Do not introduce test water into the receiving main line downstream of the project until SacSewer accepts the facility. Each system may be tested as a unit and must successfully meet the requirements specified before acceptance by SacSewer. The contractor must inform SacSewer at least five working days before testing the piping system.

Maintain specified water pressure for the duration in Table 315-1 shown below, and determine the leakage.

Table 315-1: Hydrostatic Testing Requirement

Minimum Pressure	Test Period	Allowable Leakage
135 psi	4 hours	No loss of water or pressure

Immediately correct any leaks that are found and subject the system again to the same test for a period of 4 hours. Repeat until satisfactory results are attained.

315.6.1 HDPE TESTING

Execute the hydrostatic test by providing bulkheads or plugs and filling the force main section(s) with water, in accordance with *ASTM F2164* "*Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure*."

Test all flexible main lines for obstructions and clean by an approved method in accordance with Section 329, "Pipe Cleaning," of these Standards. Remove all obstructions or irregularities or repair them. Test, clean, and repair the pipe to SacSewer's satisfaction. Dispose of all waste, including water, at no additional cost to SacSewer. Dispose of water in accordance with the latest edition of the SWPPP requirements. Do not allow water to enter the existing sewer collection system.

Test installed pipe to ensure vertical deflections do not exceed the maximum allowable deflection. Maximum allowable deflections are governed by the mandrel requirements and nominally 3% of the average ID.

Manufacturing and other tolerances are considered for determining the maximum allowable deflections.

Perform deflection tests no sooner than 30 days after completion of placement and compaction of backfill. Clean and inspect the pipe for offsets and obstructions before testing.

For pipes 24-inch ID or smaller, pull a mandrel through the pipe by hand to ensure that maximum allowable deflections have not been exceeded. Before use, SacSewer must certify the mandrel. Using an uncertified mandrel or a mandrel altered or modified after certification will invalidate the test. If the mandrel fails to pass, SacSewer will deem the pipe to be over-deflected.

Uncover all over-deflected pipe and, if not damaged, reinstall. Do not reinstall the damaged pipe; remove it from the work site. All pipes subjected to any method or process other than removal that attempts, even successfully, to reduce or cure any over deflection must be uncovered, removed from the work site, and replaced with new pipe.

The mandrel must be a rigid, non-adjustable, odd-numbered leg (nine legs minimum) mandrel having an effective length not less than its nominal diameter.

315.6.2 DIP TESTING

Execute the test by providing bulkheads or plugs and filling the force main section(s) with water, making provisions for the release of all air in the force main. The force main may be filled with water sometime before testing for leakage to allow for absorption of water by pipe joint material. The contractor must take all necessary precautions to prevent joints from moving while the pipeline and their appurtenances are being tested. The contractor must, at their expense, repair any damage to pipes, appurtenances, or other structures that result from or are caused by these tests.

The contractor must keep records of each piping test, including:

- Description and identification of piping tested
- Description of the test procedure
- Date of test
- Witnessing by the contractor and SacSewer
- Test evaluation
- Remarks, including leaks (type and location) and repairs made on leaks

315.6.3 FAILED TESTS

Repair or replace all defects and repeat leakage tests until the leakage test requirements have been met. Repair all visible leaks, even if the pipeline passes the allowable leakage test.

315.7 MEASUREMENT AND PAYMENT

Pressurized pipelines are paid for by the linear foot.

The unit price paid for pressurized pipelines includes the following:

- All labor, materials, tools, equipment, incidentals, and
- All work in constructing pressurized pipelines, including:
    - Cutting
    - Trenching
    - Laying
    - Making connections
    - Backfilling
    - Testing

316 PROTECTION

316.1 GENERAL

All materials must be new, free from defects, and of the best commercial quality for the purpose specified. All necessary items and accessories not shown on the contract documents, but required to carry out the specified intent of the work, must be furnished by the contractor without additional cost to SacSewer.

316.2 PROTECTIVE LINING, COATING, AND ENCASEMENT

Wrap DIP and ductile iron fittings with two layers of 8-mil LDPE wrapping sleeve. Secure the sleeve with three layers of 10-mil PVC tape, overlapping each layer ½-tape width. Installation of the LDPE wrapping sleeve must be in accordance with ANSI/AWWA C105/A21.5, Method A (latest edition).

316.3 CATHODIC PROTECTION

All DIP and steel casings must have cathodic protection in accordance with the contract documents and Section 204.9, "Cathodic Protection" of these Specifications.

Work included consists of all components of the cathodic protection system, including anodes, cables, test stations, coating repair, and all other work necessary to complete the installation.

Identify corrosion protection facilities with a curb stamp labeled “CP-FM.”

316.3.1 ANODES

Use prepackaged, high-potential magnesium anodes manufactured by HARCO technologies or approved equal. Use anode sizes shown in the drawings conforming to the chemical composition listed in Table 316-1.

Use factory-assembled anodes with a chemical backfill in a water permeable cloth sack. The chemical backfill mixture must consist of 75% gypsum, 20% bentonite, and 5% sodium sulfate. Firmly pack backfill around the anode within the cloth bag by vibration so that the metal ingot is completely surrounded by a minimum of 1 inch of backfill material. Supply the anode with a factory-installed lead wire, as shown in the drawings. The anode wire must be long enough to reach the appropriate test station.

Table 316-1: Anode Composition

Element	Content (%)
Aluminum	0.010
Manganese	0.50 to 1.30
Copper	0.02 max
Nickel	0.001 max
Iron	0.03 max
Other	0.05 each or 0.3 max total
Magnesium	Remainder

316.3.2 TEST STATION BOXES

Use concrete traffic valve boxes for test station boxes with cast iron lids marked “CP-TEST,” rated for H-20 loading, model G-5 manufactured by Christy Concrete products, or approved equal. The box must be $10\text{-}^{3}/_{8}$ inches inside diameter and 12 inches high. Install a terminal board inside the test station box made of Micarta or Phenolic, a minimum of 5 inches by 5

inches size, as shown in the drawings. The terminal board must have a sufficient number of terminals and shunts, as specified in the contract documents.

316.3.3 SHUNTS

Use 0.01 ohm, 6-ampere capacity shunts in test stations, Type RS Holloway, manganin, or approved equal.

316.3.4 CABLES

Anode and test lead cable sizes, colors, and type must be as shown in the manufacturer's drawing.

316.3.5 EXOTHERMIC WELD

Weld all cable connections to pipe and fittings using an exothermic welding process such as Cadweld by Erico Products, Inc., Thermoweld by Continental Industries, Inc., or approved equal. Fit each cable with a copper sleeve for accomplishing the weld. The same manufacturer must furnish cartridge, sleeves and molds for each weld. Size all welding materials in accordance with recommendations in manufacturers' literature. Please refer to Section 502, Drawing P-05, Detail A, of these Standards.

316.3.6 EXOTHERMIC WELD COVERING

Use Handicaps by Royston Products, T-caps by Calpico, or approved equal cover for sealing cable-to-pipe connections. Use a primer compatible with the weld covering.

316.3.7 REPAIR COATING

Repair coating may be used in conjunction with an exothermic weld covering and to recoat areas of the pipe or fitting not physically covered by the exothermic weld covering. Use Scotch Cast Resin No. 4, manufactured by 3M, or approved equal coating, brush applied, to repair coating damage caused by handling or installation.

316.3.8 WARNING TAPE

All buried cables must have plastic warning tape installed a minimum of 12 inches above the top of the cables. The warning tape must be a minimum of 3 inches wide and yellow with black lettering with the legend, "Caution, Cathodic Protection Cables Buried Below."

316.3.9 EXECUTION

Store and protect all materials and equipment used in construction from detrimental effects from the elements. If actual warehouse storage cannot be provided, stack materials and equipment above ground level and protect them from the elements with tarps, allowing adequate ventilation to prevent the buildup of moisture condensation.

316.3.10 INSTALLATION

Anodes

Install anodes at the locations and as specified on the drawings. Install anodes vertically or horizontally a minimum of 2 feet (laterally) from the pipe, at the pipe invert, and 5 feet apart. Do not carry, suspend, or lower anodes by means of anode lead wires. The contractor will replace any damaged anodes at his sole expense. Remove protective plastic or paper covering before anodes are installed.

Install anodes in native soil and backfill with native soil free of rocks, clods, vegetation, and debris of all types. Backfill anodes with 6-inch lifts of native soil, each lift compacted sufficiently and tightly, taking care to cause no punctures or damage to a cloth bag, anode backfill material, anode lead wire, or the anode itself. When the native soil backfill is level with the top of the anode, saturate the anode locations by adding a minimum of 10 gallons of water per anode.

Route anode lead wires underground to the appropriate test station, as shown on the drawings. Anode lead wires must be long enough to provide a minimum slack of 18 inches at anode and test station installations to avoid stress during backfilling. Care must be taken to ensure that no damage occurs to wires and insulation.

Cables

Lay cables for anodes and test leads buried in the ground straight and without kinks. The direct buried cable must have a minimum cover of 30 inches. Avoid punctures, cuts, and similar damage to insulation during installation. Any damage to insulation will require the replacement of the entire cable length. Label each cable using cable identification tags before backfilling. Backfill surrounding the cables must be native soil free of foreign materials. Place plastic cable warning tape in the backfill 12 inches directly above the cable runs.

Test Stations

Install test stations at the locations shown on the drawings. Install the test stations flush with finished grade. Set the test station box in concrete to prevent settling. Terminate all test lead wires on the test station terminals as shown on the drawings. The soil inside the test box must be free of concrete.

Exothermic Weld Connection

Install exothermic weld connections in the manner and at the locations shown on the contract documents. Remove coating materials from the surface over an area just sufficient to make the connection. Clean the steel surface to white metal by grinding or filing before welding the conductor. Resin-impregnated grinding wheels will **not** be allowed.

The contractor will test exothermic welds for adherence to the pipe and for electrical continuity between the pipe and wires.

Use a 22-ounce hammer for testing adherence by striking a sharp vertical blow to the weld. Do not hit the wires.

After successfully passing the adherence test, remove welding slag from the weld by tapping the weld with a geologist's hammer or other device that delivers a controlled impact to a precise location. Slag will be visible as black or porous metal and will frequently be loosened by the adherence test.

After welding and slag removal, coat all welds with weld cover and repair coating, as directed.

Coating Repair

Apply coating by brush in accordance with factory instructions to recoat all exposed copper wire and all external parts of coated pipe or fittings that may have suffered coating damage.

Joint Bonding

Bond all non-welded, non-isolated pipe joints using joint bond cables as shown in the drawings.

316.3.11 TESTING

After installing the test stations and cathodic protection facilities, test the system under the direct supervision of a NACE International Certified Cathodic Protection Specialist or the State of California registered professional corrosion engineer hired by the contractor to ensure conformance with all specifications. Give a minimum five-day notice to the engineer before scheduling the energizing and testing of the systems.

Testing includes a determination of proper operation and adequacy of anodes, test stations, electrical isolation of steel casings from a metallic pipe, and electrical continuity of bonded joints. Before introducing the test current or connecting the anode, obtain and record static potentials using a portable reference electrode and potentials measured using each test lead and the anode lead. Use a high impedance (10 megaohms or more) voltmeter to measure and record the potential. After connecting the anodes, measure and document potentials (on and off) and anode current output. Testing must be performed in accordance with *NACE RP0169-02*.

Submit a report containing the results of testing no later than 30 days following completion of field testing.

316.3.12 CLEAN UP

The contractor is responsible for cleanup and removal of all debris, extra material, and equipment used for installing the cathodic protection system.

316.4 SUBMITTALS

Submittals must be made in accordance with these Standards.

Submit a complete list of equipment and material, including name and manufacturer, catalog part number, size, and all other pertinent data necessary for proper identification and to determine conformance with these Standards.

Following completion of the cathodic protection installations, but before final site restoration, the contractor must submit a testing report including pipeline electrical continuity, effectiveness of casing isolation from the pipeline, cathodic protection potential data, anode current output, adequacy of test stations, and conclusions. In accordance with submittal procedures, the engineer must submit these items for approval.

316.5 MEASUREMENT AND PAYMENT

Payments for corrosion protection systems include the following:

- All labor, materials, tools, equipment and incidentals, and
- All work including providing, installing, modifying, and testing the corrosion protection systems, combination or units thereof, as shown or specified in the contract documents and as directed by SacSewer

317 LOCATING MARKERS

317.1 GENERAL

The contractor will furnish and install tracer wire, programmable locator balls, and locator ribbon for all pressurized sewer pipelines.

317.2 TRACER WIRE

Attach the tracer wire to the top of the pipe at 10-foot intervals using 10 mil PVC tape or equal to prevent movement of the wire during installation of the pipe. Install tracer wire as a single continuous wire, except where using approved connectors. Do not loop or coil wire. No breaks or cuts in tracer wire or tracer wire insulation are permitted.

Please refer to Section 502, Drawing FM-04 of these Standards for locating wire station and wire connection details.

Ensure tracer wire ends are accessible from the adjacent ground surface to allow for the connection of line tracing equipment. Tag label the locating wire at each access point to identify the purpose and service direction.

Perform continuity testing on each section of tracer wire to ensure the wire is continuous and detectable to line locating equipment throughout the length of the wire. Testing must be performed after installation, before SacSewer's acceptance of the pressurized pipeline, and in the presence of an SacSewer representative. Repair or replace any non-continuous wire and retest as required.

317.3 LOCATOR BALLS

Ship, handle, store, and install locator balls in accordance with the manufacturer's recommendation.

Place locator balls in the trench as illustrated in Section 502, Drawing FM-04 of these Standards. Do not drop locator balls into the trench. Shovel fill over the locator balls. Avoid damage to marker ball from compaction equipment. Begin backfilling of the trench after SacSewer completes its inspection.

Program locator balls above ground before placing them in the trench. Test all locator balls and verify their working condition before installation.

Program each locator ball using the manufacturer's software with the following information at the construction site:

- Facility owner (e.g., FAC_OWN=SacSewer)
- Pump Station ID Number (e.g., PSID=S138)
- Pipeline stationing for each marker ball (e.g., STA=1+48.25)
- Location types:
  - Straight (i.e., along straight sections of pressurized pipeline every 350 feet)
  - Beginning of Curves (e.g., LOC=BC)
  - Midpoint of Curves (e.g., LOC=MP)
  - End of Curves (e.g., LOC=EC)
  - Start and end of any bore and jack section (e.g., LOC=BEG_BORE and LOC=END_BORE)
  - Start and end of any pilot tube section (e.g., LOC=BEG_PT and LOC=END_PT)
  - Start and end of any microtunneling section (e.g., LOC=BEG_MT and LOC=END_MT)
  - Horizontal and vertical Bends (e.g., LOC=BEND_UP, or DOWN, LEFT, RIGHT)
  - CARV taps with the offset distance and direction if it is not located directly above the pressurized pipeline (e.g., LOC=CARV_15N for 15 feet North)

The contractor will verify the working condition and correctness of all programmed data after installation and backfill. All locator balls failing the test and incorrect data locator balls will be removed and replaced at the contractor's expense.

Do not backfill the trench until SacSewer accepts the marker ball placement.

317.3.1 SUBMITTALS

The contractor must submit the following for SacSewer for approval before placing locator balls:

- Certification of compliance with the requirements by the locator ball manufacturer
- Locator ball layout maps indicating the proposed locator ball locations
- Initial programming RFID input data for all locator balls in electronic format in a Microsoft Excel spreadsheet that includes GPS coordinates that are accurate to plus or minus 10 feet for approval
- Data sheet showing locator ball serial numbers, input data, station number, GPS coordinates (northing and easting), and locator ball location descriptions with two references to a local landmark (manhole, etc.)

The contractor must indicate the locations and GPS coordinates of the locator balls on the as-built drawings.

317.4 LOCATOR RIBBON

Center pressurized pipeline locator ribbon in the trench and place it over the entire length of all pressurized pipelines as illustrated in Section 502, Drawing FM-04 of these Standards. Place tape 18 inches to 24 inches above the crown of the pipe.

317.5 MEASUREMENT AND PAYMENT

Pipe locator ribbon and tracer wire is measured by the linear foot. Locator balls are measured by each properly installed and functioning ball. No additional compensation will be provided for additional locating devices installed at the same location. The contract price for all work, materials, and incidentals required to complete the work is specified in the contract documents.

318 WATERPROOFING STRUCTURES

318.1 GENERAL

The contractor will furnish and install a coal tar emulsion-waterproofing agent to the exterior wall surfaces of vaults, wet wells, and manholes when groundwater within the pipe zone is identified.

318.2 WATERPROOFING

Apply a coal tar emulsion waterproofing agent to all below-grade vaults, wet wells, and manholes when groundwater within the pipe zone is identified either on the plans or based on field conditions. Apply no less than two coats of coal tar emulsion for a DFT of 25 to 35 mils or as recommended by the manufacturer.

318.3 SEALANTS

Work includes the cleaning and the preparation of joints' surfaces, sealant and backing material, urethane form fillers for metal decking, and foam sealant for the seal around the pressurized pipeline discharge piping.

318.3.1 SILICON SEALANT

Silicon sealant must be silicon base; single component; chemical curing; conforming to requirements of Federal Specification *TT-S-1543*, Class B; Shore A hardness of maximum 50; and *ASTM C920*, Type S, Grade NS, non-staining. The color will be specified in the contract documents.

318.3.2 POLYURETHANE SEALANTS

Multiple component: Polyurethane base, multiple component, chemical curing, Type 1 self-leveling; conforming to requirements of Federal Specification *TT-S-227*, Class B; Shore A hardness of minimum 15 and maximum 50, non-staining, non-bleeding, and color as selected.

Single component: Polyurethane base, single component, chemical curing, Type 1 self-leveling; for horizontal surfaces and Type 2 non-sagging, for vertical surfaces conforming to Federal Specification *TT-S-230*, Shore A hardness from 15 to 50, withstand movement of 25% of the joint width, non-stinging, and non-bleeding, and color as selected.

318.3.3 FOAM SEALANT

Foam sealant must conform to *ASTM D1752*. Sealant must be self-covering, open-celled, polyurethane-polyester foam impregnated with neoprene rubber sandwiched between two outer membranes, two-component epoxy adhesive, and polyurethane splice adhesive.

318.3.4 SEALANT ACCESSORIES

The primer must be a non-staining type, recommended by the sealant manufacturer to suit the application.

Joint cleaner must be noncorrosive and non-staining type, recommended by sealant manufacturer, compatible with joints forming material.

Joint filler must conform to *ASTM D1752;* round closed cell foam rod, oversized 30% to 50%.

The bond breaker must be pressure-sensitive tape recommended by the sealant manufacturer to suit the application.

318.4 Gasket and Closure Strips

Gaskets must be filler foam sheet neoprene material precut or job cut to fit field conditions.

Closure strips must be solid, closed cell, neoprene closures custom formed by the manufacturer.

318.5 Preparation and Installation

The contractor must prepare and size joints in accordance with the manufacturer's instruction and remove all loose materials and other foreign matter that might impair adhesion of sealant.

Install in accordance with *ASTM C1193* for solvent release and *ASTM C1193* for latex base.

Install sealant in accordance with manufacturer's instructions within recommended temperature ranges; the contractor must consult the manufacturer when sealant cannot be applied within the recommended temperature range.

All joints must be free of air pockets, foreign embedded matter, ridges, and sags.

The contractor must replace sealants that fail because of loss of cohesion or adhesion or do not cure for period of two years from final acceptance.

318.6 Measurement and Payment

Waterproofing and sealant will not be paid for as separate items but are considered incidental to other items of work. Payments are included in other related items of work and include labor, equipment, tools, and incidentals necessary to complete the installation as specified in the contract documents and as accepted by SacSewer.

319 Side Forms and Headers

319.1 General

Furnish and place side forms and headers for Portland cement concrete pavement or asphalt concrete pavement upon an approved subgrade in conformance with Section 306, "Earthwork" of these Standards. All requirements specified in this section for forms also apply to headers. All forms must be mortar tight.

All side forms must be straight, free from warps, bends, indentations, or other defects. The top edge of each individual section of the form must not vary more than $^1/_4$ inch from a true, straight line in the length of the form and must be placed to the required grade and alignment of the edge of the finished pavement. Side forms must not deflect during placing, tamping, and finishing of the pavement. Side forms must not deviate more than $^1/_4$ inch laterally or more than $^1/_8$ inch vertically from proper line and grade. Remove any defective forms from the work.

Thoroughly clean and oil all forms before each form is used.

319.2 FORM JOINTS

Form joints must provide the support necessary to achieve the required tolerances. If the joints do not provide the necessary support, the contractor must substitute acceptable forms or, with SacSewer's approval, to wedge the forms with wood and provide double supporting stakes underneath the form ends. There must be a $^1/_4$ inch expansion gap between the ends of the frame.

319.3 TIMBER SIDE FORMS

Use construction grade Douglas fir timber side forms, in accordance with *Standard Grading Rules of Western Woods* by the Western Wood Products Association, consisting of at least 2-inch material, surfaced on one edge and on the side that is placed next to the pavement. The depth of timber forms must equal the specified depth of the edge of the pavement, but not less than 4 inches, except where placed on existing pavements. Do not use timbers with rounded edges, ends, corners, or split ends.

Secure timber side forms by nailing them to side stakes spaced not more than 4 feet apart. Drive timber side forms vertically so that their tops are 1 inch below the top edge of the side form. Stake dimensions must not be less than 3 inches wide, $1\text{-}^1/_2$ inches thick, and 18 inches long. Increase stake length when the character of the soil does not permit sufficient bearing to an 18-inch stake.

Splice side form joints with a section of timber 4-foot long, 1 inch thick, and 6 inches wide. Nail the splice section lengthwise, lapping the joints.

Support timber side forms on 2-inch by 3-inch stakes spaced not more than 4 feet apart and driven with their tops to the line and grade for the bottom of the side form. These stakes must be long enough to support the forms rigidly and no less than 8 inches long.

Side forms for asphalt concrete paving must be 2x4 minimum nominal dimension, pressure treated 0.40 or better, CCA or approved equivalent.

319.4 METAL SIDE FORMS

Metal side forms must be rigid enough to prevent springing during the placing, tamping, and finishing of the pavement. The depth of the metal side forms must equal the specified depth of the edge of the pavement. Forms must be of the full depth required, in one piece. Do not splice forms by adding a wooden base.

Support metal side forms at each end on a 2-inch by 3-inch stake. Stakes must be long enough to support the form rigidly and no less than 8 inches long. Drive the stakes with their tops to the line and grade for the bottom of the side form.

Stake metal forms firmly by means of steel stakes, placed not more than 5 feet apart, and designed so that stakes may be driven through the base of the form and locked in position.

319.5 FORM MAINTENANCE

Furnish, install, and maintain all sides to the required line and grade at least one day ahead of the placing of Portland cement concrete or asphaltic concrete. When side forms do not conform to the correct line and grade or have become loose, this will be considered sufficient cause to stop work until the side forms are corrected by the contractor to SacSewer's satisfaction.

319.6 MEASUREMENT AND PAYMENT

Supplying and placing side forms and headers is included in the bid prices for items involving the use of side forms and headers. SacSewer will not make a separate payment for these services.

320 CONCRETE STRUCTURES

320.1 GENERAL

Concrete structures must conform to the latest edition of the *State Specifications* and the contract documents.

Work under this section includes constructing retaining walls, slabs, foundations, and similar concrete structures.

320.2 FOOTINGS

The elevation of the bottoms of footings shown on the contract documents is approximate only. SacSewer may order, in writing, changes in footing dimensions or elevations as necessary for a satisfactory foundation. Additional structure excavation and backfill resulting from such changes will be measured and paid for as specified in Section 310, "Structure Excavation and Backfill" of these Standards.

320.3 FORMS

Forms must conform to the latest edition of the *State Specifications*.

The strength of the forms and their supporting structure are the contractor's responsibility, and SacSewer's permission to place concrete in forms does not relieve the contractor of this responsibility. If sagging or appreciable deflection or movement of the forms occurs as the concrete is being placed, SacSewer may reject the work. Rejected work must be removed and replaced at the contractor's expense.

320.4 REMOVAL OF FORMS

Removal of forms must conform to the latest edition of the *State Specifications*.

320.5 REINFORCEMENT

Show concrete structure reinforcement on the contract documents.

320.6 MIXING AND TRANSPORTING

Mix and transport concrete in accordance with the latest edition of the *State Specifications*. Mix all concrete in mechanically operated mixers, except when permitted by the contract documents.

The use of admixtures in concrete for structures is subject to SacSewer's written approval or as otherwise specified in contract documents.

Concrete structures must be Class 1 as specified in the latest edition of the *State Specifications*.

320.7 PLACING CONCRETE

320.7.1 GENERAL

Do not place concrete in forms until SacSewer has approved the forms. Concrete placements must conform to Section 308.6, "Portland Cement Concrete" of these Standards. Thoroughly clean existing concrete surfaces to be connected to new concrete as directed by the inspector. Roughen the surface to approximately $^1/_4$ inch depth. Irregular voids or surface stones may be left in place if sound, free of laitance, and firmly embedded.

320.7.2 PLACEMENT

When the contract documents show or specify a concrete placement sequence or schedule, do not vary the sequence or schedule without written approval from SacSewer.

Place fresh concrete in horizontal layers no deeper than can be satisfactorily consolidated with vibrators. Place the concrete at or near its final position; do not use vibrators for extensive shifting of fresh concrete. Do not allow fresh concrete to fall from a height greater than 6 feet. Use tremies or elephant trunks if placing concrete in a deep or hard-to-reach area.

Do not use additional water to promote free-flowing mixing of the concrete.

320.7.3 VIBRATING

The location, manner, and duration of the application of the vibrators must secure maximum consolidation of the concrete without causing segregation of the mortar and coarse aggregate. Do not attach or hold vibrators against the forms or the reinforcing steel. External form vibrators will only be permitted with SacSewer's written approval when the concrete is inaccessible for adequate internal consolidation, and the forms are constructed sufficiently rigid to resist displacement or damage from external vibration.

There must be enough vibrators to consolidate the incoming concrete within 15 minutes after the concrete is deposited in the forms. No less than two serviceable vibrators must be available at all times. Surfaces must be smooth and free from voids caused by rock pockets. Where necessary, supplement vibration by hand spading to secure these results.

320.8 BONDING

Use epoxy resin bonding compounds, as approved by SacSewer. Apply bonding compounds in accordance with the manufacturer's instructions. Appropriate uses of epoxy resin must conform to the latest edition of the *State Specifications*.

320.9 Concrete Placed Under Water

Do not place concrete underwater.

320.10 Expansion Joints

When the pre-molded joint filler is shown or specified in the contract documents, anchor the filler in the correct position before placing concrete. Finish the edges of the concrete at the joint with a $^1/_4$ inch radius-edging tool. Expansion joint material must comply with these Standards.

320.11 Construction Joints

Construction joints are required when sequencing concrete placement of areas larger than 400 square feet. Construction joints must conform to the latest edition of the *State Specifications*.

320.12 Waterstops

Waterstops must conform to the latest edition of the *State Specifications* when shown or specified in the contract documents.

320.13 Curing

Curing must conform to Section 308.6, “Portland Cement Concrete,” of these Standards. Curing compounds must conform to Section 308.7, "Curing Compounds for Concrete," of these Standards.

Curing practices for concrete placed in extreme weather conditions must prevent too rapid hydration or cold weather freeze-thaw damage as specified in the *ACI Manual of Concrete Practice* (most recent edition) or the latest edition of the *State Specifications*.

320.14 Protecting Concrete

In addition to the requirements of the latest edition of the *County Specifications*, the contractor must protect concrete in accordance with these Standards. The contractor will remove and replace all concrete that has been frozen or damaged by other causes, as determined by SacSewer, at the contractor’s expense.

320.15 SURFACE FINISH

320.15.1 GENERAL

Medium broom finish all exposed surfaces of structures. Immediately after removing forms, cut off all form bolts 1 inch below the finished surface of the structure and fill the remaining holes with cement mortar using 1 part cement to 2 parts sand. To make the surface finish uniform, repair and finish all defects in the concrete surface caused by poor material in the forms, poor form construction, or voids or pockets in the concrete. SacSewer may direct the contractor to correct such defects at the contractor's expense.

320.15.2 ORDINARY SURFACE FINISH

Ordinary surface finishes must conform to the latest edition of the *State Specifications*.

320.16 MEASUREMENT AND PAYMENT

Except as otherwise provided, concrete in structures is measured by the cubic yard in accordance with the dimensions shown or specified in the contract documents or as ordered in writing by SacSewer. No deduction is made for the volume of reinforcing steel.

The price paid per cubic yard for concrete in structures includes the following:

- All labor, materials, tools, equipment, incidentals, and
- All work involved in constructing concrete structures, complete in place, including:
  - Supplying and building all necessary forms and false work,
  - Supplying and placing all concrete, reinforcing steel, expansion joint material, and waterstops, and
  - Curing the concrete, and
  - Finishing all concrete surfaces, as shown or specified in the contract documents and as directed by SacSewer.

If the contractor elects to fabricate materials or does other work before the final determination of footing elevations, the contractor is responsible for any additional costs incurred.

321 PUMPS

321.1 GENERAL

The contractor will supply all mechanical equipment and appurtenances as specified in the contract documents. The contractor is responsible for project coordination. The contractor will coordinate the exact location, space priorities, and sequence of installation of all mechanical and electrical work with each other and with all other trades.

Locations of mechanical and electrical work will follow the locations shown on the contract documents as closely as possible; all alterations of the locations of mechanical work must be approved by SacSewer in writing.

321.2 SUBMERSIBLE CENTRIFUGAL PUMPS

Use submersible centrifugal sewage pumps as designated on SacSewer's *Pump Station Standard Equipment and Requirements List* available on SacSewer's website at www.sacsewer.com. The contractor is responsible for supplying the pumps, motors, base elbow, guide rails, power cables, lifting cable, hatches, and all other accessories necessary for proper operations as designated in SacSewer's *Pump Station Standard Equipment and Requirements List*. The lifting cable must be 316 stainless steel, rated, and tagged to extract the pump from the wet well.

321.2.1 SUBMERSIBLE PUMP REQUIREMENTS

Pumps must be explosion-proof, high-efficient, non-clog, self-clean N-pumps specifically designed to handle raw, unscreened sewage. Use discharge elbows and guide rails manufactured by Flygt. Second-named manufacturer's pumps must be able to fit the Flygt guide rail system and Flygt discharge elbows.

321.2.2 PUMP CONSTRUCTION REQUIREMENTS

Please refer to Table 321-1 for pump construction requirements.

Table 321-1: Pump Construction Requirements

Component	Standard	Requirement
Pump Case	ASTM A48	Class 35B Cast Iron
Motor Housing	ASTM A48	Class 35B Cast Iron
N-Impeller/Inserting Ring	ASTM A48	Hard-Iron (60 HRC)
Pump Motor and Shaft	ASTM A1031	Carbon Steel
	ASTM A276	Type 420 Stainless Steel
O-rings		Buna-N, Nitrile Rubber, or Neoprene
Bolts and Nuts	ASTM A276	Type 316 Stainless Steel
Guiderails	ASTM A276	Type 316 Stainless Steel Pipe
Lifting Cable	ASTM A276	Type 316 Stainless Steel
Lower Ring Seal	ASTM A276	Type Tungsten Carbide
Seal Metal Parts	ASTM A276	Type 316 Stainless Steel

Finish must be two-part epoxy baked at 350 degrees Fahrenheit and finished with enamel. Each pump will be furnished with a mechanical mix-flush valve.

321.2.3 PUMP ACCESSORIES

Power Cable

Provide power cables from the pump controller to pump suitable for submersible applications in sewage and indicate by code or legend permanently embossed on cable. Size the power cable in accordance with the NEC specifications. Provide enough power and control cable for a continuous run from the pump motor to the junction terminal box outside the wet well. Provide a 6-foot drip loop in the wet well and a 4-foot tail in the junction terminal box. Seal the pump cable end with a high-quality protective covering to make the pump cable impervious to moisture or water seepage prior to electrical installation. Provide cable with strain relief, stainless steel cord grip, and explosion-proof seal installed in accordance with NEC *Article 500* to prevent entrance of wet well gases.

Thermal Switches

Stator must incorporate 125-degree Celsius thermal switches in series to monitor the temperature of each phase winding. At high temperatures, thermal switches must open, stopping the motor and activating an alarm signal.

Leakage Sensor

Provide a FLS and a small float switch to detect the pressure of water in the stator chamber. When activated, the FLS must activate an alarm signal to shut the pump down. The use of voltage-sensitive solid-state sensors is not allowed.

Monitoring Unit

Connect the motor thermal sensor and leak detection sensor to a monitoring unit relay. The monitoring unit relay should be mounted in the motor control center, with a manual-auto reset switch and indicating lights providing the status of failure.

Lifting Cable

The lifting cable must be 316 stainless steel, rated, and tagged to extract the pump from the wet well. The cable size must be in accordance with the pump manufacturer's requirements.

Discharge Connection and Guide Rail

Provide a sliding guide bracket integral to the pump unit that properly aligns the pump discharge with the discharge connection elbow for a watertight seal during pumping. The guide rails must not support any portion of the weight of the pump. The guide rail and discharge flange assembly must consist of non-sparking components. The Contractor cannot modify the system in the field. The guide rail and discharge system must be compatible with typical industry standards.

321.3 TESTING

Please refer to Section 322.15, "Electrical Tests" of these Standards, for additional required tests.

321.3.1 SHOP TESTS

The pump manufacturer must perform certified performance tests on the pump in the manufacturer's shop in accordance with the procedures of the Centrifugal Pump section of the *Hydraulic Institute and NEMA Standards*. Test the pump for performance to determine head vs. capacity, efficiencies, and kilowatt draw required for the operating points specified. Check the impeller, motor rating, and electrical connections for compliance to specific requirements. Test the motor and cable insulation for moisture content or insulation defects.

321.3.2 TEST REPORT SUBMITTAL

Prepare and submit certified test results for review and approval. The contractor must submit complete test reports, including test arrangement, instrumentation and calibration data, test procedure, test data, and calculations.

Summarize the results of the pumping performance tests, plotted in curve form, with total head, efficiency, and brake horsepower versus discharge capacity in gpm. Show the guaranteed design performance on the curve.

321.3.3 FIELD TESTING

If any deviations from the shop test are found in the field test, notify SacSewer. Provide pressure taps with $^1/_4$ inch pipe and isolation valves on the discharge sides of the pumps for field tests. Provide taps on the piping between the pump and the shutoff valve. Taps or tees in piping must be $^3/_4$ inch size with a reduction to $^1/_4$ inch at gauge connection. Provide 4-inch pressure gauges necessary to conduct pump test. All field testing plumbing components must be stainless steel. Please refer to Section 205.5.9, "Pressure Gauges and Transmitters," of these Standards for pressure gauge requirements. The pressure gauge range must be 0 to 100 psi gauge. Conduct field pump performance test in the presence of SacSewer at a minimum of 2 points on the operating curve to verify that the pumps meet the design requirements.

321.4 MEASUREMENT AND PAYMENT

Pump station mechanical system costs or prices for various units include the following:

- All labor, materials, tools, equipment and incidentals, and
- All work involved in Supplying, installing, or modifying the mechanical system or combinations or units, as shown or specified in the contract documents and as directed by SacSewer

SacSewer pays pump station mechanical systems as a lump sum item; individual line item costs for additional labor or materials will not be reimbursed.

322 PUMP STATION ELECTRICAL

322.1 GENERAL

The contractor will provide materials, installation, testing, startup, and training for the electrical system, complete with switchboard/MCC, RTU, and all equipment specified in and as shown in the contract documents.

322.2 RACEWAY, BOXES, CONDUITS, AND FITTINGS

322.2.1 RIGID STEEL CONDUITS

Use *ANSI C80.1* and *UL-6* rigid steel conduits. Fittings must be hot dipped galvanized after threading.

Use steel or malleable iron locknuts.

Use threaded, grounding type, malleable iron bushings with a 105-degree Celsius rated plastic insulated throat. The contractor will provide grounding-type bushings on all rigid steel conduits. Plastic bushings with a temperature rating of 105-degree Celsius may be used for PVC conduits or conduits containing 24-volt direct current circuits.

The contractor will provide watertight threaded hubs consisting of sealing fittings with tapered conduit thread, neoprene O-ring, and a 105-degree Celsius rated insulating throat with grounding and bonding lug, Meyers Hub, or equal on box connectors in exterior, damp, and wet locations.

Use threaded couplings that are hot dipped galvanized after fabrication.

Conduit seals must meet the following:

- Stainless steel drain and breather
- UL listed fiber and sealing compounds for use with sealing fittings
- Appleton Type EYF, EYM, or ESU, Crouse-Hinds Type EYS or EZS; Killark type EY or EYS; or approved equal sealing fittings for rigid steel conduits. Where the condensation may collect on the top of the seal, provide a drain by using Appleton Type SF, Crouse-Hinds Type EYD, EZD, or approved equal.

List all fittings in hazardous locations for use in Class, Groups C, and D locations.

322.2.2 Rigid Non-metallic Conduits

Use 90 degrees Celsius rise rating PVC for rigid non-metallic conduits, conforming to *NEMA TC-2* type EPC-40 and *UL-651*. Conduits or bends must be Schedule 40 PVC, and all elbows, risers, or bends must be PVC-coated rigid steel. Couplings, adapters, bell ends, expansion couplings, elbows, and turns of 30 degrees or larger will be factory-made to *NEMA TC-2* and *TC-3*. Use joint cements suitable for the climate as recommended by the manufacturer, furnished with instructions to achieve watertight joints.

322.2.3 Polyvinyl Chloride Coated Rigid Steel Conduits

The contractor will provide rigid steel conduits and fittings with an exterior 0.040-inch minimum thickness factory PVC coating. Factory coat conduit interior and threads with urethane. The contractor will provide Occidental, Robroy Plasti-Bond Red, or equivalent. Use grounding-type bushings. The contractor will provide coated rigid steel cabinet sealing bushings at motor junction terminal boxes for the submersible pump cables. Use OZ Gedney GRK or equal-type bushings.

The contractor will provide factory PVC-coated rigid steel sealing fittings to the motor junction terminal boxes on conduits. Fittings will be Crouse Hinds EYS or approved equal. The contractor will use duct seal on fittings from wet well on conduits to MCC. Please refer to Section 502, Drawing E-03 of these Standards, “Junction Box Mounting Detail,” for details.

322.2.4 Liquid-Tight Flexible Conduit

Conduits must be single strip and hot-dipped galvanized prior to conduit fabrication with an overall PVC jacket. Conform to *UL-360*. Fittings must be hot-dip or mechanically galvanized with an insulated throat, locknut, and sealing ring.

322.2.5 Conduit Usage

Exterior conduits within the sump area must be PVC-coated rigid steel conduits under the decking. Conduits embedded in concrete (excluding transitions through sump walls, equipment pads, and all elbows) must be rigid non-metallic PVC conduits. Use rigid and non-metallic conduits, whether underground direct burial or below concrete slabs. Conduit elbow risers and bends must be PVC-coated rigid steel conduits using threaded adapters. Final connections to instruments (e.g., pressure switches, valve limit switches) must be liquid-tight flexible conduits with a maximum of 3-foot conduit lengths for conduits 3 inches or larger and 2-foot for remaining conduit sizes. The minimum conduit size is $^{3}/_{4}$ inch diameter.

322.2.6 CONDUIT SEALS

Locate conduit seals within 18 inches of a hazardous location area on the vertical rise of the conduit.

322.2.7 INSTALLATION

No conduits must have a fill of more than 40%. No more than three 90-degree conduit bends or an equivalent number of smaller radius bends in any conduit must run between boxes or equipment.

The maximum length of run is 400 feet; 100 feet less for each equivalent 90-degree bend.

322.2.8 SUPPORTS

The conduit that is surface mounted within the sump area must be PVC-coated rigid steel conduit clamps with PVC-coated pipe spacers (clamp back). Grouped conduits may be supported with a non-metallic channel. Anchor with anchor bolts. Please refer to Table 322-1 for details on the spacing of raceway supports.

Table 322-1: Maximum Spacing of Raceway Supports

Raceway Size (inches)	Location	Support Spacing (feet)
Horizontal Runs		
3/4	Flat ceiling or wall	5
3/4	Where it is difficult to provide support except at intervals fixed by the building construction	7
3/4	Any location	7
1 and larger	Flat ceiling or wall	6
1 and larger	Where it is difficult to provide support except at intervals fixed by the building construction	10
1 and larger	Any locations	10
Any	Concealed	10
Vertical Runs		
3/4	Exposed	7
1 to 1.25	Exposed	8
1.25 and larger	Exposed	10

322.2.9 Conduit Penetrations

Dry pack around raceways with non-shrink grout that penetrates concrete block, masonry, and concrete walls above grade, floors, or ceilings. Please refer to Section 308.30, "Nonshrink Grout," of these Standards. Maintain the integrity of all damp proofing and waterproofing membranes that are penetrated by raceways and boxes.

Nonshrink grout must conform to the *USACE Specifications for Nonshrink Grout*, *CRD-621-88* and Section 308.30, "Non shrink Grout" of these Standards. Use a non-gas-liberating type, cement base, premixed product requiring only the addition of water for the required consistency.

322.2.10 Damaged Conduits

Replace all conduits that are damaged. Replace all crushed conduit, clogged conduit, and conduit whose inner surface is damaged or not smooth. Repair cuts, nicks, or abrasions in the zinc coating of galvanized conduit with galvanized repair stick, Enterprise Galvanizing Galvabra, or equivalent. Repair cuts, nicks, or abrasions in the PVC coating of the conduit with the manufacturer's recommended PVC material and build up the surface thickness to match the factory coating thickness and color.

322.2.11 Empty Conduits

Provide 200-pound strength, $^{1}/_{8}$ inch diameter braided yellow polypropylene pull cord in empty conduits. Cap both ends with a Poly Plug cap with pull eyes, or equal. Provide a waterproof label on each end of the pull cords to indicate the destination of the other end, in addition to conduit labels.

322.2.12 Outlets for General Wiring

Use multi-gang boxes and device plates where several devices are located in the same general area.

322.2.13 Underground Conduits

Provide 24-inch minimum cover at finish grade for underground conduits. Underground conduit banks will be concrete encased. If conduits are not to be concrete encased, provide 6-inch minimum sand below conduit and 12-inch sand above conduit.

Where other utility piping systems are encountered or are being installed along a raceway routes, maintain a 12-inch minimum vertical separation between raceways and other systems at crossings. Maintain a 12-inch minimum separation between raceways and other

systems in parallel runs. Do not place raceways over valves or couplings in other piping systems.

Thoroughly clean conduits before installing. Keep the conduit ends plugged with caps at the manholes or pull boxes during construction and after completion.

Terminate conduits with end bells in manholes and pull boxes, entering at a right angle to the wall.

Place conduits separators every 4 feet in the duct bank.

In unpaved areas, use native backfill, compacted in 12-inch layers to 90% relative compaction. The final backfill elevation must match the existing.

In paved areas, provide 18 inches of minimum $^{3}/_{4}$ inch Class II base rock from the top of concrete duct bank in maximum 12-inch lifts. Compact to 95% relative compaction.

322.2.14 Conduit Identification

Identify conduits with stainless steel conduit tags at the following locations:

- Conduit stub ups within electrical equipment
- Underground pull boxes and handholes
- Within 12 inches at entrances into electrical equipment, field devices, pull boxes, and junction boxes

At a minimum, label every conduit at both ends.

322.2.15 Warning Tape

Bury warning tape approximately 12 inches below grade and above all conduits and duct banks. Align parallel to and within 3 inches of the centerline and conduit or duct bank.

Use yellow warning tape, 6-inch minimum width. Use tape made of material resistant to corrosive soil. Use tape with a printed warning that an electric circuit is located below the tape. Manufacturers and types are ITT Blackburn Type YT, Griffolyn Co., Terra-Tape, or equivalent.

322.2.16 Adjusting and Cleaning

After installing raceways and boxes, inspect interiors of raceways and boxes and clean all blockages, remove burrs and dirt, and vacuum clean all construction debris.

322.2.17 Underground Pull Boxes

Provide precast concrete units complying with *ASTM C858* with a load designation of A-16, or as shown in the contract documents. Dimensions specified in the contract documents are inside box dimensions. Provide units manufactured by Associated Concrete Products, Brooks Products, Christy, or equivalent.

The size of handholes must be in accordance with contract documents. In unpaved areas, handholes must have concrete bolt-down covers. Handholes must have flush-mounted cast iron traffic covers in paved areas with bolt downs and lifting hooks.

Concrete pull boxes and vaults must have a pull-in iron, a hot-dipped galvanized cover with a hot-dipped galvanized frame, and two galvanized cable racks with porcelain blocks on each of the two longest sides. Provide parkway-rated covers in non-traffic areas and AASHTO H-20 traffic-rated covers in traffic areas. Refer to the contract documents for size.

After the cables have been pulled and inspected, seal box between cover and frame with mastic compound similar to Permagum, Dukaseal, or equivalent.

For pull boxes, 2 feet by 3 feet and larger, provide end hinged, torsion spring opening assist type cover assemblies. Provide single leaf assemblies for 2-foot by 3-foot pull boxes. Provide double leaf assemblies for pull boxes larger than 2 feet by 3 feet.

322.2.18 Metallic Junction and Pull Boxes

Construct metallic junction and pull boxes of 12-gauge steel for boxes larger than 30 inches wide by 30 inches high and 14-gauge steel for smaller boxes. The contractor must provide factory-made standard sizes.

For the interior, exposed dry locations, use NEMA 1 pull boxes hot-dipped galvanized after fabrication in accordance with *ASTM A123*.

Where located outdoors, in wet locations, or specified in the contract documents as waterproof, and where threaded-hub cast boxes and fittings are not practical, provide pull boxes constructed of code-gauge steel, prime coated, and finish with two coats of rust-resistant paint, color must match the surrounding. The cover must have Type 304 stainless steel bolts and provide NEMA 3R or NEMA 4x construction where required.

322.2.19 Motor Junction Boxes

Motor junction boxes must be stainless steel NEMA 4x rated.

322.3 WIRES AND CABLES

322.3.1 POWER WIRE

Use conductor material class B stranded, soft annealed copper in accordance with *ASTM B3*, with THHN/THWN insulation. The minimum field conductor size is 12 AWG.

322.3.2 CONTROL WIRE OUTSIDE THE REMOTE TELEMETRY UNIT PANEL

Use conductor material class B stranded soft annealed copper in accordance with *ASTM B3*. Use insulation THHN/THWN, 600-volt insulated. The minimum conductor size is 14 AWG.

322.3.3 CONTROL WIRE INSIDE THE REMOTE TELEMETRY UNIT PANEL

Use stranded soft annealed copper. Use THHN/THWN type insulation. The color code must be as shown in the plans. The minimum conductor size is 16 AWG.

322.3.4 INSTRUMENTATION CABLE

Provide PVC coated shielded twisted pair, 16 AWG, 600-volt rated, Belden 8719 or an approved equal at all locations.

322.3.5 CONDUCTOR CONNECTORS AND SPLICES

In above-ground, dry, and damp locations, use 10 AWG or smaller with wire nuts per 3M Scotchlok, Ideal Super Nut, Buchanan B-Cap, or equivalent.

In above-ground, dry, and damp locations, use 8 AWG or larger as follows:

- 1-piece, standard length barrel, copper compression splice
- Thomas and Betts, Burndy Hylink, Teledyne Penn-Union Penn Crimps 2-way connectors or equivalent.

For in-ground handholes and pull boxes, use 10 AWG or smaller. Follow the specifications above and seal with individual sealing packs of Scotchcast 400 Resin or equivalent.

322.3.6 MOTOR TERMINATIONS

Splice conductors to motor leads with copper compression terminal lugs bolted together and insulated with an EPDM rubber slip-on lug cover or other approved method. Provide 3M unshielded cable motor lead splicing kits for electrical products for 1,000 volts or less. Provide motor stub splice insulators Thomas & Betts MSC or equivalent.

322.3.7 WIRE IDENTIFICATION

Provide color coding throughout the entire network of feeders and circuits (600 volts and below) as follows. Please refer to Table 322-2 for details on wire color coding.

Table 322-2: Wire Color Coding

Description	Phase / Code Letter	Non-Field Wire Color (Enclosure)	Field Wire Color	AWG	Insulation Class
480 VAC. 3Ø	A	Brown	Brown	Per U.L	Per U.L
	B	Orange	Orange		
	C	Yellow	Yellow		
	N	Gray	White		
	G	Green	Green		
240 VAC. or 208 VAC. 3Ø	A	Black	Black	Per U.L	Per U.L
	B	Red Orange if high leg	Red Orange if high leg		
	C	Blue	Blue		
	N	White	White		
	G	Green	Green		
240/120 VAC. 1Ø	L1	Black	Black	Per U.L	Per U.L
	L2	Red	Red		
	N	White	White		
	G	Green	Green		
AC Control	N/A	Red (Yellow for foreign circuits)	Red	14	600V
AC Digital Input Status	N/A	Red	Red	16	600V
AC Digital Output	N/A	Red (Yellow for foreign circuits)	Red	16	600V
DC Control	N/A	Blue (Blue/White for foreign circuits)	Blue	16	600V
DC Digital Input Status	N/A	Blue	Blue	16	600V
DC Digital Input Common	N/A	Brown	N/A	16	600V
DC Digital Output	N/A	Blue	Blue	16	600V
24 VDC Positive	N/A	Blue	Blue	16	600V
24 VDC Negative	N/A	Brown	Brown	16	600V
12 VDC Positive	N/A	Blue/white stripe	Blue/white stripe	16	600V
12 VDC Negative	N/A	Brown	Brown	16	600V
5 VDC Positive	N/A	Violet	Violet	16	600V
5 VDC Negative	N/A	Brown	Brown	16	600V
Shielded Pair	+	Red	Red	18	600V
	-	Black	Black		
Intrinsically Safe Wiring	N/A	Light blue	Light blue	18	600V

Use blue conductors for 24 volts, direct current. Conductors designated as foreign voltage must be yellow. Conductors 6 AWG and smaller must have factory color-coding with solid color insulation.

Control wires must have colored insulation. Provide separate color codes for each wire in conduit that has seven wires or less. Conduits with more than seven wires must have at least seven types of colored insulation.

Tag control wires and instrument cable in panels pull boxes, handholes, wireways, and at control devices. Tag control wires and instrument cables with wire numbers as shown on the shop drawing submittals or contract drawings. Tag power wires in pull boxes, handholes, and wireways with a motor control center or a panel board number and circuit numbers. In panel boards, tag conductors with circuit numbers 1 inch from termination at the circuit breaker.

322.4 OTHER ELECTRICAL EQUIPMENT

322.4.1 DISCONNECT SWITCHES

Use non-fusible or fusible disconnect switches with ampere rating and based on the number of poles shown in the contract documents. Use NEMA general duty type GD switches on 240-volt and below circuits. Use NEMA heavy-duty Type HD switches on 480-volt circuits. For switches located outdoors, use stainless steel NEMA 3R, unless specified in the contract documents to be waterproof, then provide NEMA Type 4X.

Equip disconnect switches with quick-make and quick-break operating handles and provisions for padlocking in the off position. Provide an interlock to prevent unauthorized opening of the hinged cover when the switch is in the on position and interlock to prevent closing the switch mechanism with the hinged cover open.

Use disconnect switches with fusible switches with rejection feature or as in the contract documents.

Disconnect switches must have nameplates indicating load served, voltage, phases, and the feeding power source.

322.4.2 GENERAL LIGHTING SWITCHES

Provide molded composition, ivory, specification grade switches per Federal Specification WS-896E, with a single pole, 2, 3, or 4-way switches as in the contract documents.

Provide black selector switches as part of the lighting control panel for site lighting. Use Allen-Bradley Type 800H or approved equal switches.

322.4.3 RECEPTACLES

Duplex Receptacles: Provide molded composition, ivory, specification grade receptacles complying with Federal Specification W-C-596/40D, *Connector, Receptacle, Electrical, General Purpose, Duplex, General Grade and Hospital Grade, Grounding, 2 Pole, 3 Wire, 20 Amperes, 125 Volts, 50/60 Hertz,* NEMA Type 5-20R.

Ground Fault Circuit Interrupter Duplex Receptacles: Provide Leviton 6899-1, or equivalent receptacles, rated 20 amperes complying with *UL-943*, Class A.

Provide GFCI type receptacle at each exterior street light fixture. Mount on the fixture pole.

322.4.4 COVER PLATES

For surface-mounted boxes, use malleable iron cover plates. Use gasket weatherproof cover plates for outdoor locations and where noted in the contract documents. Provide a die-cast aluminum cover plate with a neoprene gasket, exterior toggle switch, and locking arrangement for light switches. If the light switch is pushbutton style, provide NEMA 4-rated pushbutton. For receptacles, provide a gray polycarbonate lift-cover type suitable for use in a wet location with the cover closed with receptacles in use.

322.4.5 THERMOSTATS

Use line voltage type Honeywell T631C-1020 or approved equal thermostats. Thermostats must be 70 to 140 degrees Fahrenheit set point range and motor current rated contacts.

322.5 PANEL BOARDS

Provide dead front, bolt-on type circuit breakers, and safety-type panel boards in accordance with *NEMA PB-1* with voltage ratings as scheduled in the contract documents. Panel boards must be the same manufacturer as the MCC major components (General Electric, Cutler-Hammer, or equivalent). Mount panel boards in the MCC.

Panel boards must have permanent typed circuit numbers. In addition, panel boards and circuit breakers must be individually suitable for the specified short circuit ratings in the contract documents.

322.5.1 BREAKERS

Molded case: Provide bolt-on, quick-make, and quick-break toggle mechanism, inverse-time trip characteristics, and trip-free operation on overload or short circuit type circuit breakers.

Indicate automatic tripping by a handle position between the manual OFF and ON position.

Provide trip ratings in accordance with the panel board schedules. Provide all panel board breakers with individual padlock hasps (lockable in the off position).

Single-pole breakers must be full module size; do not install two poles in a single module. Multiple circuit breakers must be of the common-trip type having a single operating handle.

Provide heating, air conditioning, and refrigeration rated circuit breakers for heating, ventilation, and air conditioning equipment or grouped motor installations.

Breaker Connections

Circuit breaker current carrying connections to the bus must be bolted type.

322.5.2 BUS BARS

Use copper bus bars.

322.5.3 GROUNDING BAR

Provide copper grounding bars with main lug provisions and grounding termination points for each branch circuit, including spaces. Bond grounding bar to the panel enclosure.

322.5.4 PANEL BOARD SCHEDULE

Provide a typed panel board schedule located in the directory holder. Type the schedule with capital letters with odd-numbered circuits on the left side or top and even circuits on the right side or bottom. Define accurately and briefly the connected load and location.

322.5.5 NAMEPLATE

Provide nameplate with $^{1}/_{4}$ inch lettering. Designate the panel name on the first line. Center each line on the nameplate. The remaining lines must indicate voltage, amperes, phases, the number of wires, short circuit rating, and conductor color coding associated with the voltage used according to the following example:

PANEL LP-1
208/120V, 3PH, 4W, 100A
14,000 AIC
PH. A-BLK, B-RED, C-BLU

322.6 GROUNDING

322.6.1 UFER GROUNDING SYSTEM

All grounding system installations must comply with NFPA 70, NEC article 250. Install grounding up to the latest code updates to NEC article 250, "*Concrete-Encased Electrode*." Grounding must be at least 20-foot (6 m).

322.6.2 GROUND CLAMPS

Ground clamps for connection of the ground wire to handrails, flanges, gateposts, and other metal structures must be high strength corrosion resistant copper alloy and *UL-467* listed for direct burial.

322.6.3 GROUND CONDUCTORS

Underground ground conductors not in conduit must be annealed bare standard copper conforming to *ASTM B8*. Size must be #4/0 copper.

322.6.4 EXOTHERMIC CONNECTIONS

Weld connections together using an exothermic fusion type process. Provide connections equal to or larger in size than the conductors joined and with the same current carrying capacity as the largest conductor. Connections must be Cadweld or equivalent. All buried or concealed ground connections and ground bus to ground rod connections must be exothermic type connections.

322.6.5 GROUND WELLS

Please refer to Section 502, Drawing E-05 of these Standards for detail.

322.6.6 GROUND ELECTRODE

Bond the exposed metallic piping system to the grounding system in accordance with NEC *Article 250*. Bond all structural steel, water pipes, rebar mats, and all other items as specified in the contract documents for a complete ground electrode system. Enclose all ground rods in ground wells.

322.6.7 EQUIPMENT GROUNDING

Ground all gates, fences, and handrails, even if grounding is not specifically called out in contract documents. Grounding conductor from the ground grid to gates, fences, and handrails must be 2 AWG minimum. Encase all exposed grounding conductors in conduits or sleeves to minimize vandalism.

322.7 TRANSFORMERS DRY TYPE

Transformers KVA, voltage and the number of phases must be as specified in the Contract Documents. Transformers must be *NEMA TP-1* and EPA Energy Star compliant, meeting all locally recognized requirements.

Transformers must be rated for continuous operation in 40 degrees Celsius maximum ambient temperature with 150 degrees Celsius winding rise. Construct transformers in accordance with *ANSI C89.2*, *NEMA ST 20,* and *UL-506*.

Transformers must have nameplates with $^{1}/_{4}$ inch lettering and in accordance with these Standards. Indicate identification, KVA, primary and secondary voltage, phases, number of wires, and supply source according to the following example. Mount nameplates on the front of the transformer.

XFMR: T1
KVA:10
PRI: 480V, 3PH, 3W MCC-1
SEC: 208/120V, 3PH, 4W

The maximum transformer sound level must be in accordance with *ANSI C89*, as shown in Table 322-3.

Table 322-3: Transformer Rating

KVA	Level Decibels
0-9	40
10-50	45

322.7.1 THIRTY KVA TRANSFORMERS AND BELOW

Transformers must have 2.5% taps on the primary side, with encapsulated core and coil in an insulating resin of a class equal to the temperature rise and embedded in a resin and filler system to attenuate the sound level. Transformers must have a 115 degrees Celsius

rise and 220 degrees Celsius insulation system. Transformers must be General Electric Type QL, Culter-Hammer Energy Efficient, or equivalent.

322.8 SWITCHBOARD AND MOTOR CONTROL CENTER

322.8.1 ELECTRIC SERVICE ARRANGEMENT AND COORDINATION

The electric service must be 3-phase, 4-wire, and 480-volt, or as specified by the jurisdictional agency. The contractor must furnish and install new primary and secondary underground ducts, primary pull boxes, transformer pad, and transformer bollards in accordance with local electrical utility requirements and the contract documents.

The contractor must obtain copies of the electrical service requirements from the local electrical utility agencies. The contractor must furnish and install the secondary conductors, metering sockets, and metering CT facilities. The local electrical utility agency must furnish the meter and the current transformers.

Prior to installation, the contractor must field-verify the locations for the underground ducts, primary pull boxes, and transformer pad with the local electrical utility agency.

The contractor is required to coordinate with the local electrical utility agency for new services. The contractor must include all local electrical utility-related schedules in the project schedule.

322.8.2 RATINGS

Switchboard ratings must be in accordance with the contract documents and exceed the maximum fault current from the local jurisdiction.

322.8.3 STRUCTURE

Provide NEMA 3R, non-walk-in for outdoor use, including lighting and intrusion switches on all doors.

The utility metering compartment door must be as follows:

- Ambient temperature range of 0 to 40 degrees Celsius, with a 150 degree Celsius temperature rise rating for all components.
- Completely enclosed, dead-front, self-supporting metal structure
- Vertical panel sections bolted together

- Provide frames bolted together to support and house bus, cables, and other equipment.
- Provide frames and insulating blocks to support and brace main buses for short circuit stresses up to ratings specified in the contract documents.
- Provide three-point latches on doors with provisions for padlocking. All doors must open more than 90 degrees. Open doors must not interfere with other open adjacent doors.

322.8.4 ARRANGEMENT

Front access only. Arrange the switchboard in accordance with the contract documents.

322.8.5 BUSES

The main horizontal bus bar must be high-strength tin plated copper with sufficient size to limit temperature rise to 65 degrees Celsius over average air temperature outside the enclosure of 30 degrees Celsius. Buses must be fully rated and continuous over the length of Switchboard/MCC.

322.8.6 MAIN BUS TAP CONNECTIONS

Tap connections must be tin plated copper over the entire surface of the joints, with four bolts at each connection for maximum conductivity.

322.8.7 GROUND BUS BAR

The ground bus bar must be continuous over the length of the switchboard and solidly grounded to each structure section. The ground bus bar size must be in accordance with contract documents.

322.8.8 NEUTRAL BUS

The neutral bus must be fully rated and continuous over the length of the Switchboard/MCC. Use similar materials to the main bus.

322.8.9 METERING

Provide utility metering facilities in accordance with local electrical utility requirements and Equipment Utility Service Requirements Committee Standards. This condition includes all testing requirements, clearances, and grounds.

The contractor must provide and install all required metering CTs and PTs in accordance with local electrical utility requirements. The local electrical utility agency must provide and install the meter.

322.8.10 INCOMING POWER

The underground duct bank must be in accordance with local electrical utility requirements.

322.8.11 COMPONENTS

For pump stations with pump size equal to or greater than 100 HP, use a compact power quality meter with an integrated display and connect it on the load side of the main circuit breaker as shown on the contract documents. For pump stations with a pump size less than 100 HP, power quality meters are not required.

Provide Time Mark Model 258-B, or approved equal, Octal Base 3 Phase Power Failure Monitoring Relay with phase loss, low voltage, phase reversal, and phase unbalance functions. Provide Time Mark Smart Socket mounting socket that lowers 480 volts AC to 240 volts AC, and secure each relay to socket with Time Mark hold down clamp.

322.8.12 MAIN SERVICE SURGE SUPPRESSION DEVICES

Provide 300 kiloamperes per phase main service TVSS device with remote alarm capability. Locate in the isolated cubicle of switchgear.

The device must protect a 480 volts AC 3-phase main service with the features listed in Table 322-4 TVSS Specifications.

Table 322-4: TVSS Specifications

Feature	Specification
Enclosure	NEMA 4
Warranty	20-year free replacement of TVSS device
Protection Modes	All Modes, including L-N, L-L, L-G, N-G
Protection Method	Provide with Threshold Suppression Network suppression features
Response Time	<1 nanosecond
Diagnostics	LED indicators, one per phase, normally on
Remote Alarm	Form C dry contacts with optional surge counter
Circuit Design	Totally Encapsulated

322.8.13 Seismic Requirements

Switchboard anchoring supports must be in accordance with contract documents.

322.8.14 Nameplates

Provide a main switchboard nameplate with $^1/_2$ inch lettering. The first line gives the switchboard designation. The remaining lines indicate the voltage, amperes, number of phases, number of wires, and short circuit rating like the following example:

SWBD1
480V, 200A, 3P, 3W,
65,000 AIC

322.8.15 Instrument Transformers

Current and potential transformers must conform to *ANSI C57.12*, accuracy Class 6-3. Provide current transformers with secondary shorting terminal blocks. Current transformers must be accurate within 0.3%.

322.8.16 Painting

Painting must meet the following requirements:

- Phosphate cleaned all metal surfaces
- Use two coats of rust inhibitive enamel primer
- Use two coats of alkyd enamel finish, gray color, or as selected by the Engineer

322.8.17 Miscellaneous Features

Provide circuit protective devices and other associated equipment in accordance with the contract documents. All control wiring must be neatly laced and have flexibility at hinge locations. Tag switchboard and all circuit breakers identifying equipment and circuit fed. Provide intrusion switches on all exterior Switchboard/MCC doors, except the local electrical utility metering cabinet. Switches must be closed when doors are closed. Provide lights, controlled by a toggle switch, within Switchboard/MCC non-walk-in enclosure.

322.8.18 Main and Generator Circuit Breakers

Use molded or insulated case type or low voltage power type rated to have an interrupting capacity to withstand maximum fault current. Provide 100% rated breakers in accordance

with the contract documents. Frame size, current sensor, rating plug, and trip setting must be in accordance with the contract documents.

Thermal magnetic or solid-state trip size up to 150 amperes must be a non-interchangeable, non-adjustable thermal-magnetic trip unit. Thermal magnetic or solid-state trip size 200 amperes and above must be a solid-state trip unit, with a fixed current sensor, interchangeable rating plug, a minimum range of 50% to 100% of current sensor rating, adjustable current setting, and minimum range of 70% to 100% of rating plug.

The adjustable delay must have a minimum three 3 taps, adjustable instantaneous pickup, and minimum range of three to eight times rating plug, and integral ground fault protection on frame sizes 400 amperes and above. Adjustable pickup, minimum range 0.2 to 0.6 times current sensor, and adjustable delay, minimum of three taps. Fault interrupting rating equal to or greater than main bus fault withstand rating.

The Trip/Close mechanism must clearly indicate ON, OFF, and TRIPPED. The operation must be manually operated where a shunt trip is needed.

322.8.19 MOTOR CONTROL CENTER

MCC must be floor standing and front-accessible NEMA 3R outdoor rated construction, non-walk-in. The voltage and ampere rating and physical dimensions must be in accordance with the contract documents. Wiring must be NEMA Class IIS, Type B, with wiring schematics showing field connections. Tag control wiring within 2 inches of termination at each device and terminal board. Schematics must also show terminal numbers and interior and field wire numbers. Provide channel iron sills and removable lifting angles.

Provide a separate 4-inch vertical wireway for each MCC section with cable supports and a hinged door separate from the unit starters. Provide 6-inch horizontal wireways, both top and bottom, for each MCC section with removable covers held closed by captive screws. Isolate wireways from bussing.

Provide removable, plug-in-type individual compartments separated by steel barriers and with separate hinged doors for each starter, circuit breaker, or other unit. Locate equipment to enable termination of field wiring from the front without equipment removal.

Mechanically interlock starter and circuit breaker doors so doors cannot be opened with the unit energized. Provide a defeater mechanism to allow intentional access while the

starter or circuit breaker is energized. Provide provisions for padlocking external disconnect handles in the OFF position.

Provide a continuous, front-accessible 200-ampere minimum ground bus extended the full length of the MCC. Motor control centers must comply with applicable NEMA, UL, and ANSI standards for industrial control. Provide a UL label on each motor control center section. Provide space heaters and adjustable thermostats. The voltage must be 120 volts. Provide thermostats with a range of 40 to 80 degrees Fahrenheit and contacts rated 120 volts, 10 amperes continuous, and 60 Hertz. Provide a shield and an on/off toggle switch for each heater.

Provide intrusion switches and lights as outlined in Section 322.8.17, "Miscellaneous Features" of these Standards. Provide NEMA-rated Allen-Bradley, Square D, General Electric, or Cutler-Hammer, manufactured components for MCC construction, or approved equal.

For medium and large-sized pump stations, provide spare buckets in accordance with the contract documents.

322.8.20 Breakers

Provide molded-case type feeder circuit breakers. Provide quick-make and quick-break toggle mechanism, inverse-time trip characteristics, and trip-free operation on overload or short circuit. Indicate automatic tripping by a handle position between the manual OFF and ON position. Provide trip ratings and the number of poles in accordance with the contract documents. Provide breakers with fault current interruption ratings equal to or greater than the motor control center short-circuit current rating in the contract documents.

Provide MCP-type circuit breakers as shown in the contract documents.

322.8.21 Reduced Voltage, Variable Frequency Motor Starter

Provide an SacSewer-approved motor controller with a pump control option. Please refer to SacSewer's *Pump Station Standard Equipment and Requirements List* available on SacSewer's website at www.sacsewer.com.

Provide starter with the following field selectable starting methods. Only one starting method may be selected during operation.

The soft start must start the motor at an adjustable initial torque and adjustable acceleration ramp time. Provide with kick-start that provides a current pulse of 500% of full load current for an adjustable time frame from off to 2 seconds.

The current limit start must limit the maximum starting current over an adjustable range and adjustable time frame. The engineer must determine settings after motor information has been submitted.

The across-the-line start must start the motor across the line within 0.25 seconds. Defeat this starting method.

Starter must have adjustable soft stop from 0 to 15 seconds, minimum, and capability to reach 30 seconds.

Provide start with separate automatic bypass capability.

The microprocessor-based control module must have all the circuitry required to drive the power semiconductors located in the power section. The power section must provide the following:

- A full voltage rating of 600% for 10 seconds
- A centrifugal pump and fan duty of 300% for 10 seconds
- A continuous full load rating of 150% of the full load amps
- Starters with an Energy Saver function that reduces the starter output voltage during times when the motor is unloaded or lightly loaded
- Selector switch to defeat the Energy Saver function
- Protection during starting and running modes for starting fault, line fault, temperature fault, and stalled motor

The power section must also provide status and fault annunciation with LEDs for the conditions listed in Table 322-5.

Table 322-5: LED Condition Colors

Condition	Color
Control Voltage Present	White
Running	Red
Stopped or Off	Green
Fault	Amber

Provide start with one Form C auxiliary contact. The contacts must be field adjustable to change state either instantaneously on the start command or when the motor is at full speed. Factory adjust the switch to change the state on the start command.

Provide starter logic with a latch circuit for stop-start three-wire control.

322.8.22 MISCELLANEOUS COMPONENTS

Control Power Transformer

Provide a copper wound, and vacuum impregnated dry type control transformer with screw-type terminals. Provide 120-volt with minimum 250 volt-amperes spare capacity that is in addition to contactor load plus other loads per the plans. Size transformer for a maximum voltage drop of 5% with 100% primary voltage during contactor inrush. Fuse one side of the secondary winding and ground the other side. Provide primary winding fuses for both sides of the primary winding.

Relays

The control relays must have magnetically held type with NEMA A300 convertible contacts for 120 or 208-volt circuits and NEMA A600 convertible contacts for 480-volt circuits, with coil voltage, the number of poles, and pole arrangement in accordance with the plans. Relays must be pushed to test, indicating type, IDEC RR or RH, or equivalent, for less than 480-volt relays. Relays must be Allen-Bradley Bulletin 700, Square D Class 8501 Type X, General Electric CR120B, or equivalent, for 480-volt relays.

Time-delay relays must be a solid-state, magnetically held type with NEMA A300 rated convertible contacts, with coil voltage, number of poles, pole arrangement, and maximum timing adjustment in accordance with the plans.

Power fail relays must be Octal Base 3-Phase Power Monitoring Relay with phase loss, low voltage, phase reversal, and phase unbalance functions. Provide Time Mark Model 258-B, or approved equal, rated for 208/240 volts AC nominal supply voltage. Provide Time Mark Smart Socket mounting socket that lowers 480 volts AC to 240 volts AC, and secure each relay to socket with Time Mark hold down clamp.

Control power fuses

Provide $1\text{-}^{1}/_{32}$, $^{1}/_{4}$ inch by $1\text{-}^{1}/_{2}$ inches with an AIC rating of 10,000 amperes Cooper Bussmann HG series or equivalent control power fuses. Provide a panel-mounted fuse holder with a clear bayonet knob and a blown fuse indicating a neon lamp.

Pushbuttons and Selector Switches

Provide NEMA Type $^{4}/_{13}$ for indoor and exterior areas with NEMA A300 rated contacts. Provide standard size, round pushbuttons (30.5-millimeter mounting hole), flush head with

momentary contacts. Provide standard size selector switches (30.5-millimeter mounting hole) round with standard operator.

Pilot Lights

Provide standard full-size transformer type pilot lights (30.5-millimeter mounting hole) NEMA Type $^{4}/_{13}$ for interior and exterior areas, complete with the color of lens specified in the contract documents and legend plate. Use high-density light emitting diode lamps. Indicating lights must be push-to-test type.

Control Wiring

Provide class C stranded copper MTW or THHN. Provide 14 AWG minimum conductor size control wiring. Provide 16 AWG conductor size only when conductors directly connect to terminal blocks in the RTU control panel.

Identify all wires with either heat shrinkable machine printed sleeve markers or clip-on markers covered with clear plastic heat shrinkable tubing. Hand-lettered wired labels are not acceptable and must be replaced at the contractor's expense. All wires that are electrically the same (connected to common termination points) and do not pass through a contact or other switching device must have the same wire identification.

The wire labeling code for each end of the same wire must be identical. Size tubing for the wire and shrink into place with the properly sized heat gun. Use Thomas & Betts SM series, Raychem Thermofit TMS wire labels, or approved equal.

Nameplates

Provide exterior nameplates indicating the device controlled, the identification number, the device size, and the starter type. Provide additional information if indicated on the single-line diagrams. Provide nameplates within the enclosure to identify relays and all other components.

Provide nameplates for operator interface devices (e.g., pushbuttons, pilot lights). Provide anodized aluminum nameplates with $^{1}/_{8}$ inch high black engraved lettering and contrasting painted lower half. Nameplate lettering must be on the schematic wiring diagrams.

322.8.23 TERMINAL BLOCKS

Furnish and install terminal blocks as required for fan-out of control, power, and instrumentation wiring in equipment. Use blocks rated 600 volts at a minimum of 20 amperes or sized for the conductors served.

Provide terminal blocks with follower plates that compress the wires and have wire guide tangs for ease of maintenance. Terminal blocks that compress the wires with direct screw compression are unacceptable. All power, control, and instrument wires must terminate on terminal blocks with wire numbers on terminals and on both ends of the wires. Use Phoenix Contact Terminal blocks.

Use snap-in type terminal blocks for mounting on DIN rails. Provide end clamps and cover plates to hold terminal blocks securely in place.

Each strip of terminal blocks must have a unique identifying alphanumeric nameplate at one end. Provide plastic marking strip segments to label terminal blocks. Each marking strip segment length must provide labeling for no more than four terminals at one time. Numbers on this marking strip must be machine printed and $^{1}/_{8}$ inch high.

Physically separate terminal blocks into groups by the level of signal and voltage served. Power and control wiring above 100 volts must have a separate group of terminal blocks from terminal blocks for wiring below 100 volts.

Provide a ground terminal or connection point for the power system grounding conductor.

322.9 PROGRAMMING

The contractor must program all setup programming of the power quality meter, VFD, and soft starters. In addition, the contractor is responsible to coordinate with SacSewer on desired parameters.

322.10 SPARE FUSES

Provide three spare fuses for control power transformer protection of each type supplied. Provide five spare pilot light LED lamps.

322.11 LIGHTING

This specification section covers the furnishing, installing and testing of lighting fixtures, wiring devices, poles, conduit, wiring, and other material for the complete lighting systems as shown in the contract documents.

The lighting system must use long-life, energy-efficient LED lighting and operate on 120 volts, 60 Hertz AC power source. Install LED lighting fixtures and hardware as shown in the contract documents.

LED lighting fixtures must be complete with mounting brackets and hardware, LED lamps, optics, fixtures wire, and all required accessories. Show the LED lighting fixtures and fixture accessories in the contract documents.

Exterior LED lighting fixtures, in combination with their mounting pole and bracket, must withstand 100-mile-per-hour winds without damage. Exterior fixtures must have stainless steel corrosion-resistant hardware and hinged doors or lens retainer.

322.11.1 LED LAMPS

120V AC power supply, the color temperature under 4,000 degrees Kelvin, minimum CRI of 70, and rated average LED lamp life over 50,000 hours.

Manufacturers: Lithonia, Philips, or equivalent.

322.11.2 POLES

Use anchor base, hot dipped galvanized steel light poles, height as specified in the contract documents, complete with handhole and gasketed cover, anchor bolts with leveling and locking screws and cover, and grounding connection. The pole must have a receptacle and switch as specified in the contract documents.

Equip with a handhole of sufficient size to permit the pulling and splicing of wires and grounding of the pole. Provide a grounding lug accessible through the handhole to accept a $^1/_2$ inch diameter copper conductor. Equip the handhole with a cover equipped with a tamper-proof screw.

322.11.3 PHOTOELECTRIC CELL

Construct the photocontrol enclosure of die-cast zinc, gasketed for weather protection. The cell must be cadmium sulfide, epoxy coated, 1 inch in diameter, and rated for 1,800 volt-amperes. Provide TORK Model 2101, or approved equal.

322.11.4 SPARE PARTS

Provide two spare lamps of each type, boxed and delivered to SacSewer before project completion.

322.12 NAMEPLATES

Fabricate nameplates from black-letter, white-face laminated plastic phenolic engraving stock, Formica type ES-1, or approved equal. As required, fasten each securely using stainless steel screws, screwed into inserts, or taped holes.

Use block-type engraving with characters no smaller than $^{1}/_{8}$ inch high. All electrical equipment must have a nameplate attached. This applies to pull boxes, MCC control panels, transformers receptacles, and switches. All conduits must have stainless steel stamped tags with stainless steel tie wire. Label every conduit at both ends.

322.13 WIRE SPLICING AND CONNECTING

Tighten electrical connections and terminals, including screws and bolts, in accordance with the manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in *UL-486A* and *UL-486B*, or *NETA Standards*.

Retighten bolt-type connectors 24 to 48 hours after initial installation and before taping.

Insulate splices with tape or shrinkable insulators. Tape connections as follows:

- Step 1: Apply a minimum of four layers of varnished cambric tape
- Step 2: Apply a minimum of six layers of rubber tape half-lapped
- Step 3: Apply a minimum of six layers of vinyl tape half-lapped

322.14 PROTECTIVE DEVICE STUDIES

The contractor must hire a third-party licensed professional electrical engineer to perform and submit the following protective device studies for the electrical power system in accordance with the Contract Documents: Short Circuit Study with recommended protective device settings and Arc Flash Study.

The studies must include all portions of the electrical distribution system for normal, alternate, and standby power sources. The Contractor is responsible for obtaining all data required to perform all of the studies from the local utility.

The Contractor must obtain the ratings and time-current curves for all protective devices, including fuses, circuit breakers, motor circuit protectors, relays, and overload protective

elements. The Contractor must perform all needed field investigations and inspections to properly identify all cable and wire sizes, types, sizes, and materials for use in the final studies.

Studies must be stamped and signed by an electrical engineer registered in the state of California with experience in performing short circuit and arc flash studies.

322.15 ELECTRICAL TESTS

The following test requirements are intended to supplement NETA Acceptance Testing Standards or other test and acceptance criteria that may be stated elsewhere.

Factory functional testing of switchboard and MCC must be witnessed by SacSewer.

Electrical field tests must be performed by a third-party NETA-certified testing agency that has been regularly engaged in testing equipment for at least five (5) years. SacSewer must witness all electrical testing.

322.15.1 SWITCHBOARD AND MOTOR CONTROL CENTER

Clean the switchboard and MCC before testing. Verify lubrication on moving and sliding surfaces.

Inspect all devices and hardware for physical damage and sizing, and compare equipment nameplate information with latest one line diagram and report discrepancies. Inspect and verify anchorage, area clearance and correct alignment. Verify current and potential transformer ratios, and inspect installation.

Test insulation on each bus, phase-to-phase, and phase-to-ground with a suitable megohmmeter.

Test insulation of all control and relay field wiring circuits to ground with a suitable megohmmeter.

Test each instrument and meter for proper operation, correct rotation, and circuitry. Test instruments and meters energized from instrument transformers at the transformer secondary level.

Functional test of all devices, such as ATS, protective relays, meters, circuit breakers, VFD, solid-state starter, contactors, relays, switches, overloads, indicating lights and space heaters, simulation of all remote control and alarm points.

Confirm correct operation and sequencing of the electrical and mechanical interlock system.

Check for proper grounding connections at both ends of the assembly. Check for external, visible ground lug connections. Check ground bus continuity. Perform ground resistance tests.

Perform current injection tests on the entire current circuit in each section.

Check for proper torquing of all bolted connections.

Calibrate and test all circuit breakers and relays. Test circuit breakers and adjust final settings according to Section 322.15.5, "Miscellaneous Electrical Tests" of these Standards. Determine the accuracy of all meters and calibrate as required.

322.15.2 CABLES

Perform a shield continuity test by ohmmeter method for instrumentation cables. Record ohmic value and check for proper cables' termination. An Electrical Contractor may do this work.

322.15.3 MOTORS

Inspect each motor installation for any deviation from rated voltage or frequency and improper installation. Inspect for physical damage, anchorage, and proper connection. Verify nameplate data with contract documents.

Check motor protective relay connection and verify its functional operation. Visually check the frame for proper ground connection.

Test each motor for proper connection, rotation, and automatic operation.

Perform resistance measurements through all bolted connections. Test insulation of motors and drop cables through a standard 60-second DC megger test using a minimum of 500 volts DC as the test voltage.

Test motor starter. Measure running current and evaluate relative to load conditions and nameplate full load amperes.

Test motor control circuits. Inspect motor starters. Inspect all bolted connections for high resistance.

Perform insulation resistance of each combination starter, phase-to-phase, and phase-to-ground, with the starter contacts closed and the protective device open.

Test the motor overload relay by injecting primary current through the overload circuit and monitoring trip time. Test circuit breakers, including motor circuit protectors. Perform operational tests by initiating control devices.

322.15.4 SYSTEM GROUND

Verify each ground system is installed in compliance with contract documents.

Before placement of sidewalks, landscaping, or paving, measure the resistance of each electrode to the ground using a ground resistance tester. Perform the test not less than two days after the most recent rainfall, in the afternoon, after all ground condensation has evaporated. Submit readings as part of the system ground test.

After all individual ground electrode readings have been done, interconnect the ground grid as required and measure the system's ground resistance at the switchboard/MCC ground bus, the emergency generator ground bus, and each ground electrode.

Do not energize the electrical power system unless the system ground resistance is less than 5 ohms at all points tested. For system ground resistance greater than 5 ohms and individual electrode ground resistance of 5 ohms or more, notify the engineer.

322.15.5 MISCELLANEOUS ELECTRICAL TESTS

Circuit Breaker Tests (Molded Case and Power): Perform contact resistance test. Make adjustments for final settings in accordance with the protective device coordination study in Section 322.14, "Protective Device Studies" of these Standards.

Determine minimum pickup current on power breakers. Perform long time delay time characteristic test by passing 300% rated primary current through each pole separately.

Determine short-time pickup and delay by primary current injection. Determine ground fault pickup and time delay by primary current injection. Determine instantaneous pickup current by primary injection using run-up or pulse method. Activate auxiliary protective devices, such as a ground fault or undervoltage relays, to ensure the operation of shunt trip devices. Verify operation of charging mechanism for power circuit breakers.

Demonstrate that light fixture outlets are switched as specified in the contract documents.

Test photocell and lighting timer switch. Demonstrate that circuitry is in accordance with panel schedules. Test GFI receptacles.

Perform overall system function tests upon completion of equipment tests. Verify correct operation of all interlock devices, alarms, sensing devices, and indicating devices.

322.16 MEASUREMENT AND PAYMENT

Pump station electrical system and lighting costs, prices for units of these systems include:

- All labor, materials, tools, equipment, incidentals, and
- Pull boxes, excavation, and backfill, concrete foundations (except when shown as separate contract items)

All work involved in supplying, installing, or modifying the systems, combinations, or units must be in accordance with the contract documents or as directed by SacSewer. SacSewer pays pump station electrical systems as a lump sum item; individual line item costs for additional labor or materials will not be reimbursed.

323 INSTRUMENTATION AND RTU CABINET

323.1 GENERAL

The contractor must provide all the hardware in accordance with the contract documents and is responsible from the PLC terminal out to and including the field components.

323.2 PROGRAMMABLE LOGIC CONTROLLER HARDWARE

323.2.1 PLC UNIT

Refer to SacSewer's *RTU Bill of Materials* list for the latest approved device available on SacSewer's website at www.sacsewer.com. SacSewer will provide the PLC logic. Field testing is a joint effort between the contractor and SacSewer. The contractor will notify SacSewer 2 weeks before factory acceptance testing to allow SacSewer to perform programming and troubleshooting.

323.2.2 Operator Interface Panel

Provide and install the OIP in accordance with contract documents. SacSewer will provide the OIP programming. Refer to SacSewer's *RTU Bill of Materials* list for the latest approved device available on SacSewer's website at www.sacsewer.com.

323.2.3 Cellular Modem, Cable, and Antenna

Provide and install the cellular modem and related equipment in accordance with contract documents. Provide an Ethernet cable as required for cellular modem connection to PLC. SacSewer will configure the cellular modem. Refer to SacSewer's *RTU Bill of Materials* list for the latest approved device available on SacSewer's website at www.sacsewer.com.Provide a minimum 3-foot section of super-flexible transmission cable between the RTU mounted transient surge suppressor and the cellular modem. Refer to SacSewer's *RTU Bill of Materials* list for the latest approved cable, surge suppressor, and connector types.

The contractor must provide a low-loss foam dielectric type coaxial cable that is weatherproof and suitable for direct exterior exposure between the RTU-mounted transient surge suppressor and the riser-mounted antenna. Refer to SacSewer's *Pump Station Standard Equipment and Requirements List* available on SacSewer's website at www.sacsewer.com for the latest approved antenna cable type.

Use weathertight connectors. Unless otherwise stated in the contract documents, run a 1.5-inch rigid galvanized conduit from the RTU panel to the nearest rear vertical canopy support post. If that location does not provide easy access to the antenna, or the antenna will interfere with surrounding objects, another SacSewer's approved location may be used. Extend the conduit riser above the canopy roof by 5 feet at that location. Secure the riser to the support post every 5 feet. Route cable from the riser-mounted antenna into a Weatherhead fitting as shown on the contract drawings. The coaxial cable must be routed inside the conduit to protect it from damage.

Seal the exterior cable connections in accordance with manufacturer-recommended weatherproofing methods, materials, and installation practices. Ordinary electrical tape or ordinary heat shrink tubing is not acceptable.

Provide and install a Tri-Band cellular antenna in accordance with the contract documents. Provide an antenna mounting kit with a standoff bracket in accordance with the contract documents. Refer to SacSewer's *Pump Station Standard Equipment and Requirements List* for the latest approved devices.

323.2.4 Radio, Cable, and Antenna

If SacSewer requires radio backup communications, the contractor must provide all necessary components to make the system operational. All the following components are generally needed for a functioning system:

- Antenna
- Conduit
- Feedline
- Lightning arrestor
- Mast
- Radio
- Signal cable and adapter

Mount the radio in the RTU cabinet inside the swing door or on the backpan unless specified in the contract documents. Provide a minimum 3-foot super-flexible cable between the radio and cabinet-mounted lightning arrestor. The contractor must provide a low loss foam type dielectric weatherproof coaxial cable between the lightning arrestor and mast-mounted antenna that is suitable for direct exterior exposure. Use a minimum 2-inch conduit between the RTU cabinet and antenna unless otherwise stated in the contract documents.

Use large radius sweeps at all 90-degree bends. Route the coaxial cable inside the conduit to protect it from damage. Use a weatherhead fitting and cable drip loop to prevent water from entering the conduit. Seal the exterior cable connections in accordance with manufacturer-recommended weatherproofing methods, materials, and installation practices. Ordinary electrical tape or ordinary heat shrink tubing is not acceptable. Refer to SacSewer's *Pump Station Standard Equipment and Requirements List* and SacSewer's *RTU Bill of Materials* list for the latest approved devices and equipment available on SacSewer's website at www.sacsewer.com. SacSewer will configure the radio.

323.2.5 RTU Cabinet Power Supply

Provide a 24VDC switching power supply that will provide the voltage for the PLC, RTU Cabinet, and instrumentation. Mount the unit according to the manufacturer's specifications. Refer to SacSewer's *RTU Bill of Materials* list for the latest approved device available on SacSewer's website at www.sacsewer.com.

323.2.6 CONTROL POWER FAILURE RELAY

The control power failure relay contacts are incorporated into the power supply and should be used to detect an AC power failure within the RTU cabinet.

323.2.7 EQUIPMENT CABINETS

Provide equipment cabinets, as shown in the contract documents, to accommodate PLC, power supplies, batteries, fans, heaters, terminal strips, communication equipment, level transducer equipment, high water switch, magmeter transmitter, and wireways.

323.3 CONFIGURATION

SacSewer will configure the PLC and OIP, cellular modem, and radio. Allow two weeks in the schedule for SacSewer to download and test the program in the field. All devices must be installed; all wiring must be complete and rung out before this two-week allotment. The electrical contractor must account for two weeks to assist SacSewer in testing the PLC program with field components as part of contract work.

323.4 CONTROL PANELS

Provide control panel for the RTU and all related instrumentation as required and shown on contract documents. The panel must have dimensions as shown on contract documents. The panel must be at a minimum NEMA 3R outdoor rated, with lockable handles. The panel must have an interior mounted swing door for mounting panel front instruments, as shown on the contract documents. The panels must be by Hoffman Products or an approved equal. Mount all interior components on a white back pan. Refer to SacSewer's *RTU Bill of Materials* document for a complete list of approved devices available on SacSewer's website at www.sacsewer.com.

323.4.1 CONTROL WIRING AND INSTRUMENTATION CABLE

Provide wiring and cable in accordance with Section 322.3, "Wires and Cables" of these Standards for the RTU panel, including all related instrumentation.

323.4.2 MARKINGS

Identify wire terminations with a number to correspond with the schematic diagrams. Identification tags must be preprinted white heat shrinkable tubing, Raychem Thermofit TMS, or equivalent. Plainly and permanently, identify control devices using the same identification as shown on the schematic diagrams. Show identification for devices inside

the enclosure on a plate adjacent to the device, not on the device itself, with the following exceptions:

- Where the size or location of the device makes individual identification impractical, such as on electronic assemblies, use group identification.
- Where panel layouts do not permit mounting identification plates adjacent to components, such as relays, place the permanent relay identification on the relay where the label is plainly visible and provide a second identification on the top of the panel wireway cover directly below the relay. Identify the wireway covers to show their proper location.

Identification plates for devices mounted inside and outside the control enclosure must be laminated phenolic for engraving stock, a minimum of 0.062-inch thick hold plates in place with stainless screws or rivets only.

323.4.3 Control Devices

Push buttons and selector switches must be NEMA Type 4/13 rated with NEMA A300 rated contacts. Push buttons must be standard size (30.5-millimeter mounting hole) round, flush head with momentary contacts. Selector switches must be round.

Pilot lights must be standard full size (30.5-millimeter mounting hole) round, NEMA Type 4/13 rated, complete with the color of lens specified in the contract documents. Lamps must be high-density light emitting diodes. Indicating lights must be push-to-test type.

Control relays must be magnetically held type with rated contacts and coil voltage, number or poles, and pole arrangement in accordance with the contract documents. Relays must be IDEC Series RR or RH, or equivalent with indicating light.

323.4.4 Detachable Header and Plug Terminal Blocks

SacSewer has standardized the use of detachable header and plug terminal blocks in the RTU panel to interface with I/O points, as shown in the contract documents.

The controls system integrator must follow a predetermined and sequential method for the assignment of these detachable terminal blocks, as shown on the plans.

Provide detachable terminal blocks within the RTU panel at locations shown and as specified on the RTU panel drawings and the plans.

Detachable terminal blocks must consist of a header and a detachable plug terminal block assembly. Terminal block identification and terminal assignment must be as shown on the plans.

Provide terminal blocks for incoming and outgoing control wires. Wire and mount terminal blocks so internal and external wiring does not cross over the terminals. Terminate no more than two conductors at each terminal.

Terminate field wiring on the field side of the terminal blocks. Do not connect internal panel wiring to the field side of the terminal blocks. Do not connect field wiring to the panel side of the terminal block.

Terminal blocks must be modular, rail mounted, rated at 10 amperes, 300 volts, terminate wire sizes 12 through 18 AWG, constructed of thermoplastic, and UL listed in accordance with *UL-486A* and *UL-1059*. Provide copper or brass current carrying parts electroplated with tin/lead. The terminal connection must be a screw clamp pressure plate connection. The clamping screw must not clamp the screw directly to the wire.

Provide symmetric steel assembly rails, end brackets, jumper devices, and other accessories as required for a complete terminal block assembly.

Number terminal blocks as shown on the plans.

Refer to SacSewer's *RTU Bill of Materials* document for a complete list of approved devices available on SacSewer's website at www.sacsewer.com.

323.4.5 POWER DISTRIBUTION TERMINAL BLOCKS

Provide terminal blocks for the distribution of power within the RTU panel at locations shown and as specified on the contract documents.

Terminal blocks must be modular, rail mounted, rated at 30 amperes, 600 volts, terminate wire sizes 12 through 18 AWG, constructed of thermoplastic, and UL listed in accordance with *UL-486A* and *UL-1059*. Provide copper or brass current carrying parts electroplated with tin/lead. The terminal connection must be a screw clamp pressure plate connection. The clamping screw must not clamp the screw directly to the wire. Provide Allen Bradley series 1492-W4 or equivalent terminal blocks.

Provide symmetric steel assembly rails, end brackets, jumper bars, and other accessories as required for a complete terminal block assembly.

Consecutively number terminal blocks on both sides from top to bottom with preprinted white polyamide marking tags hot printed with permanent black symbols. Provide Allen Bradley 1492-SM markers or equivalent.

323.4.6 Remote Telemetry Unit Fuse Blocks

Provide fuse blocks within the RTU panel at locations shown and as specified on the contract documents. Fused block identification and terminal assignment must be as specified on the contract documents.

Terminal blocks must be modular, rail mounted, rated at 12 amperes, 300 volts, terminals for wire sizes 12 through 18 AWG, and UL listed. The terminal connection must be a screw clamp pressure plate connection. The clamping screw must not clamp the screw directly to the wire.

Refer to SacSewer's *RTU Bill of Materials* document for a complete list of approved devices available on SacSewer's website at www.sacsewer.com.

Provide symmetric steel assembly rails, end brackets, jumper bars, and other accessories as required for a complete terminal block assembly.

323.4.7 Remote Telemetry Unit Ground Bus Bar

Provide a single-point ground bus bar. Locate the single-point ground bus bar in the lower left-hand corner of the RTU panel on the backplane. Grounding bus bar must be tin plated copper 3-mm thick, 10-mm wide and available in sections up to 1 meter and cut as required for the panel grounding application.

Support the grounding bus bar with insulating support equipped with a retaining screw. Grounding terminal block for ground connection to bus bar must be modular, rated at 41 Amperes, and terminate wire sizes 10 through 20 AWG. The grounding terminal must be a screw clamp pressure plate connection. The clamping screw must not clamp the screw directly to the wire. Refer to SacSewer's *RTU Bill of Materials* document for a complete list of approved devices available on SacSewer's website at www.sacsewer.com.

323.4.8 Terminal Blocks

Provide terminal blocks for all control wires. Mount terminal blocks so that wiring does not cross over the terminal blocks. Terminate no more than two conductors at each terminal.

Terminate field wiring on the field side of the terminal blocks. Do not connect field wiring to the panel side of the terminal block.

Terminal blocks must be modular, rail-mounted, rated at 20 amperes, 600 volts, terminals for wire sizes 12 through 24 AWG, constructed of thermoplastic and UL listed in accordance with *UL-486A* and *UL-1059*. Provide copper current carrying parts electroplated with tin/lead. The terminal connection must be a screw clamp pressure plate connection. The clamping screw must not clamp the screw directly to the wire.

Provide symmetric steel assembly rails, end brackets, jumper bars, and other accessories as required for a complete terminal block assembly.

Number terminal blocks consecutively on both sides from top to bottom with preprinted white polyamide marking tags hot printed with permanent black text.

Refer to SacSewer's *RTU Bill of Materials* document for a complete list of approved devices available on SacSewer's website at www.sacsewer.com.

323.4.9 Wiring Methods

Contain wiring in panel wireways, including incoming and outgoing field control wiring. Provide white or light gray colored PVC or NORYL wireways with restricted slot design, matching snap-on covers, holes, and nylon push rivets for mounting. Provide Panduit products or approved equal.

Provide a minimum of 3 inches of clearance between panel wireway and wire terminations to allow for clear viewing of wire identification marking.

Wiring to control devices on the front door must be tied together at short intervals and secured to the inside front door with Panduit adhesive mounts. Provide CLINCHER adjustable releasable clamp mounts for wire bundles 0.69-inch in diameter or smaller or AM2-C mounts with UNI-TY releasable nylon cable ties for bundles larger than 0.69-inch in diameter. Attach mounts to the front panel with Eastman 910 adhesive or equivalent. Enclose wiring between panel and front door in gaped polyethylene spiral wrapping.

Provide wiring from RTU input modules to terminal blocks. Label wire and terminal blocks.

323.4.10 PLC Transient Surge Protection

Transient surge protector equipment must meet the specifications shown in Table 323-1.

Table 323-1: PLC Surge Protection Specifications

Item	Specification
Response Time	5 nanoseconds Maximum
Surge Current Test	IEEE C62.41
Operating Voltage	120 volts AC, 60 Hertz
Operating Current	15 or Above Ampere Service
Connections	Brass Studs Terminal Screws
Indicator	Neon failure indicator Illuminated Failure Indicator
Manufacturer's Reference	Entrelec 025 004.14

Refer to SacSewer's *RTU Bill of Materials* document for a complete list of approved devices.

323.4.11 Batteries

Batteries must be lead acid, 12-volt, two in quantity, and a minimum of 17 amp-hours, sealed in plastic containers to form a permanent leak-proof unit. Covers must have spray-proof vent plugs.

Provide stainless steel nuts and bolts for the battery terminal lugs. Refer to SacSewer's *RTU Bill of Materials* document for the latest approved batteries available on SacSewer's website at www.sacsewer.com. Batteries must be six months or newer, as indicated by the date code on the batteries.

323.4.12 Remote Telemetry Unit Panel Heater and Fan

Provide and install a cabinet thermostat-controlled heater and thermostat-controlled fan. Set the heater to 50 degrees Fahrenheit and the fan to 90 degrees Fahrenheit. Refer to SacSewer's *RTU Bill of Materials* document for the latest approved devices available on SacSewer's website at www.sacsewer.com.

323.4.13 Field Wiring

Terminate power and control wiring on terminal blocks, with terminal connections numbered as shown on the contract documents.

All wires must be marked with printed heat shrink tubing such as Brady WMS Series or approved equal.

Clearly label terminations with 50 volts or more present with Brady Series 44000, Style B, or approved equal. Identify voltage as appropriate.

Install field wiring in conduit in accordance with contract documents. Use separate conduits for different functions (status, analog, control).

Bundle and tie down wires in the RTU panel neatly and orderly manner. For shielded cables, terminate shield at RTU panel terminal block only.

323.4.14 SERVICES OF MANUFACTURER

Provide the services of an authorized service representative of the controls system integrator to perform the following inspection, startup, calibration, and training services: Inspection, Startup, and Field Adjustment- An authorized service representative of the controls system integrator must be present at the site for a minimum of two days to witness and certify in writing that the equipment and controls have been properly installed, adjusted, and readied for operation.

- Inspection, checking, and adjusting the equipment
- Startup and field testing for proper operation – Performing field adjustments to ensure the equipment installation and operation comply with the specified requirements
- Instruction of SacSewer's staff – An authorized training representative of the manufacturer or controls system integrator must be present at the site for a minimum of one day to instruct SacSewer's staff in operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment or notebook computer. Instruction must be specific to the models of equipment provided.

323.4.15 PROTECTIVE BARRIERS

Provide a protective barrier to prevent accidental contact with any terminals or connections of 50 volts or greater. Label barriers to identify the voltage as appropriate.

323.5 PLC TESTING

The contractor must perform a thorough field test in conjunction with SacSewer and the Engineer. Provide a 2-week notification of when the field test will occur. Complete field-testing will only be after SacSewer has installed and tested the PLC program, OIP configuration, and radio communication to the master SacSewer's SCADA system. Field testing includes:

- Point-to-point verification of all PLC digital input circuits from the field device to the PLC terminal. With all PLC outputs disabled by SacSewer, the contractor must activate each input device manually and check for status changes at the appropriate input point.

- Point-to-point verification of all PLC digital output circuits from the PLC to the field device. With all outputs disconnected, use forcing to verify that each output is properly addressed and wired. This verification will require disconnecting and reconnecting wires by the contractor.
- Verification of all PLC analog I/O loops from the field device to the PLC terminal. The contractor must calibrate and test these loops. SacSewer will witness signals at PLC.
- Functional testing of all communication networks, including radio communication, back to the main SacSewer's SCADA system.
- Place all systems in normal operation mode and operate them under PLC control with SacSewer observing PLC controls. Monitor systems closely while testing each rung of PLC logic. The contractor must stand by while SacSewer tests logic, and the contractor must include 8 hours of work as part of this scope.
- The contractor must provide Final As-builts and Operation and Maintenance Manuals that reflect all changes and revisions made in the field.

323.6 WET WELL LEVEL

323.6.1 SUBMERSIBLE LEVEL TRANSDUCER

The Submersible Level Transducer senses the level of fluid in the wet well and transmits that Datum to the PLC via a 4 to 20-milliampere signal. The transducer kit consists of a level transducer, weatherproof cable, protective sleeve, hanger, a sink weight, a termination box with remote electronics, and a moisture protective bellows assembly.

The instrument sits at the bottom of a 6-inch stainless steel conduit. This conduit is mounted to the side of the wet well from top to bottom behind the pumps and holds the face of the transducer sensor at 6 inches off the bottom of the wet well. The stilling well must have a 2-inch minimum length and ½ diameter stainless steel nuts and bolts forming a cross pattern at the bottom to prevent the transducer from falling through and still allow fluid to reach the transducer.

The signal cabling is run inside the stilling well and is held in place with the supplied cable hanger (no exceptions). The cable then runs through a 1 inch conduit between the wet well and the stainless steel termination box adjacent to the motor connection junction boxes. Located inside the junction box are the transducer termination box and bellows assembly. The transducer cable must be sealed from a wet well with a Duct Seal and not a compression-type seal that may damage the cable.

A 1 inch conduit is run between the stainless steel junction box and the RTU cabinet, which contains a 16 gauge shielded twisted pair cable for supplying the transducer signal to the

RTU cabinet. Refer to SacSewer's *Pump Station Standard Equipment and Requirements List* available on SacSewer's website at www.sacsewer.com for the latest approved transducer.

323.6.2 HIGH WATER LEVEL SWITCH

High water level switch LSH-051 must be diaphragm operated type with a 0.4 to 1.6-inch water column operating range (set at 1.0); 45-inch water column maximum pressure; and have one 5-ampere minimum, 120-volt, 60-Hertz snap switch. Locate the unit in the Transducer Junction Box. Refer to SacSewer's *Pump Station Standard Equipment and Requirements List* available on SacSewer's website at www.sacsewer.com for the latest approved device.

Tubing should be Parker Parflex 3/8 O.D. X.062 wall thickness or equivalent. Fittings must be 3/8 Parker brass compression type, and a tubing insert must be used.

323.6.3 PLACARDS

Use plastic laminated placards with a blue background, white symbols, and lettering. Provide $^{5}/_{16}$ inch minimum symbol size, $^{1}/_{8}$ inch minimum letter size, and 8-$^{1}/_{2}$ by 11-inch minimum placard size. Mount placards to the RTU cabinet dead front next to the OIP with # 4 Phillips round head; Type 316 stainless steel self-tapping screws.

Provide a laminate placard of the sump section, and indicate the following:

- Cross section of the sump, parallel with water flow
- Bottom of sump elevation
- Top of sump elevation
- Set point descriptions with elevations
- Bottom Level Transducer Head elevation
- Show all elevations in chart form with three elevation baselines as follows:
    - Elevation in feet with respect to sea level
    - Elevation in feet with respect to the bottom of Level Transducer Head
    - Elevation in inches with respect to the bottom of Level Transducer Head

323.6.4 SPARE PARTS

Provide new spare parts in the manufacturer's original packaging in accordance with the contract documents. Deliver all spare parts to SacSewer's representative when the operational startup testing is conducted. Provide a bill of material type inventory transmittal form.

323.6.5 TESTING

The contractor must perform a 5-point calibration verification test on all transducers, transmitters, and other related instrumentation. Perform the testing during the facility startup, phase 2, as documented in SacSewer's *Pump Station Startup Checklist* available on SacSewer's website at www.sacsewer.com.

324 PUMP STATION SITE

324.1 GENERAL

Grade the pump station site to prevent local ponding and provide positive drainage away from structures. Grade the site not to create a low point in relation to the adjoining properties.

324.2 CANOPY

Metal work for canopy must be fabricated to shapes, size, and tolerances as shown on contract documents, with straight lines, square corners of smooth bends, free from twists, kinks, warps, dents, and other imperfections.

The contractor must verify all dimensions, make necessary field measurements, and be fully responsible for the accuracy and layout of the work.

Construct connections and joints exposed to the weather to exclude water.

Metal work for the canopy must be set accurately in their proper locations to the lines and elevations specified in the contract documents. The various items for the canopy must be aligned, adjusted, leveled, and plumbed in true alignments with related and adjoining construction within specified AISC (latest edition) tolerances before permanently fastening or welding. Please refer to Section 205.2.10, "Canopy" of these Standards for additional design requirements.

324.2.1 CONNECTIONS

The contractor must provide all connectors, fasteners, welded metal, and miscellaneous items required to construct the canopy, as shown in the contract documents. Protect dissimilar metals from galvanic corrosion by means of pressure tape, coatings, or isolators.

324.3 BOLLARDS

Comply with jurisdictional agency's requirements. If there are no jurisdictional agency's requirements, all bollards must be removable, schedule 40 steel pipes, 4 inches diameter, and

4-inch dished head or pipe cap. The sleeve for bollards must be Schedule 40 galvanized steel, with 5 inches diameter.

Paint application for bollards must be in accordance with contract documents. Paint all bollards chrome yellow.

324.4 PERIMETER FENCE

Perimeter fences must be a minimum of 8 feet high and either ornamental picket fencing or concrete masonry units.

324.5 GATES

A fabricator with 10 years of demonstrated experience with fabrications of ornamental gates must manufacture ornamental iron or tubular steel swing gates. All structural steel must be manufactured in accordance with *ASTM A513*.

All members of the gates must have galvanized coating, inside and outside, in accordance with *ASTM A653* or *ASTM A153*. Apply a final epoxy coating in accordance with contract documents following the completion of all welding and machining. Epoxy color must be in accordance with the contract documents. Please refer to Section 205.4.3, "Gates" of these Standards for additional design requirements.

Ornamental gates must have a latch mechanism or chain for multiple locks to suit a minimum of three padlocks. SacSewer will provide padlocks upon project acceptance.

In addition, all gates must have drop-bolts type gate stops with received sleeves for all gates.

324.6 HOSE BIB

Provide a potable water hose bib near the wet well as shown on the contract documents. Protect the hose bib from vehicular traffic with removable bollards according to Section 205.4.4, "Potable Water" of these Standards.

324.7 WATER METER

The contractor must provide a water meter in accordance with the local water agency having jurisdiction.

324.8 Backflow Device

The contractor must install a reduced pressure backflow preventer assembly in accordance with the contract documents.

324.9 Odor Control Pad

The odor control pad must be as shown on the contract documents. . If no control pad is referenced, please refer to Section 502, Drawing M-04 of these Standards.

At a minimum, the odor control pad must be 6 feet by 6 feet by 6 inches concrete slab with number 4 reinforcement rebar at 6 inches on center both ways.

324.10 Exterior Lighting

Exterior lighting must conform to Section 205.4.8, "Exterior Lighting" of these Standards.

324.11 Maintenance Pad

Unless otherwise shown in the contract documents, the maintenance pad must be a square concrete pad, 8 feet by 8 feet, with a 2% slope towards the floor drain. Grade the site around the maintenance pad to slope away from the wet well, so storm water does not have a natural path into the wet well from the pad.

325 Base Materials

325.1 General

The contractor must conform to the jurisdictional agency's requirements for sedimentation and erosion control.

325.2 Aggregate Base

The aggregate base must conform with the latest version edition of Section 26, "Aggregate Bases," *State Specifications*.

Deposit the material in such a manner as to provide a uniform section of material within 0.05 feet of the design elevation. The deposition must be by methods that prevent segregation of the material. The deposited material must contain sufficient moisture to prevent segregation. Aggregate base material must be spread to its planned grade and cross-section. Segregation or excessive drifting or spotting of material will not be permitted. All material determined by

SacSewer to be unsuitably segregated must be removed from the base or completely reworked to provide the desired uniformity of the material.

The contractor is responsible for maintaining the required moisture content until the next successive layer of material is placed.

Compact aggregate bases to a minimum relative compaction of 95% as determined by *California Test Method 231* or jurisdictional agency.

The surface of the finished aggregate base at all points must not vary more than 0.05-foot above or below the grade shown on the contract documents.

325.3 CEMENT TREATED BASES

Cement-treated bases must conform to the latest edition of the *State Specifications* and may require jurisdictional agency approval.

325.4 LIME TREATED SOIL

Lime-treated bases must conform to the latest edition of the *State Specifications* and may require jurisdictional agency approval.

Compact lime treated base to a minimum relative compaction of 95%, or as required by the jurisdictional agency.

325.5 MEASUREMENT AND PAYMENT

Lime stabilization is measured by the square yard in accordance with the latest edition of the *State Specifications*. The price per square yard for lime-treated base includes the following:

- All labor, materials, tools, equipment, incidentals, and
- All the work involved in constructing lime treated base complete in place, as shown or specified in the contract documents and directed by SacSewer.

Full compensation for removal of rocks and solids greater than 2-$^1/_2$ inches in size is included in the price paid per square yard for the lime-treated base; no additional compensation will be allowed.

The quantity of aggregate base is measured either by the ton or cubic yard, as designated in the contract documents. Calculate the quantity using the dimensions shown on the contract

documents adjusted by the amount of any change ordered by SacSewer. No allowance will be made for any aggregate base placed outside said dimensions.

The price paid per ton or cubic yard for aggregate base includes the following:

- All labor, materials, tools, equipment, incidentals, and
- All the work involved in supplying and placing aggregate base, complete in place, including:
  - Applying water,
  - Compacting the material, and
  - Finishing the surface, as shown or specified in the contract documents, and directed by SacSewer

326 ASPHALT CONCRETE

326.1 GENERAL

Asphalt concrete within the public ROWs must conform to the jurisdictional agency's requirements. Asphalt concrete outside the public ROW must conform with the latest edition of Section 39, "Asphalt Concrete," of the *State Specifications*. Asphalt concrete is designated as Type A. Asphalt concrete is also designated by gradation, according to the percentage of crushed particles and the sand equivalent of the aggregate (for dense graded mixtures) or according to the intended use (for open graded mixes) and by class, according to the texture of the mixture. The contractor's operations must be conducted in a manner that will not harm or damage existing facilities or improvements.

326.2 SUBGRADE PREPARATION

Obtain relative compaction of not less than 95% for a minimum depth of 0.5-foot below the subgrade grading plane, whether in excavation, embankment or at original ground level.

When the next layer of material placed on the subgrade is an asphalt concrete pavement, asphalt concrete base, or asphalt concrete subbase, the subgrade grading plane at all points must not vary more than 0.05-foot above or below the grade established by the contract documents.

Subgrade or aggregate base must be stable before paving. SacSewer may require the contractor to proof roll the area before placing asphaltic concrete. The equipment used for the proof rolling must be subject to the approval of SacSewer.

For pavement construction, material encountered at the subgrade grading plane, as shown on the contract documents, that SacSewer determines unacceptable for pavement foundation must be removed. Fill the area with geotextile fabric and 12 inches of Class 2 aggregate base to 90% compaction.

If there are insufficient quantities of native material to make subgrade for pavement construction, recycled asphalt concrete from project removals may be used with SacSewer's approval. Removed asphalt concrete must be processed to 3-inch maximum size and thoroughly mixed with local native material, and placed in the lower lift fills as necessary to achieve subgrade.

Subgrade preparation requirements will be waived where the width of the subgrade to be prepared is less than 4 feet and SacSewer determines that the existing undisturbed subgrade is firm and stable. SacSewer may order mechanical tamping to obtain the desired firmness and stability. SacSewer may order removal of soft and unstable material below the grading plane and backfill with acceptable import materials if the subgrade (grading plane) is unsuitable for placing the next layer of the structural section.

326.3 UNSUITABLE MATERIALS

Remove unsuitable or unacceptable material encountered during pavement construction and backfill according to requirements in Section 306, "Earthwork" of these Standards.

Unsuitable material must conform to Section 310.2, "Unsuitable Materials" of these Standards.

326.3.1 BACKFILL

Place and compact backfill to replace unsuitable materials to a minimum relative compaction of 90%.

Suitable backfill material must be one of the following:

- Imported borrow in accordance with Section 306, "Earthwork" of these Standards
- Woven geotextile fabric that meets requirements of Section 308.10, "Geotextile Fabric" of these Standards and backfilled with Class 2 aggregate base

326.4 MIX FORMULA AND DESIGN

The contractor must submit to SacSewer for approval a job mix formula and mix design. Mix designs must be accompanied by current test results that indicate compliance with these Standards. Submit a job mix formula for each designation of asphalt concrete, based on

samples of conforming aggregate materials supplied for each source or supplier proposed, with optimum bitumen content determined in accordance with *California Test Method 367,* with the exception that the centrifuge kerosene equivalent test is waived and *California Test Method 309* is used to determine the Maximum Theoretical Density of the mixture.

The job mix formula must establish a single percentage of aggregate passing each required sieve size and a percentage of asphalt binder to be added to the aggregate. The asphalt concrete binder content must be based on 4.0% air voids.

Where more than one source or supplier is designated to supply asphalt concrete, those mixes will be kept separated. The mixes must not be intermixed in the same lift or section of pavement. The contractor must submit paving plans showing, in advance, where the mixes from each source will be used. This plan will be subject to approval by SacSewer.

Use current Sacramento County Mix Design Requirement PG64-10 for minor roadways and PG70-10 for major roadways. Other mix designs may be required based on location, including "High Stability Intersection Mix = (64-10 Type C)" and Rubberized Mix HMRA (Hot Mix Rubberized Asphalt) = 64-10 with PG70-10 base course below rubberized aggregate.

326.5 AGGREGATES AND BINDERS

326.5.1 AGGREGATES

Use Type A aggregate in asphalt concrete as specified in the latest edition of Section 39, "Asphalt Concrete," of the *State Specifications.* Aggregate size selection is as shown in Table 326-1.

Table 326-1: Aggregate Selection Requirements for Asphalt Concrete

Asphalt Concrete Lift Thickness	Aggregate Size (inches)
Less than 2-1/4 inches	1/2
Greater than or equal to 2-1/4 inches where total AC section is less than or equal to 3 inches	1/2
Greater than or equal to 2-1/4 inches where the total AC section is greater than 3 inches	3/4

326.5.2 BINDERS

The asphalt binder grade must comply with the latest edition of Section 92, "Asphalts" of the *State Specifications* and the following:

- Conventional dense graded asphalt used on facilities must use PG 64-10 binder

- Rubberized asphalt must use PG 64-16 base

326.5.3 Quality Control Testing

Perform quality control testing in a timely manner. Provide quality control test results to SacSewer upon request. For quality control, the contractor must perform the tests shown in Table 326-2.

Table 326-2: Quality Control Testing for Asphalt Concrete

Quality Characteristic	Action Limit	Test Method	Testing Frequency	Point of Sampling
Gradation	Specified Tolerance	California Test Method 202	1 per 500 tons (1)	Composite cold feed or hot bins (2)
Mix Asphalt Content	±0.5 %	California Test Method 379 or 382	1 per 1,000 tons (1)	From truck, windrow, or behind the paver
(1) One per day minimum (2) At continuous mix plants from composite cold feed belt. At batch plants from hot bins.				

326.6 Recycled Asphalt Pavement

RAP may be substituted for the virgin aggregate at a rate of up to 15% by the total weight of aggregate in the asphalt concrete.

RAP stockpiles may be from a single source or multiple sources and consist solely of RAP material. Perform stockpiling and processing of RAP in a manner that will prevent contamination and segregation and result in a uniformly blended and homogenous material. Locate stockpiles on surfaces that are smooth and free of debris and organic material. Give SacSewer unrestricted access to stockpiles for inspection and testing as deemed necessary.

The amount of virgin asphalt binder to be mixed with the combined virgin aggregate and RAP will be determined by the contractor in conformance with *California Test Method 367*, with the exception that the CKE test will be waived and *California Test Method 309* used to determine the Maximum Theoretical Density. In lieu of historical data, the approximate asphalt demand may be calculated in accordance with *MS-4 The Asphalt Institute Handbook*.

Designate the percentage of RAP and the mixture gradation target values at the time of the asphalt mix design. Subsequent changes in the target values of the aggregate grading and design asphalt content will not be permitted without additional testing to verify compliance with the requirements for stability and air voids.

Submit the proposed mix design to SacSewer for review and approval. In addition to the requirements of the latest edition of Section 39, "Asphalt Concrete," of the *State Specifications*, the contractor will provide SacSewer with the following information:

- The individual and average asphalt content test results representative of the proposed RAP stockpile based on a minimum of one test per 5,000 tons of material in the RAP stockpile. Determine the asphalt content in accordance with *ASTM D2172*, Method B.
- The individual and average asphalt-free gradations of the RAP material derived from the samples used to determine the asphalt content.

Produce asphalt concrete in conformance with the requirements of the latest edition of Section 39, "Asphalt Concrete," of the *State Specifications*, except that the requirement for storing and drying does not apply to the RAP material. Ingredient proportioning must comply with the requirements of the latest edition of Section 39, "Asphalt Concrete," of the *State Specifications*. Asphalt concrete with or without RAP must not exceed 325 degrees Fahrenheit.

When the recycled asphalt pavement mixture is produced by batch mixing, the time of mixing must not be less than 35 seconds. When combined mathematically, the virgin aggregate and the asphalt-free RAP aggregates must conform to the design gradation in the latest edition of Section 92, "Asphalts," of the *State Specifications*.

The contractor's mixing equipment must be equipped with a suitable, safe sampling device or locations and provide representative samples of virgin aggregates and RAP production materials being incorporated into the recycled asphalt pavement mixture. If a continuous mixing plant is used, protect the RAP material from direct contact with the burner flame by means of a shield, separator, secondary drum, or other method approved by SacSewer.

Introduce the binder into the mixer after combining the virgin aggregate and RAP material. If a batch mixing plant is used, keep the RAP material separate from the virgin aggregate until both ingredients enter the weigh hopper or pugmill.

326.7 HAULING EQUIPMENT

Vehicles used for hauling asphalt concrete mixtures must have tight, smooth metal beds and be free from dust, screenings, excessive petroleum oils, volatiles, or other mineral spirits that may affect the mix being hauled. Provide trucks with tarpaulins or cargo covers of sufficient size and weight to protect the entire load. Cover loads when necessary to achieve the specified density and finish quality.

326.8 PLACEMENT METHOD

326.8.1 GENERAL

Place the top layer of asphalt concrete in a lift no less than 1-$^1/_2$ inches and no greater than 2-$^1/_2$ inches in compacted thickness. Place the next lower layer of asphalt concrete in a lift no less than 1-$^1/_2$ inches and no greater than 3 inches in compacted thickness. Place all other lower layers in lifts no greater than 4 inches in compacted thickness.

The total thickness of asphalt concrete will be as shown on the contract documents. Paving work will be a continuous nonstop operation with delivery trucks arriving in a uniform manner.

Deliver the asphalt concrete to the site in a thoroughly blended condition and spread by a self-propelled asphalt paving machine in such a manner as to avoid segregation during the placing operations. Perform initial rolling immediately after placement. Do not place asphalt concrete when the atmospheric temperature is below 50 degrees Fahrenheit, except as follows:

- When asphalt concrete is placed as a base course, the asphalt concrete may be placed when the ambient temperature is 45 degrees Fahrenheit and rising if the material is deposited directly into the hopper of the paving machine.
- No paving work is allowed when there is standing water. No paving work is allowed when it is raining. For this provision, raining means any weather condition that causes the roadway to become moist or damp. In the case of sudden precipitation, all paving work must stop immediately, all asphalt concrete on site not yet placed, and all asphalt concrete in transit from the plant will be rejected, and no payment will be allowed.
- The minimum compacted thickness of asphalt concrete is the thickness shown on the contract documents. The tolerance for minimum thickness for all operations is 0.01-foot. The tolerance for maximum thickness for asphalt concrete structural sections less than 0.35-foot thick is 0.02-foot, and for sections more than 0.35-foot thick is 0.03-foot.

326.8.2 SPREADING

Spread all mixtures at a temperature of not less than 260 degrees Fahrenheit.

326.8.3 HAND SPREADING

Areas inaccessible to spreading and compaction equipment may be paved by SacSewer-approved methods. In areas where irregularities or unavoidable obstacles make

mechanical spreading and finishing equipment impracticable, the asphalt concrete mixture may be spread, raked, and luted by hand tools.

Thoroughly compact the mixture by means of pneumatic tampers or other methods. Asphalt concrete paving placed by hand as defined above is exempt from the pay reduction factors included in Section 326.9.4, "Pay Factors" of these Standards. When hand spreading is permitted, dump the mixture either on the grade or on dump sheets outside the area where the mix is to be spread, and then distribute into place using hot shovels, and spread with hot rakes in a uniformly loose layer to the full width required, and at a depth that, when the work is completed, will have the required thickness and will conform to the grade and surface tolerance specified.

Whenever hand spreading or backwork is required behind the paving spread, stop the paving machine until hand spreading, or backwork is completed.

326.8.4 MECHANICAL SPREADING EQUIPMENT

In addition to the requirements in the latest edition of Section 39-5.01, "Spreading Equipment," of the *State Specifications*, equip asphalt equipment with automatic screed controls and a sensing device or devices. A 12-foot-long straightedge is required on all paving machines.

Asphalt pavers must be self-propelled mechanical spreading and finishing equipment, provided with a screed or strike-off assembly that distributes the material not less than 12 feet wide. Screed actions will include any cutting, crowding, or other practical action is effective on the mixture without tearing, shoving, or gouging and produces a surface texture of uniform appearance. The screed must be adjustable to the required section and thickness. Pavers cannot leave ridges, indentations, or other marks that cannot be eliminated by rolling or prevented by adjustment of operation.

The paver must have a receiving hopper of sufficient capacity to permit a uniform spreading operation. Equip the paver with distributing screws to place the mixture uniformly in front of the screed.

Equip the screed with a controlled heating device for use when required. The screed must strike off the mix to the depth and cross-section specified.

The material being placed in the abutting lane must be tightly crowded against the face of the previously placed lane. Position the paving machine to overlap the existing mat only to the extent that the material placed against the joint is tightly crowded against the vertical face at the joint and that the conform raking leaves no ridges or depressions. Before

compacting or pinching the joint, remove and discard the coarse aggregate in the overlapped material that has dislodged through raking from the pavement surface.

The automatic controls will control the longitudinal grade when placing asphalt concrete to lines and grades established by SacSewer. The contractor must furnish, install, and maintain grade and slope references. Use a ski device on roadways with two or more lanes in any one direction. The minimum length of the ski device is 27 feet, and use the entire length in activating the sensor.

When paving contiguously with previously placed mats, control the end of the screed adjacent to the previously placed mat by a sensor that responds to the grade of the previously placed mat and will reproduce the grade in the new mat within a 0.01-foot tolerance. The end of the screed farthest from the previously placed mat must be controlled in the same manner as when placing the initial mat.

Should the automatic screed controls fail to operate properly during any day's work, the contractor may use manual control of spreading equipment for the remainder of that day. However, the equipment must be corrected or replaced with alternative automatically controlled equipment conforming to the requirements in this section before starting another day's work.

Construct transverse construction joints and temporary runoff tapers so that no gradual ramping down of the mat occurs back from the joint. Bond breaking paper may be required under the runoff taper for later removal if specified by the contract documents.

326.8.5 COMPACTING

The contractor must furnish equipment that produces the required compaction. The vibratory mode must automatically shut off when machine direction is changed for vibratory rollers.

Construct all asphalt concrete paving to produce material with a density of not less than 92% nor greater than 97% (per *California Test Method 309*) except for base course paving. Asphalt placed directly on subgrade or aggregate base (base course paving) must be not less than 90% nor greater than 97% (per *California Test Method 309).*

326.9 PLACEMENT ACCEPTANCE TESTING

Materials testing, excluding bituminous distributor testing, will be performed by SacSewer, and SacSewer will bear the cost.

326.9.1 PAVEMENT DENSITY TESTING

Pavement density will be determined in accordance with the jurisdictional agency or by comparing the average density of cores taken from the compacted pavement to the Maximum Theoretical Density as determined by *California Test Method 309*.

Determine asphalt concrete density by nuclear gauge testing or approved nondestructive testing method. For all such paving, the contractor must provide quality control testing at locations based on a random sampling plan with no less than one test per 500 tons or one test per day if placing less than 500 tons. If the density does not fall within the density range, the contractor may test at two additional locations within the same 500 tons and average the results of all three tests. This averaged result must fall within the above-specified range. The contractor must notify SacSewer's inspector before paving and provide contact information for the contractor's testing personnel. SacSewer reserves the right to conduct parallel quality assurance testing at its discretion in accordance with *California Test Methods 308, 309, and 375*.

326.9.2 MAXIMUM THEORETICAL DENSITY

Bituminous mixture for maximum theoretical density must be randomly sampled on a lot basis.

326.9.3 CORE DENSITY

Cores for determining the density of the compacted pavement must be taken on a lot basis, a minimum of 3 cores per lot, on a random basis, and in the presence of the inspector. The lot size must be in accordance with the contract documents. The cores must be taken in accordance with the contract documents. Determine the density of each core in accordance with *California Test Method 308*.

The contractor will obtain core samples for determination of the density of completed pavements at the contractor's expense, and no additional compensation will be paid. The core samples must be 4 inches in diameter. The contractor may use a nuclear density gauge for preliminary testing. Dry ice may be used for cooling the pavement prior to coring. The number and locations of the samples will be as agreed upon in the field by SacSewer and the contractor. Samples must be neatly cut with a saw, core drill, or other approved equipment. The contractor must provide the core samples to SacSewer within 2 hours after final compaction. Special arrangements must be made with SacSewer's material testing laboratory if the contractor wishes test results within less than 12 hours for night paving or normal work performed late in the day.

SacSewer will meet in the field with the contractor and mutually agree on several locations for compaction testing for the given lot. The actual test location will be randomly selected from the several agreed-upon locations.

326.9.4 PAY FACTORS

For all asphalt concrete pavement subject to acceptance testing, the finished asphalt concrete pavements that do not conform to the specified relative compaction requirements will be paid for using the pay factors listed in Table 326-3.

Table 326-3: Reduced Payment Factors for Asphalt Concrete

Asphalt Concrete Type A and B and Percent of Maximum Theoretical Density	Reduced Payment Factor	Asphalt Concrete Type A and B and Percent of Maximum Theoretical Density	Reduced Payment Factor
92.0	0.0000	97.0	0.0000
91.9	0.0125	97.1	0.0125
91.8	0.0250	97.2	0.0250
91.7	0.0375	97.3	0.0375
91.6	0.0500	97.4	0.0500
91.5	0.0625	97.5	0.0625
91.4	0.0750	97.6	0.0750
91.3	0.0875	97.7	0.0875
91.2	0.1000	97.8	0.1000
91.1	0.1125	97.9	0.1125
91.0	0.1250	98.0	0.1250
90.9	0.1375	98.1	0.1375
90.8	0.1500	98.2	0.1500
90.7	0.1625	98.3	0.1625
90.6	0.1750	98.4	0.1750
90.5	0.1875	98.5	0.1875
90.4	0.2000	98.6	0.2000
90.3	0.2125	98.7	0.2125
90.2	0.2250	98.8	0.2250
90.1	0.2375	98.9	0.2375
90.0	0.2500	99.0	0.2500
< 90.0	Remove and Replace	> 99.0	Remove and Replace

326.10 MEASUREMENT AND PAYMENT

Measurement and payment for asphalt concrete must be in accordance with the latest edition of the *State Specifications*.

When acceptance testing is required for asphalt concrete placement, include the placement of the test section in the price paid per ton for asphalt concrete; do not include acceptance testing as a separate line item.

326.10.1 COMPENSATION ADJUSTMENTS

The provisions of this section apply only to asphalt concrete and asphaltic emulsion (paint binder).

The quantity of paving asphalt used in asphaltic emulsion (paint binder) will be determined by multiplying the item quantity for asphaltic emulsion (paint binder) included in a monthly estimate by the minimum percent residual specified in the latest edition of Section 94, "Asphaltic Emulsions," of the *State Specifications*. The asphaltic emulsion minimum percent residual obtained from the latest edition of Section 94, "Asphaltic Emulsions," of the *State Specifications*, will be based on the type of emulsion used by the contractor.

The contractor may provide actual daily test results for paving asphalt residual for the asphaltic emulsion (paint binder) used at the contractor's option. Test results provided by the contractor must be from an independent testing laboratory that participates in the AASHTO Proficiency Sample Program. The contractor must take samples of asphaltic emulsion from the distributor truck at mid-load from a sampling tap or thief. Tate two separate 2-liter samples in the presence of the Inspector. The contractor must provide one sample to the contractor's independent testing laboratory within 24 hours of sampling. The second sample must be given to the inspector. Deliver the test results from the contractor's independent testing laboratory to SacSewer within 10 days from the sample date.

The compensation payable for paving asphalt used in asphalt concrete and asphaltic emulsion (paint binder) will be increased or decreased in conformance with the provisions of this section for paving asphalt price fluctuations exceeding 10% (see calculation below) which occur during the performance of the work.

The adjustment in compensation will be determined in conformance with the following formulas when the item of asphalt concrete or asphaltic emulsion (paint binder) or both is included in a monthly estimate:

- Total monthly adjustment = AQ
- For an increase in paving asphalt price index exceeding 10%:
  - A = 0.90 (1.1023) (Iu/Ib - 1.10) Ib
- For a decrease in paving asphalt price index exceeding 10%:
  - A = 0.90 (1.1023) (Iu/Ib - 0.90) Ib

  Where:

  - A = Adjustment in dollars per ton of paving asphalt used to produce asphalt concrete and asphaltic emulsion residual used as paint binder rounded to the nearest $0.01.
  - Iu = The *California Paving Asphalt Price Index*, which is in effect on the first business day of the month within the pay period in which the quantity subject to adjustment was included in the estimate.
  - Ib = The *California Paving Asphalt Price Index* for the month in which the bid opening for the project occurred.
  - Q = Quantity in tons of paving asphalt that was used in producing the quantity of asphalt concrete shown under "This Estimate" on the monthly estimate using the amount of asphalt determined by the engineer plus the quantity in tons of paving asphalt that would have been used as residual in the asphaltic emulsion (paint binder) shown under "This Estimate" on the monthly estimate.

The adjustment in compensation will also be subject to the following:

- The contractor is liable to SacSewer or jurisdictional agency for decreased compensation adjustments and SacSewer or jurisdictional agency may deduct the amount thereof from moneys due or that may become due to the contractor.
- Compensation adjustments under this section will be considered in making adjustments in conformance with these Standards.
- In the event of an overrun of contract time, an adjustment in compensation for paving asphalt included in estimates during the overrun period will be determined using the Caltrans California Paving Asphalt Price Index in effect on the first business day of the month within the pay period in which the overrun began.

Please refer to the *California Paving Asphalt Price Index* available on the State of California website.

327 SURFACE RESTORATION

327.1 GENERAL

327.1.1 PUBLIC PROPERTY AND PUBLIC RIGHTS-OF-WAY

On public property and within the public ROW, the contractor must restore all surface improvements that were removed, damaged, or displaced during the work. Restoration must meet the standards and specifications of the jurisdictional agency. Restored items must not impede access by SacSewer for maintenance purposes, or damage SacSewer's facilities (e.g., nodes may not be paved over).

327.1.2 PRIVATE PROPERTY

Within easements on private property, the contractor must restore all surface improvements that were removed, damaged, or displaced during the work. The contractor must coordinate the restoration of surfaces with the property owner or homeowner's association. Restored items must not impede access by SacSewer for maintenance purposes or damage SacSewer's facilities.

327.2 PRIVATE ROADS

Trench restoration within private roads must be in accordance with Section 311, "Trench Excavation, Bedding, and Backfill," of these Standards. The contractor must match the existing pavement thickness and place a minimum of 2 inches of asphalt where asphalt surfaces are removed, damaged, or displaced. Place asphalt on a minimum 6-inch bed of class 2 aggregates compacted to a relative compaction of 95%. Asphalt material must meet the requirements of Section 326, "Asphalt Concrete," of these Standards.

For unpaved private roads, the contractor must match the existing surface material. Place surface material on a minimum 6-inch bed of class 2 aggregate base compacted to a relative compaction of 90%. Reshape the surface to preexisting cross sections.

327.3 ACCESS ROADS AND PUMP STATION LOTS

Restoration of access roads to facilities and pump station lots must be in accordance with the contract documents. Access roads to pump stations must be accessible at all times.

327.3.1 AGGREGATE BASE

The aggregate base materials and placement must meet the requirements of Section 308.8, "Aggregate Bases" of these Standards.

327.3.2 ASPHALT CONCRETE

Immediately prior to placing asphalt concrete pavement, the top 4 inches of base material, or more where the greater depth of paving is shown on the contract documents, must be recompacted to a minimum relative compaction of 95%. Remove base or underlying material that is wet, loose, or otherwise unsuitable for supporting the new paving to a maximum of 12 inches, and replace it with the aggregate base material and compacted in layers not exceeding 6 inches in depth to a minimum relative compaction of 95%. If unsuitable material is evident, please refer to Section 326.3, "Unsuitable Materials" of these Standards. Remove edges of trenches that are broken or damaged and neatly trim back to stable and undisturbed base and surface materials.

Give the edges of the existing pavement a tack coat of asphaltic emulsion. Fill and compact trenches within facilities access roads and pump station sites in layers not to exceed 2 inches, with asphalt concrete, Type A, conforming to Section 326, "Asphalt Concrete" of these Standards until the trenches in facilities access roads or pump station sites have been brought to approximately $^{3}/_{4}$ inch below the finish grade and cross-section of the street. The contractor must immediately repair all settlements more than 1 inch below finish grade.

Prior to placement of the second lift, the surface of the first lift of pavement and the edges of the existing pavement must be given a tack coat of asphaltic emulsion. Trenches located within facilities access roads and pump station sites must then be filled and compacted with asphalt concrete Type A, $^{1}/_{2}$ inch maximum gradation, as specified above, until the pavement has been brought to the final grade.

Apply a single seal coat after placement of the final lift of asphalt concrete.

The final pavement surface for trenches greater than 3 feet wide must not vary from the edge of a 10-foot straight edge by more than $^{3}/_{8}$ inch (placed parallel and perpendicular to the trench). Final pavement surface for trenches 3 feet or less in width and bore holes having an area less than 50 square feet must match the smoothness of the existing pavement, except final pavement surface grade must not exceed $^{3}/_{8}$ inches above a line between the existing pavement surface at each edge of the excavation. The final pavement below this line is not acceptable.

Remove pavement not meeting the above requirements and replace it to a minimum depth of 1-$^{1}/_{2}$ inches for the full width of the trench. The minimum length of removal along the trench must extend to 4 feet beyond the ends of the nonconforming areas, but in no case will the removal and replacement exceed the limits of the original excavation.

The density of compacted asphalt concrete may be tested at the discretion of the inspector. Core samples taken for testing compaction of asphalt concrete must be tested in accordance with *ASTM D2726* and be 92% or greater of than the maximum Theoretical Density as determined by *ASTM D2041* (based on the full depth of the asphalt section).

327.3.3 SEAL COATS

Apply seal coat treatment at locations specified on the Contract Documents. Place seal coats in accordance with the jurisdictional agency's requirements.

327.4 STREETS

327.4.1 CUTS IN NEW PAVEMENT

Requirements for cutting new pavement vary in each jurisdiction. The contractor must not make all cuts in pavement on public property or within public ROWs without approval from the jurisdictional agency or SacSewer. If cuts are made without approval from the local jurisdiction or SacSewer, the contractor will be responsible for all costs related to the restoration of unauthorized cuts.

327.4.2 PAVEMENT MARKINGS

Pavement markings removed, damaged, or displaced within the public property or public ROWs during the work must be restored in accordance with the jurisdictional agency's requirements.

For pavement markings that were removed, damaged, or displaced on private property, the contractor must coordinate the placement of pavement markings with the owner or homeowner's association.

327.4.3 PAVEMENT RESTORATION

All pavement that is removed, damaged, or displaced by the contractor must be restored per the jurisdictional agencies' standards and specifications. A contractor must coordinate with the jurisdictional agency prior to placing the final pavement surface.

327.5 CONCRETE

327.5.1 CONCRETE ON PUBLIC PROPERTY AND WITHIN PUBLIC RIGHTS-OF-WAY

Restore concrete curbs, gutters, sidewalks, driveways, and other concrete surfaces that were removed, damaged, or displaced during the work in accordance with the standards of the jurisdictional agency. Restored items must not impede access by SacSewer for

maintenance purposes, or damage SacSewer's facilities (e.g., nodes may not be paved over).

327.5.2 CONCRETE ON PRIVATE PROPERTY

The contractor must coordinate removal and restoration within easements on private property with the property owner or homeowner's association. The contractor will only functionally restore concrete curbs, gutters, sidewalks, driveways, and other concrete surfaces with Portland cement concrete.

327.6 TEMPORARY PAVING

Place and maintain temporary paving at locations wherever excavation is made through pavement, sidewalk, or driveways, as shown on the contract documents, unless otherwise directed by the jurisdictional agency. Place temporary paving as soon as the backfill condition is suitable to receive temporary paving, and it will remain in place until the condition of the backfill is suitable for permanent resurfacing. Use asphalt concrete Type A, conforming to Section 326, "Asphalt Concrete" of these Standards, as temporary paving on all major streets.

Temporary paving in all other paved areas may be asphalt plant-mix cutback unless otherwise directed by the jurisdictional agency. The thickness of temporary paving will be $1\text{-}{}^{1}/_{2}$ inches. The temporary bituminous surface must be at least 1 inch thick in sidewalk areas. Maintain temporary paving at the same level as the existing pavement until the permanent surfacing is placed. In no case will temporary pavement be allowed to remain for a period greater than 30 calendar days unless approved in writing by the jurisdictional agency.

Identify all temporary paving by painting the words "TEMPORARY PAVEMENT" along with the name of the contractor responsible for maintaining the temporary paving material and the date on which the material was placed. Painted text will be in white lettering at the beginning, ending, and along the length of the temporary paving at maximum intervals of 500 feet. Neatly stencil the text a minimum of 5 inches in height and maintain it in a neat and legible condition.

Identify temporary pavement and portions of temporary pavement totaling 1,000 feet or greater in length with a construction sign placed along the edge of the roadway. Temporary pavement signs must be 30 inches by 30 inches in a diamond configuration and orange with 5-inch black lettering. Install signs at the beginning, ending, and at maximum intervals of 1,000 feet and within the road ROW whenever possible. Do not install signs in a location that would obstruct visibility or create an obstacle for pedestrians. Obtain the property owner's permission if signs are placed on private property.

327.7 TURF

When necessary for the restoration of surfaces, stockpile existing topsoil separately. Use the topsoil over the areas where it was previously located after completing backfill operations. Where there is a shortfall of existing topsoil, use approved imported topsoil.

327.7.1 PUBLIC PROPERTY AND PUBLIC RIGHTS-OF-WAY

On public property and within the public ROWs, all turf improvements that were removed, damaged, or displaced during the work must be restored as near as practicable to the original condition by the contractor. This work includes any grading necessary to restore the topography of the disturbed area. The restoration must meet the standards of the jurisdictional agency on public properties and within the public ROWs. Restored items must not impede access by SacSewer for maintenance purposes, or damage SacSewer's facilities (e.g., nodes may not be paved over).

327.7.2 PRIVATE PROPERTY

Within easements on private properties, the contractor must coordinate the restoration of surfaces with the property owner. SacSewer will not pay for special or custom items that are not required for the functional restoration of the property.

Restoration using sods removed prior to construction will only be approved if the sods are of equivalent standard to imported turf. Also, use turf to restore areas with a significant risk of erosion, such as on steep or long slopes.

Following backfilling and initial settlement, spread and grade topsoil to achieve a smooth surface free from lumps, stones, or other debris, blending into the levels and shapes of the adjoining undisturbed ground. Mix an approved fertilizer of N:P:K ratio of 10:4:6 into the topsoil at a rate of 40 grams per square meter.

Lay the turf without gaps on the prepared topsoil surface and lightly top dress and compact. Water the turf thoroughly such that it is soaked through to the base.

327.7.3 TREES AND SHRUBS

Where replacement of trees and in the easement is required in the contract documents, provide trees and shrubs suitable for planting adjacent to sewer in accordance with Section 100.1, "Purpose" of these Standards. Replacement of trees and shrubs outside the easement must be specified in the project-specific plans and specifications.

327.8 SETTLEMENT

Make good any settlement of the trench by placing additional approved fill such that the finished surface level conforms to the adjacent surface. Complete settlement repairs within five days of when the settlement was first noticed.

For trenches not through paved areas, turf areas, grassed areas, or other improved surfaces, backfill may be placed high enough to compensate for expected settlement unless the backfill would create a hazard or inconvenience to the public. Prior to the end of the one-year warranty, trim back excess material to conform to the adjacent surface and dispose of the surplus.

327.8.1 TUNNELING

Where tunneling has been used in lieu of trenching to avoid improved surfaces, backfill such as to restore full support to the surface. Repair all damage to the improved surface that occurs at any time due to subsidence of the backfill.

327.9 CERTIFICATION

Submit certificates issued by relevant jurisdictions that all roads, footpaths, and surfaces in public places under the jurisdiction's control have been satisfactorily restored. Project acceptance will not be given until this certificate is submitted to SacSewer.

327.10 MEASUREMENT AND PAYMENT

Surface restoration is paid at a lump sum price and includes the following:

- All labor, materials, tools, equipment, incidentals, and
- All work involved, complete in place, as shown or as specified in the contract documents, and as directed by the jurisdictional agency.

If no item is included in the contract documents for surface restoration, SacSewer understands that surface restoration is included within the various items of work involved, and no separate payment will be made.

Temporary paving is measured by the weight of asphalt concrete placed in the work, in accordance with the latest edition of the *State Specifications*.

The price paid per ton for temporary paving includes the following:

- All labor, materials, tools, equipment, incidentals, and
- All work involved in temporary paving, complete in place, as shown or specified in the contract documents, and directed by the jurisdictional agency.

If there is no item in the contract documents for temporary paving, SacSewer understands that temporary paving is included within the various items of work involved, and no separate payment will be made.

328 CURBS, GUTTERS, AND SIDEWALKS

328.1 GENERAL

Concrete curbs, gutters, sidewalks, and drainage structures within the public ROW will be constructed as shown on the plans unless otherwise directed by the jurisdictional agency. Where curb, gutter, and sidewalks are to be removed for constructing sewer facilities, remove the concrete as shown on the contract documents and reconstruct in accordance with the jurisdictional agency's requirements. The contractor will dispose of removed materials at no additional cost to SacSewer.

328.2 MEASUREMENT AND PAYMENT

Curb and gutter will be measured and paid for by the linear foot for the type of curb, gutter, or curb and gutter designated in the contract documents and includes the following:

- All labor, materials, tools, equipment, incidentals, and
- All work involved in constructing curb, gutter, or curb and gutter, complete in place, including:
  - Preparing the subgrade,
  - All form work,
  - Finishing and curing the concrete,
  - Supplying and placing expansion joint material,
  - Supplying and placing dowels and reinforcement,
  - Curb and gutter testing, and
  - Repairing the damage, as shown in the contract documents and as directed by the jurisdictional agency.

Sidewalks are measured and paid for by the square foot for the type of sidewalk designated in the contract documents and include the following:

- All labor, materials, tools, equipment, incidentals, and
- All work involved in constructing the sidewalk complete in place, including:
    - All form work,
    - Finishing and curing the concrete,
    - Supplying and placing expansion joint material, and
    - Repairing the damage, as shown on the contract documents and as directed by the jurisdictional agency

Curb ramps are measured and paid for by the unit, as designated in the contract documents, and include the following:

- All labor, materials, tools, equipment, incidentals, and
- All work involved in constructing curb ramps complete in place, including:
    - All form work,
    - Finishing and curing the concrete,
    - Supplying and placing expansion joint material, and
    - Repairing the damage, as shown in the contract documents and as directed by the jurisdictional agency.

If curb ramps are not included as a separate item in the contract documents, SacSewer understands that curb ramps are included within the various items of work involved, and no separate payment will be made.

Driveways will be measured and paid for by the square foot or by the unit, as designated in the contract documents, and includes the following:

- All labor, materials, tools, equipment, incidentals, and
- All work involved in constructing driveway complete in place, including:
    - All form work,
    - Finishing and curing the concrete,
    - Supplying and placing expansion joint material, and
    - Repairing the damage, as shown in the contract documents and as directed by the jurisdictional agency.

If driveways are not included as a separate pay item in the contract documents, SacSewer understands that the curb and the gutter portion of the driveway are included within the various items of work involved, and no separate payment will be made.

Removal of the sidewalk, curb, and gutters will be measured and paid for by the linear foot as designated in the contract documents.

Include excavation for aggregate base beneath the sidewalk, curb ramps, driveways, and curb and gutter sections in the bid item for roadway excavation if the contract documents include such an item.

If there is no item for roadway excavation, the excavation for the aggregate base beneath the sidewalk, curb ramps, driveways, and curb and gutter sections are considered incidental and included in the various pay items, and no additional payment will be made.

Supply and placement of aggregate base material are measured and paid for as detailed in Section 327.3.1, "Aggregate Base" of these Standards.

If the removal of sidewalks, curbs, gutters or curb and gutters are not designated as separate pay items in the contract documents, SacSewer understands that these items are included in the various items of work, and no additional payment will be made.

329 PIPE CLEANING

329.1 GENERAL

Pipeline cleaning is performed as part of SacSewer's maintenance programs. Clean all pipelines to be inspected for structural condition or rehabilitated before starting work. The contractor must assume a reasonable amount of debris within the pipe.

Clean pipelines by removing all sludge, dirt, sand, grease, rocks, roots, and other material and obstructions from the pipelines and manholes. Take all necessary precautions to prevent overflows and backups into structures and protect existing facilities from damage from cleaning equipment.

Upon completion of construction and before final inspection, the contractor must clean new pipelines of all dirt and debris. Pipeline installation will not be accepted as complete until the cleaning is complete and acceptable to SacSewer.

For new construction, install and maintain temporary plugs during cleaning operations at points of connection to existing facilities to prevent water, dirt, and debris from entering the

existing facility. SacSewer will approve the temporary plugs and plugs must remain in place until the completion of the cleaning operation. Install and remove the plugs in the presence of SacSewer. Do not return any water, dirt, or debris recovered from the cleaning operation to SacSewer's system; dispose of it in accordance with the project SWPPP.

329.2 EQUIPMENT

Clean the pipe using standard mechanically powered or hydraulically propelled cleaning tools. Choose cleaning equipment based on the condition of the pipelines at the time the work commences. SacSewer must approve equipment.

Only use hydraulic or mechanical equipment for pipe cleaning activities. When hydraulic or high-velocity cleaning equipment is used, remove all solids and debris by manual or vacuum method. Trap and remove all solids and debris, preventing any material from passing into the downstream system.

When using any equipment, make sure it does not cause damage or flooding to public or private property being served by the facilities.

329.2.1 HYDRAULICALLY PROPELLED CLEANING

Sewer cleaning balls, other equipment, and cleaning methods may be used as specified in the contract documents. When using this type of equipment, ensure that it does not cause damage or flooding to public or private property being served by the facilities.

329.2.2 HIGH-VELOCITY JET EQUIPMENT

Operate all high-velocity cleaning equipment as directed by the manufacturer. The equipment must have a selection of two or more high-velocity nozzles with a minimum capacity of 30 gpm for pipe diameters 8 inches and below with a minimum working pressure of 2,000 psi.

The nozzles must produce a scouring action from 15 to 45 degrees in all sizes of pipelines designated to be cleaned. The equipment must have a minimum of 600 feet of $^{3}/_{4}$ inch inside diameter high-pressure hose. Equipment must also include a high-velocity gun for washing and scouring manhole walls and floors. The gun must produce flows from a fine spray to a solid stream.

The equipment must carry its own water tank, auxiliary engines, pumps, and hydraulically driven hose reel. Return all liquid decanted or separated from the solids to the collection system. The liquid must not contain solids.

Perform all high-velocity work at the downstream node unless approved by SacSewer.

329.2.3 MECHANICALLY POWERED EQUIPMENT

Power rodding machines must be either a sectional rodder or continuous rod type that can clean between nodes or the length of the laterals. The contractor is responsible for verifying the lengths between nodes before starting work. To ensure safe operation, the machine must be fully enclosed and have an automatic safety clutch or relief valve.

329.3 EXECUTION OF WORK

329.3.1 WATER

When water from fire hydrants is necessary, apply to the local water purveyor for permission, regulations, and requirements for access to potable water.

329.3.2 ACCESS

Access for cleaning purposes is only through existing node openings, SacSewer's cleanouts, or excavations approved by SacSewer.

329.3.3 ROOT REMOVAL

Special attention must be used during the cleaning operation to ensure the removal of roots. Only #1 roots may remain as specified in SacSewer's *Television Inspection Manual*, available on SacSewer's website at www.sacsewer.com. Procedures include the use of mechanical equipment such as rodding machines, winches using root cutters, and equipment such as high-velocity jet cleaners.

329.3.4 LARGE DIAMETER SEWERS

In pipelines 24 inches in diameter and greater, the contractor may employ a combination of hydraulic high volume water pumping and solids separation system for cleaning. Plugging may be required if high flows limit the effectiveness of cleaning operations. Plugging operations must be approved by SacSewer.

Solids moved to the downstream manhole must be captured, removed, and dewatered to 95% before transport to an approved disposal facility. Use a continuous operation pumping and separation system.

Return all liquid decanted or separated from the solids to the collection system. The liquid must not contain solids.

329.3.5 Major Blockage or Defect

If cleaning an entire main line segment cannot be successfully performed from one manhole, immediately notify SacSewer of the problem and wait for further direction. A reverse setup may not be attempted with high-velocity jetting equipment unless directed explicitly by SacSewer. If successful cleaning also cannot be performed on reverse setup or equipment fails to traverse the entire main line segment, it is assumed that a major blockage or defect exists. The effort will be halted, and the contractor must immediately notify SacSewer.

If cleaning of a lateral cannot be successfully performed, notify SacSewer. The contractor must inform SacSewer where the problem was found based on the length of cleaning equipment used.

If the contractor's cleaning equipment becomes lodged in a pipeline, the contractor must immediately notify SacSewer. The cleaning equipment must be removed immediately at the contractor's expense. This activity includes excavation and sewer repair, underground utilities, backfilling, and surface restoration.

329.3.6 Disposal

Remove all sludge and other solid or semi-solid materials resulting from the cleaning operation at the manhole of the section being cleaned. Material is not allowed to pass from one section to another.

All materials resulting from pipeline cleaning operations must be captured, removed, dewatered to 95%, and conveyed by the contractor to a SacSewer-approved waste disposal site. The contractor is responsible for all disposal fees. Under no circumstances may materials removed from the sewer be disposed of outside approved facilities.

Vehicles that convey the waste materials to the disposal sites must have water-tight containers for liquids, and solids loads must be tightly covered.

329.3.7 Sewage Overflow

If any liquid or solid matter from the sewer collection system overflows, discharges, leaks, or is otherwise deposited into the open environment; the contractors must immediately notify SacSewer. The contractor must simultaneously attempt to contain the overflow and initiate the required cleanup operations at no additional cost to SacSewer.

The contractor must comply with all local, State, and Federal regulatory requirements regarding overflows, including the WDRs. Improper disposal of sewage or solids removed

from the sewers may subject the contractor to fines imposed by regulatory entities. In addition, the contractor may be subject to civil and criminal penalties for improper disposal of removed materials under law.

329.4 ACCEPTANCE

SacSewer will inspect a percentage of cleanings for quality control using TVI. The acceptance of pipeline cleaning will be based on an inspection at manholes or a viewing of the TVI video completed following cleaning. A pipeline will be considered clean if the depth of debris remaining is negligible throughout the entire pipeline and the root rating is #1 or less.

If cleaning is deemed unsatisfactory, the contractor must repeat the cleaning and TVI the pipeline until cleaning is shown to be acceptable, all at the contractor's expense.

329.5 MEASUREMENT AND PAYMENT

Payment for pipe cleaning is based on the actual number of linear feet of the main line cleaned, accepted main lines, and per lower lateral cleaned and accepted. No additional payment allowance will be made for reverse setups.

For main lines, the length is measured along the centerline of the pipe from the inside face of the manhole to the inside face of the manhole.

The unit price includes all the following items:

- Supply and set up all equipment and labor necessary to clean the pipeline to be rehabilitated
- Supply water for jetting
- Supply energy required for de-rooting equipment and other power cleaning machines
- Removal of all foreign material from the pipeline walls
- Clean and inspect manholes
- Payment for all other related and necessary materials, work, and equipment required to complete this item in accordance with these Standards

330 TESTING

After installing facilities, the contractor will perform all facilities testing in accordance with the manufacturer's requirements and as described in these Standards. To perform all required tests, the contractor must provide all equipment, material, utilities, and appurtenances.

Most tests can be found under their particular material or facility section in Section 300, "Construction" of these Standards. General tests can be found in this section.

330.1 PIPELINES

330.1.1 DYE TESTING

A dye test can be used to determine if a structure is connected to the public sewer collection system or if storm water from a property is entering the sewer collection system. Dye testing can also be used with TVI to verify lower lateral connection to a main line if there are multiple lower laterals or multiple main lines available.

Materials

Use non-toxic, concentrated fluorescent dye.

Execution

To determine if a structure is connected to SacSewer's sewer collection system, a small amount of dye is flushed down a toilet or other plumbing fixture inside the structure. Do not use an SacSewer or private cleanout to verify the connection for dye insertion. A connection can only be verified by observing dye entering SacSewer's main line at the tap with a lateral or main line camera, with the video provided to SacSewer. If multiple locations or structures on the same main line or property are to be tested, use of multiple dye colors is necessary.

To determine if storm water from a property is entering the sewer collection system, a small amount of dye is inserted into all exterior drains on the property. The system is observed for evidence of dye at SacSewer's cleanout, if available, or the nearest accessible manhole downstream of the lower lateral tap. The contractor is responsible for verifying they view the system at an appropriate location.

Traffic control, if necessary, is the responsibility of the contractor.

Submittal

The contractor must prepare and submit a drawing, inspection, work order, and videos of the dye testing to SacSewer for review and approval within five days of the completion of all assigned work. The report must contain a typed log that clearly identifies each property tested, each point of dye insertion, and the results.

Measurement and Payment

Payment for dye testing is based on a single property confirmation. Each system may be tested as a unit and must successfully meet the requirements specified before acceptance by SacSewer. The contractor must inform SacSewer at least five working days before the time set for testing the piping system.

The unit price for dye testing includes all the following items:

- Supply and set up all equipment and labor necessary to perform the dye test
- Supply water for flushing pipelines as necessary
- Observation at the manholes or other locations necessary
- Payment for all other related and necessary materials, work, and equipment required to complete this item in accordance with these Standards

330.1.2 Pressure and Leakage Testing

Perform the test by providing bulkheads or plugs and filling the pipeline section(s) with water, making provisions for releasing air in the pipeline. The pipeline may be filled with water sometime before leakage testing to allow the pipe joint material to absorb water.

Specified water pressure and durations are listed in Table 315-1 of Section 315.6, "Testing" of these Standards.

Immediately correct all leaks that are found and subject the system to the same test for 2 hours. Repeat until satisfactory results are attained.

The contractor must take all the necessary precautions to prevent joints from drawing while testing the pipeline and appurtenances. At the contractor's expense, the contractor must repair damage to the pipes and appurtenances, or to other structures, resulting from or caused by these tests.

The contractor must keep records of each piping test, including:

- Description and identification of piping tested
- Description of the test procedure
- Date of test
- Name of inspector
- Test evaluation

- Remarks, including leaks (type and location) and any repairs made on leaks

Repair or replace all defects and repeat leakage tests until conformance to the leakage test requirements specified in these Standards has been met. Repair all visible leaks, even if the pipeline passes the allowable leakage test.

330.2 HYDROSTATIC LEAKAGE TESTING

After the completion of the installation, the contractor must test the pipeline system in accordance with the manufacturer's recommended procedures and as specified in these Standards. The contractor will furnish all material, equipment, and labor for testing the piping systems.

The contractor will perform leakage tests after the pipe is installed and backfilled but before permanent resurfacing.

Perform the test by providing the appropriate mechanical joints and bracing and filling the pipeline section(s) with water, making provisions for releasing air into the pipelines.

Maintain specified water pressure for the duration shown in Table 330-1, and determine leakage within a tolerance of 0 psi to 5 psi.

Table 330-1: Hydrostatic Leakage Test Requirements

Maximum Pressure	Test Period	Allowable Leakage
65 psi	8 hours	No loss of water or pressure

No leakage is indicated if the amount of make-up water at the end of the test does not exceed the manufacturer's calculated allowance for expansion.

Immediately correct all leaks found, and subject the system to the same test for 8 hours.

If the leakage rate exceeds the allowable, repair or replace the installation and repeat the leakage test until conformance to the leakage test meets the requirements specified in these Standards. Repair all visible leaks, even if the pipeline passes the allowable leakage test.

330.3 FIELD SAMPLING AND TESTS FOR CONCRETE

Perform field sampling and testing by the contractor's testing laboratory. Take samples of and concrete at random locations and at such times to represent the quality throughout the project. The laboratory must provide the necessary labor, materials, and facilities for sampling and testing.

330.3.1 CONCRETE SAMPLING

Obtain samples of concrete at the point of placement and in accordance with *ASTM C172*. Take samples for pumped concrete at the hose discharge point. Take samples for other concrete at the hopper of concreting equipment or transit mix truck.

330.3.2 CONCRETE STRENGTH TESTING

Verify the strengths specified for the design mix by the testing laboratory during placement of the concrete. Complete verification by testing standard cylinders of concrete samples taken at the job site.

Standard cylinders must represent the concrete placed in the forms. Cast one set of four standard cylinders of each class of concrete for every 100 cubic yards, or less or every 4,000 square feet of surface area poured per day. Cast the fifth cylinder for every three sets of four cylinders. Casting, handling, and curing of cylinders must be in accordance with *ASTM C31*. Provide additional cylinders when an error in batching is suspected. For the first 24 hours after casting, keep the cylinders moist in a storage box constructed and located so that its interior air temperature is between 60 and 80 degrees Fahrenheit. At the end of 24 hours, transport the cylinders to the testing laboratory.

Test specimens for compressive strength are in accordance with *ASTM C39*. Test at 7 and 28 days from the time of casting. Test two test cylinders from each group of four at the end of 7 days and test 2 at the end of 28 days. Test the fifth cylinder at the end of 90 days only. Strength tests consist of the average strength of two cylinders cast from material taken from a single load of concrete.

During construction, there may be a need to cast additional cylinders and conduct strength testing between the seven-day and the 28-day breaks. Structural elements that have specified strength requirements prior to backfill, removal of false work and other engineering considerations may fall into this category.

Each strength test result is the average of the strengths of two test cylinders at 28 days, except if one cylinder in a set of two shows evidence of low strength due to improper sampling, casting, handling, or curing, use the result of the remaining one cylinder.

The average of any three consecutive 28-day strength test results of the cylinders representing each class of concrete for each structure must be equal to or greater than the specified strength. No more than 10% of the strength test results may have values less than the specified 28-day strength for the total job concrete. No individual strength test results may be less than the specified strength by more than 500 psi.

Provide certified reports of the test results directly to SacSewer. Test reports must include sufficient information to identify the mix used, the stationing or location of the concrete placement, and the quantity placed. Note concrete slump, air content, concrete temperature, and ambient temperature. Evaluate the 28-day strength test results in accordance with *ACI 214*. Include quality control charts showing field test results with the test results for each class of concrete in each major structure. Prepare charts in accordance with *ACI 214*. Maintain quality control charts throughout the entire job. These charts must be available to SacSewer's inspector at all times.

If the 28-day test results fall below the specified compressive strength for the class of concrete required for any portion of the work, adjust the proportions, water content, or both, as necessary at the contractor's expense. Report changes and adjustments in writing to SacSewer.

If compressive test results indicate concrete in place may not meet structural requirements, tests must be made to determine if the structure or portion thereof is structurally sound. Tests may include but are not limited to cores in accordance with *ASTM C42* and any other analyses or load tests acceptable to SacSewer. The contractor will bear the costs of these tests.

330.3.3 Concrete Consistency Testing

The slump must be as specified when measured in accordance with *ASTM C143*. Take samples for slump determination from the concrete during placing. Test at the beginning of concrete placement operation and subsequent intervals to ensure that the specification requirements are met. Perform slump tests whenever standard cylinders are cast.

The contractor may adjust the slump to the specified slump before casting cylinders. Do not add additional water after the initial adjustment. If the contractor adds water after the initial slump adjustments or during the pour, SacSewer may order additional samples to be taken without compensation.

330.3.4 Concrete Temperature and Air Content Testing

Test for the temperature at frequent intervals during hot or cold weather conditions until satisfactory temperature control is established. Whenever standard cylinders are cast, perform temperature tests.

Air content must be as specified when measured in accordance with *ASTM C231*. Measure air content whenever standard cylinders are cast.

330.3.5 Final Laboratory Report

Provide a final report, prepared by the testing laboratory, at the completion of all concreting. This report summarizes the findings concerning concrete used in the project and provides concrete totals used by class and structure. Include final quality control charts for compressive strength tests for classes of concrete specified in each major structure. The report also includes the concrete batch plant's coefficient of variation and standard deviation results for each class of concrete as determined in accordance with *ACI 214*.

330.4 Controlled Low Strength Materials

If required, sample and test CLSM in accordance with *ASTM C94* or *ASTM C685* and *ASTM D4832*. SacSewer must approve CLSM in writing before use.

330.5 Pump Stations

10-day continuous (240 hours) tests must simulate the actual operating conditions of the pump station. Tests must check the performance of the units concerning vibration, noise, overheating of motor bearings, lubricating motor system, cooling and circulation, start/stop sequencing, alarms, and for any display of unfavorable operating characteristics. The contractor must follow the guidelines set in SacSewer's *Pump Station Startup Checklist* available on SacSewer's website at www.sacsewer.com.

The contractor must retest all component equipment exceeding allowable limits and correct all defects until satisfactory results are obtained.

330.5.1 10-Day Test Requirements

Pull the pumps out of the wet well before starting and after completing the test to check the oil condition inside the pumps.

The contractor must provide water storage with enough volume to perform the test; the water storage must be greater than or equal to the water volume used for the test. Equip the water storage with a valve to control water from flowing back into the wet well.

The contractor will introduce fresh water to the wet well at an elevation of 1 foot above the pump start point. Please refer to Section 502, Drawing P-03 of these Standards.

Connect a bypass hose to the pressurized pipeline at the bypass assembly to pump fresh water from the wet well to the storage tank. Connect a sufficient size hose to the tank's

valve to introduce water back into the wet well. Water flowing to the wet well must flow through the approach manhole or directly into the wet well.

330.6 MEASUREMENT AND PAYMENT

Payments for all testing are at the contract lump sum price. Payments include all the following items:

- Supplying all equipment, materials, tools, labor, shipping, and transportation
- Performing all operations in connection with satisfactory sampling, testing, and reporting of all tests results
- Providing all other items necessary and incidental to the completion of the work

No additional payments will be made for items of work described in the Contract Documents but not listed in this section.

331 TELEVISION INSPECTION

All television inspections must meet requirements according to SacSewer's *Television Inspection Manual*, available on SacSewer's website at www.sacsewer.com.

331.1 EXISTING ASSETS

NONCONFORMING TVI STANDARDS

If the quality, content, or other aspects of the inspections are not in compliance, SacSewer will reject the submittal, and the contractor will reinspect or revise the inspection at their own expense. SacSewer will reject all inspections, not in compliance.

MEASUREMENT AND PAYMENT

The cost of each TVI and inspection must be all-inclusive and must be included in the price paid per linear foot of pipe or as specified.

Payment for TVI work which is not required as part of construction work for rehabilitation must be made on an actual inspected lineal footage basis per diameter of pipe inspected and must include the cost of all items necessary to complete the TVI, including bypass pumping or flow control which may be required.

No direct payment must be made for TVI services required as part of construction work for rehabilitation. Payment for TVI must be included in the contract bid prices for the related rehabilitation items.

331.2 SacSewer's Approved TV Contractor List

Before a TVI contractor performs a TVI on SacSewer's sewer collection system, the contractor must demonstrate that their documentation, equipment, video quality, and data capture system is in compliance with the Standards. When the TVI contractor has met the SacSewer's requirements, the TVI contractor will be added to *SacSewer's Approved TV Contractors List*, existing or new assets.

The TVI contractor must be on the *SacSewer's Approved TV Contractors List*, existing or new assets, prior to the submittal of any work to be done. SacSewer may remove TVI contractors from the *SacSewer's Approved TV Contractors List*, existing or new assets, at its discretion. *SacSewer's Approved TV Contractors List*, existing or new assets, will be updated as needed.

331.3 New Assets

331.3.1 Submittals

Inspect all new main lines, nodes and 20% of lower laterals per project. SacSewer reserves the right to request sample videos from the TVI contractor on any new construction project to verify the system complies with these Standards. Submit TVIs in accordance to the requirements in the current version of SacSewer's *Television Inspection Manual* available on SacSewer's website at www.sacsewer.com.

Submit the inspection to SacSewer within 5 working days. SacSewer will review the inspections within 10 working days. SacSewer will notify the contractor whether or not the inspection is acceptable and, if so, whether or not the review revealed a satisfactory installation or deficiencies. The hard drive may be picked up after this review. SacSewer is not responsible for damage to the hard drive.

SacSewer requires a completed TVI form or written certification (in accordance with the "Proof of Compliance with the Contract" section of the County of Sacramento *Standard Construction Specifications*) that the installation meets the acceptance criteria.

SacSewer compliance letters expire 2 years after they are issued.

Please refer to SacSewer's *Television Inspection Manual* for TVI standards and for procedures here.

331.4 Acceptance Criteria for New Assets

The contractor will correct the following types of deficiencies at no cost to SacSewer:

- Joint separation equal to or greater than $^1/_2$ inch
- Offset main line joints equal to or greater than those specified in Section 312.4, "Laying Pipe" in these Standards
- Joint deflection of more than 75% of manufacturer's recommended maximum cracked or damaged pipe, including liner pipe
- Debris in the pipeline
- Identifiable sags or high points (i.e., out of tolerance grades), offset service joints (ABS to clay) equal to or greater than 1 pipe wall thickness of the ABS
- Noncompliance with other requirements of the contract documents

Record all necessary easements before collection system acceptance.

SacSewer will notify the contractor in writing of any deficiencies. The contractor may request to review the video with SacSewer. The contractor must correct all deficiencies and resubmit the data electronically to SacSewer within 10 working days. Data must reflect current coding and labeling procedures in this section, and meet all requirements detailed in the current version of SacSewer's *Television Inspection Manual* available on SacSewer's website at www.sacsewer.com.

Upon completion of all required corrective actions, clean and reinspect (TVI) the pipes as necessary and submit the results within 5 working days after completing the TVI. Repeat this process until SacSewer's review of the final TVI report indicates that the pipe installation, repair, cleaning, and electronic data meet all requirements.

332 Final Documents

332.1 General

Final Documents are required for all projects where SacSewer will be accepting operation and maintenance of the facilities.

332.2 Record Drawings

The contractor must maintain a neat and accurately marked set of Record Drawings, that must be provided to SacSewer for review and approval prior to final acceptance of the work. The Record Drawings represent the work as constructed, document changes to the work shown on

the approved plans and specifications, and show the actual as-constructed conditions of installed or modified systems, equipment, and material.

Record Drawings are produced by marking a full-size copy of the approved plans as follows:

- Red: Additions including notes and dimensions
- Green: Deletions (by hash marks or appropriate lines through the deletion)
- Graphite (gray): General comments and notes used by the contractor or SacSewer and not required on the as-built
- Yellow: Work completed as shown and used by SacSewer in the field review of the as-built, during the submittal phase
- Blue: SacSewer verification and notes required to be added and noted by SacSewer in the review of the as-built, during the submittal phase

The Record Drawings show, by field measured dimensions, the exact locations of all underground work and the final elevations and locations of all improvements constructed, modified, or adjusted. Record Drawings must be available for inspection by SacSewer at all times and updated at least weekly with all written directives. Contract change orders and contract adjustments must be shown thereon and initialed by SacSewer. Progress payments or portions thereof may be withheld if Records Drawings are not kept up to date.

These Record Drawings must include certification by the contractor that the Record Drawings are a true representation of the work as actually constructed.

332.3 AS-BUILT DRAWINGS

The contractor must submit a minimum of two bond paper sets of the original plans and specifications showing all changes made during construction and labeled “As-built Plans” to SacSewer and one electronic copy, in a format acceptable to SacSewer of the labeled “As-built Plans” at the final inspection. The work will not be formally accepted for operation and maintenance until the as-built or record drawings are provided and approved by SacSewer. Record Drawings can be substituted for As-built Drawings as long as they are stamped as-built. Final payment or field acceptance may be withheld if the As-built Drawings are not provided.

332.4 PUMP STATION OPERATION AND MAINTENANCE MANUALS

332.4.1 GENERAL

As appropriate, the contractor who prepares the operation and maintenance manual must have personal experience in the maintenance and operation of the described products.

332.4.2 FORMAT

Submit two copies of the pump station manual - one copy in an electronic format acceptable to SacSewer and a second hard copy in the form of an instructional manual. Submit the instructional manual in commercial quality, 8 $^1/_2$ x 11 inch 3 D side ring binders with durable plastic covers; 2-inch maximum ring size. Each binder should have a cover with a typed or printed title “OPERATION AND MAINTENANCE INSTRUCTIONS” along with the title of the project and the volume number for multiple volume references indicated.

Index each separate product and system with a typed description of the product and major component parts of equipment. The text must be manufacturer’s printed data, or typewritten data on 24-pound paper. Do not submit photocopies of preprinted data. Drawings must be bound in the text and provided with reinforced, punched binder tabs. Fold larger drawings neatly to the size of the text pages.

332.4.3 CONTENT

The contractor must prepare a table of contents for each volume, with each product or system description identified in three parts as follows:

- Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, contractor, subcontractors, and major equipment suppliers
- Part 2: Operation and maintenance instructions arranged by the system and subdivided by the specification section. For each category, identify the names, addresses, and telephone numbers of subcontractors, supplies, and parts distributors:
    - Significant design criteria,
    - List of installed equipment,
    - Parts list for each component and viable alternatives,
    - Operating instructions,
    - Maintenance instructions for equipment and systems,
    - Maintenance instructions for finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents,

- Operating instructions must include all the following items:
  - Start-up, break-in, and routine normal operating instructions and sequences
  - Regulation; control; stopping; shut-down and emergency instructions
  - Summer, winter, or other special operating instruction
  - Routine maintenance procedures
  - A guide for troubleshooting
  - Disassembly, repair, and reassembly instructions
  - Alignment, adjusting, balancing, and checking instructions
  - Servicing and lubrication schedule
  - Manufacturer's printed operation and maintenance instructions
- Include Operating and Maintenance Procedures

- Part 3: Project documents and certificates, including all the following items:
  - Shop drawings and product data
  - Certificates
  - Photocopies of warranties
- Part 4: Design data
  - Each item of equipment and each system must include a description of the unit or system and component parts.
  - Identify the function, normal operating characteristics, and limiting conditions
  - Include performance curves with supporting engineering data and sets, and complete nomenclature and model number of replacement parts.
  - For panel board circuit directors, the electrical service characteristics, controls, and communications must be typed and provided.
  - Include color-coded wiring diagrams as installed
  - Include a factory-certified pump test curve for the actual pumping units (including motors) installed at the station.

332.4.4 SUBMITTALS

Submit six hard copies of all operation and maintenance manuals to SacSewer for review and approval during phase 1 of the pump station startup. Please refer to SacSewer's *Pump Station Startup Checklist* available on SacSewer's website at www.sacsewer.com.

During phase 2 of the pump station startup, leave one hard copy of the final approved operation and maintenance manual at the station, and present two hard copies and one electronic copy in a format acceptable to SacSewer, to be placed at SacSewer's main office, for a total of four copies of the final approved manual.

332.5 MEASUREMENT AND PAYMENT

Full compensation for all final documentation is included in the prices paid for the various items of work; do not include final documentation as a separate line item.

333 WARRANTY PERIOD

333.1 GENERAL

Warranties for all construction, materials, equipment, and workmanship are for a minimum period of one year from the date of SacSewer's project acceptance.

SacSewer will make exceptions for particular equipment and items where extended warranties are otherwise identified in the Contract Documents.

If a pump station is constructed and not required to be immediately placed in service due to the lack of occupancy, the overall warranty period extends two years from the acceptance, one year from the first occupancy, or other time period as agreed by SacSewer.

The contractor must repair or remove and replace any and all work that is found to be defective in workmanship and materials within the warranty periods, without expense whatsoever to SacSewer. Replaced equipment must have a new one year warranty period.

SacSewer is hereby authorized to make such needed repairs if the contractor fails to undertake, with due diligence, the needed repairs within 10 days after the contractor is given the written notice of such failure and without notice to the surety provided; however, that in case of an emergency where, in SacSewer's opinion, a delay will cause serious loss or damages to the public, the repairs may be made for lights, signs, and barricades erected without prior notice to the contractor. The contractor will pay the entire cost.

Warranties, guarantees, and certificates, furnished or available to equipment and materials, must be properly filled out as of the date of acceptance and delivered to SacSewer.

SacSewer reserves the right to perform maintenance with SacSewer's staff, as necessary, to meet SacSewer's operational requirements without voiding warranties.

Warranties for SacSewer's work on privately maintained sewer facilities are covered under Section 7.14 of the *SacSewer Sewer Ordinance*.

SECTION 400: REHABILITATION

This section outlines the design and construction requirements for the rehabilitation of existing SacSewer assets.

400 GRAVITY PIPELINES

Perform all work in accordance with all sections of these Standards.

400.1 LEAK DETECTION

The most common methods to detect leaks are TVI, dye testing, hydrostatic testing, air testing, vacuum testing, and smoke testing. The most common causes of defects which might cause leaks are as follows:

- Cracks
- Fractures
- Joint displacement
- Root intrusion
- Deformation
- Collapse
- Poorly constructed connections
- Abandoned laterals left unsealed

400.2 LEAK CORRECTION

The method for rehabilitating the collection system varies depending on the location of the leak. Rehabilitation methods to control leaks are as follows:

- Excavation and replacement with new pipe
- Chemical grouting
- CIPP
- Sliplining
- Pipe Bursting

400.3 SPOT REPAIRS

Point repairs are defined as the work required to repair defective sections of existing pipelines for rehabilitation. Generally, the work will include joint repair or pipe replacement.

Point repair locations indicated on the plans cannot always be determined before the pipeline is exposed. The location shown on the plans will be considered accurate if it is within 5 feet of the actual location.

400.3.1 CONVENTIONAL EXCAVATION AND REPLACEMENT

Materials

Use the same pipe and materials as the existing pipeline whenever possible. All pipes and materials must conform to these Standards.

Execution of Work

Excavation must conform to these Standards. Excavate a repair pit that uncovers the pipeline a minimum of 1 foot around the damaged section or as directed by SacSewer.

Remove damaged pipe by a power saw cutting to a flat vertical surface. A snap ring cutter is permitted only on VCP and asbestos cement pipe, provided a flat vertical surface is obtained. Cut the replacement pipe to a flat vertical surface. Reshape and compact the bottom of the trench as necessary, so the grade of the new pipe matches that of the existing pipe.

Connect the newly installed pipe to the existing pipeline to provide a watertight connection. When applicable, cut the pipeline so that a smooth plain-end spigot exists at both ends of the trench and reconnect by means of an adapter or solid sleeve. Use shielded, banded couplers for connections. Install the couplers in accordance with the manufacturer's recommendations.

Use an electrofusion coupling or butt-fusion to repair HDPE pipelines, if possible. All mated pipe ends must be flush to each other across the face with no gaps or offsets and match inverts on each diameter.

When replacing more than one consecutive pipe section, use the conventional bell and spigot joint with a rubber gasket on the interior pipe sections. Join the entire replacement length to the existing pipeline with a banded and shielded coupler, adaptor, or sleeve. Bed, backfill, and compact the pipeline in accordance with these Standards.

400.3.2 CURED-IN-PLACE SPOT LINER

Design

All CIPP spot liners must have a minimum 50-year service life under continuous loading conditions. Base the design of the liner on the existing pipe classified as fully deteriorated as defined by *ASTM F1216*. If applicable, the liner must withstand all imposed loads, including live loads and hydrostatic pressure.

The liner wall must be thick enough to withstand the anticipated internal and external pressures and loads that may be imposed after installation. Use a minimum safety factor of 2, and reduce the short-term modulus of elasticity by 50% in the calculations.

Certifications

The contractor must provide SacSewer with certifications from the CIPP manufacturer that all personnel has been trained in installing CIPP spot liners. The certification must describe the manufacturer's training program and, if applicable, licensing policies and procedures for installers.

Previous Experience

The foreman or installer must have successfully installed a minimum of 150 spot liners. All experience is subject to SacSewer's review and approval.

Submittals

The contractor must submit the following information to SacSewer before starting work. No changes are allowed without written approval from SacSewer.

- CIPP System Data
- Manufacturer's Resin Data Test Results
- Resin Enhancer Manufacturer's Data
- Bond Enhancer Manufacturer's Data
- Certification of Applicability of Resin

Materials

Construct the liner of felt, fiberglass, polyester fiber, polypropylene, composite, nylon, or a combination thereof, meeting the manufacturer's standards and acceptable to SacSewer. The liner must form to the internal circumference of the original pipeline and conform to

all off-set joints, bells, and disfigured pipe sections. It must carry resin and withstand installation pressures and curing temperatures.

Fabricate the liner from materials which, when cured, can withstand internal exposure to and corrosive effects of normal sewage; effluent liquids and gasses containing hydrogen sulfide, carbon monoxide, carbon dioxide, methane, dilute sulfuric acid; and external exposure to soil bacteria and chemical attack which may be due to materials in the surrounding soil or sewage within. Corrosion requirements for the collection system are specified in *ASTM F1216* and *ASTM F1743* for domestic residential discharges.

Execution of Work

400.3.2.1.1 Size Criteria

Construct the liner so that when installed, it fits neatly and tightly in the internal circumference of the existing rehabilitated pipeline in one continuous length over the area receiving the liner.

The liner length must extend beyond the section(s) of deteriorated pipeline plus a minimum of 2 feet beyond joints on either side of the last crack or open joint. The contractor must verify the length by visual documentation and record the necessary length before fabrication and insertion. The completed repair must be uniform in thickness throughout the entire length and circumference, except that the finished liner will have tapered ends to allow for a smooth transition to and from the host pipe. Do not overlap circumference or length.

400.3.2.1.2 Installation

The resin may be applied by vacuum impregnation or by pouring and rolling. With either technique, fully saturate the liner with the resin.

Distribute and install the liner so that after curing, the liner becomes part of the host pipeline with smooth, tapering transitions.

Insert the resin-impregnated liner through an existing manhole and install it in accordance with *ASTM 2599* and the manufacturer's standards. Carrying devices are permitted. Avoid gouging and overstressing the tube during the inversion and insertion process, particularly if a carrying device is not used. If recommended by the manufacturer, use a lubricant during inversion and insertion to reduce friction. The lubricant must be non-toxic, unable to support bacterial growth,, and not adversely affect the fluid to be transported.

Completely protect the resin and tube during the insertion process. Do not lose any resin through contact with manhole walls or with the pipeline during insertion. Contain all resin within a translucent bladder to prevent contamination or dilution by exposure to dirt, debris, or water during insertion and to prevent resin loss during the insertion process.

Force the liner to conform to the host pipe by air pressure, hydrostatic pressure, inflation bladder, or other approved means as recommended by the manufacturer.

400.3.2.1.3 Curing

After completing the liner installation, cure the liner in strict accordance with ASTM and the manufacturer's recommendations. The cure and post-cure temperature and period are based on the manufacturer's recommendation and the resin-catalyst system used, modified for the cured-in-place process. The curing process will consider the existing pipeline material, the resin system, and site conditions.

400.3.2.1.4 Cool Down

Cool the finished cured-in-place pipe to the specified temperature in strict accordance with ASTM and the manufacturer's recommendations before relieving the internal pressure in the cured-in-place pipe. Release the static head to prevent a vacuum from developing that could damage the newly installed cured-in-place pipe.

400.3.2.1.5 Finish

After curing is complete, release pressures and remove the inflation bladder and carrying device from the host pipe. In the case of cure using heat (water or steam), cooling may occur before pressure release. Do not leave barriers, coatings, or other material in the host pipe.

400.3.2.1.6 Inspection and Testing

All point repairs must be inspected by TVI.

400.3.3 MEASUREMENT AND PAYMENT

Measure point repairs in place for each size and material in the horizontal plane from end to end of the point repair performed. Payment is made per linear footage and, for conventional excavation and replacement, is based on the average plan depth for each repair.

Point repair items include all the following:

- Removing and disposing of existing pipeline
- Disposing of surplus or unsuitable material
- Supplying and installing the new pipe, appurtenances, plugs, or caps
- Bypass pumping, control of water, dewatering, excavating, temporary sheeting, and bracing
- Testing
- Backfilling and compacting
- Inspection
- Other site restoration and cleanup

400.4 FULL SEGMENT REPAIR BY CIPP

This section specifies existing pipeline rehabilitation by the CIPP method for full segment (node to node) installations. This method includes rehabilitating existing pipelines by inserting a uniform flexible tube through the pipeline to be rehabilitated. Saturate the inserted tube with a thermosetting polyester, epoxy, or vinyl ester resin, inflated to the diameter of the host pipe, and cured by heated water, steam, or UV light.

400.4.1 DESIGN REQUIREMENTS

All CIPP liners must have a minimum 50-year service life under continuous loading conditions. Liner design is based on the existing pipeline condition as classified as fully deteriorated based on the definitions contained in *ASTM F1216*. The liner must withstand all imposed loads, including live loads (if applicable) and hydrostatic pressure. The liner must be thick enough to withstand the anticipated internal and external pressures and loads that may be imposed after installation. Use a minimum safety factor of 2 and reduce the short-term modulus of elasticity by 50% in the calculations.

The minimum thickness for the installed CIPP after curing has been calculated based on *ASTM F1216*. The latest edition of referenced publications at the time of the bid will govern. Please refer to Table 400-1 for CIPP references.

Table 400-1: CIPP References

Reference	Title
ASTM F1216	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
ASTM F1743	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)
ASTM F2019	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled-in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP)
ASTM D578	Standard Specification for Glass Fiber Strands
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D790	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

400.4.2 PREVIOUS CIPP EXPERIENCE

The following requirements must be met:

- Manufacturer: A minimum of 100,000 linear feet of CIPP installation
- Installation Contractor: A minimum of five years of active experience in the commercial installation of CIPP. In addition, a minimum of three successfully completed projects totaling at least 50,000 linear feet of CIPP installation on pipelines. A minimum of 10,000 linear feet of CIPP installation on pipelines between 6 inches and 36 inches in diameter. Each of the referenced CIPP lining projects must be in service in the collection system for at least one year and free of defects.
- Field Superintendent: The field superintendent must supervise and be on-site during all pipeline rehabilitation operations. The field superintendent must have field experience on a minimum of three successfully completed projects totaling at least 10,000 linear feet of CIPP installation with a diameter between 6 inches and 36 inches that required sewage bypass pumping or diversions.
- Installation Crew: At least two persons from the CIPP installation crew must have a minimum of two years of CIPP installation experience. At least one experienced person from the installation crew must be on-site during all pipeline rehabilitation operations.
- Curing Technician: The curing technician must be certified and approved as an operator by the rehabilitation system manufacturer or an independent testing agency. The contractor must provide SacSewer with the name and certification information of the curing technician.

- Lateral Reinstatement Technician: The lateral reinstatement technician must have a minimum of one year of experience operating the remote cutting equipment during the reinstatement of laterals after CIPP installation.

The final decision to accept or reject the product, manufacturer, or installer lies solely with SacSewer. The CIPP manufacturer, installation contractor, field superintendent, installation crew, curing technician, and lateral reinstatement technician will perform the work under this project. Any changes to these personnel are subject to SacSewer's approval. Special provisions within the contract may override these experience requirements.

400.4.3 MATERIALS

Materials provided and process variables used in the CIPP installation process are the contractor's responsibility. Materials, installation procedures and the final product must meet or exceed the CIPP manufacturer's requirements and requirements of *ASTM F1216* and *ASTM F1743* or *ASTM F2019* as applicable.

Liner Tube

Fabricate the liner tube of one or more layers of a noncorrosive flexible material (woven or nonwoven) to meet the requirements of *ASTM F1216*, *ASTM F1743*, and *ASTM F2019* as applicable. The liner tube must be suitable for the conveyance of municipal sewage; carry resin; withstand installation stresses; withstand installation pressures and curing temperatures; be compatible with the resin and catalyst system used; and be free of tears, holes, and cuts, foreign materials, and other surface defects.

Resin

The resin must be compatible with the CIPP liner tube used and designed for a sewage environment. Use a thermosetting polyester, epoxy, or vinyl ester resin meeting the manufacturer's service conditions specified for the tube system and the applicable sections of *ASTM F1216*, *ASTM F1743*, and *ASTM F2019* as applicable. When impregnated into the liner tube, the resin must be sufficiently thixotropic to obtain non-draining characteristics.

Catalyst

Select a catalyst based on the curing conditions and recommendations of the resin manufacturer that is compatible with the resin and other materials used.

400.4.4 PRODUCT

Liner Tube

Verify the host pipeline diameter before fabricating the liner. Size the liner tube so that it will fit tightly to the internal circumference of the host pipe when cured. Verify that the liner tube diameter is appropriate based on the host pipeline diameter before inserting the liner tube.

The liner tube must be uniform and continuous. Verify the lengths in the field before impregnating the tube with resin to ensure that the tube is long enough to extend the entire length of run after curing is complete.

The liner tube must be homogeneous across the entire wall thickness, either white, light green, blue, or light red (vitrified clay color) in color, free of cracks, holes, foreign materials, blisters, and other faults. The physical properties of the cured liner must meet the minimum chemical resistance requirements of *ASTM F1216*, *ASTM F1743*, and *ASTM F2019* as applicable and conform to the minimum structural properties listed in Table 400-2.

Table 400-2: CIPP Liner Tube Properties

Property	ASTM Test Method	Polyester, Epoxy, or Vinyl Ester Resin
Tensile Strength, psi	D638	4,000
Flexural Strength, psi	D790	4,500
Flexural Modulus of Elasticity (short-term), psi	D790	300,000
Flexural Modulus of Elasticity (long-term), psi	D790	150,000

After the curing of the liner tube is complete, the beginning and end of the new liner tube must protrude a minimum of $^1/_4$ inch and not more than $1\text{-}^1/_2$ inches into each manhole. Use a sealing material that is compatible with the liner tube to ensure a watertight seal. Place the sealing material along the entire circumference of the new liner tube on all surfaces in contact with the manhole channel, interior wall, and rehabilitated host pipe.

Manufacturer Marking

Mark the liner tube with the manufacturer stamp at regular intervals along its entire length.

Delivery and Storage

Properly ship, handle and store the CIPP liner tube to prevent damage in accordance with the manufacturer's recommendations. Damage includes but is not limited to gouging, abrasion, flattening, cutting, puncturing, or UV degradation.

Promptly remove all damaged materials rejected by SacSewer from the project site at no additional cost to SacSewer and dispose of them in accordance with the current applicable regulations.

400.4.5 SUBMITTALS

The contractor must submit the following:

- Documentation demonstrating compliance with specified experience requirements, in accordance with these Standards
- All product specifications and data sheets on the CIPP materials, including lining material and resins
- Documentation of the CIPP manufacturer's recommended storage procedures, resin application, curing process details, and cure schedules, including heat up, hold, and cool-down cycles, and temperature control for each diameter to be used and CIPP thickness
- Documentation describing safety systems associated with the proposed curing equipment and operational safety systems for use with the curing process
- Documentation describing methods, materials, equipment, and procedures employed to seal the annular space between the CIPP and the host pipeline at manholes and at all reinstated lateral connections, if applicable
- Documentation describing methods, equipment, and materials used to reinstate lateral connections
- Literature and background information on the third-party testing laboratory proposed for testing the physical properties of the CIPP
- Certification from the CIPP manufacturer that the resin, catalyst, and tube material comply with the required application, meet the intended service conditions and comply with the physical requirements.
- The manufacturer's certification that the CIPP material is manufactured, sampled, tested, and inspected in accordance with *ASTM F1216*, *ASTM F1743*, and *ASTM F2019* as applicable. Include the manufacturing date of the lining materials in the certification.

- Verification of product conformance by third-party testing for the chemical resistance and physical testing requirements, along with a report of test results
- For each diameter and thickness to be installed on the project, provide the volume of resin required per unit length to fill the volume of air voids in the tube plus the additional allowance for polymerization shrinkage and to meeting the finished liner strength requirements.
- After each impregnation of a tube for an installation, submit a process record that verifies that the resin impregnation yield matches the required quantity for the diameters and thickness.
- A scaled drawing showing field wet-out operations, including tent location, equipment for cooling or heating, roller beds, lifting equipment, mixing equipment, quantity control equipment, and other equipment required for proper liner impregnation and verification of the product
- Documentation of the design calculations. Design calculations must be checked and approved by a Registered Civil Engineer in the State of California. Liner design calculations must be supported by a field analysis, technical assumptions, requirements of these Standards, and the requirements of *ASTM F1216* and *ASTM F2019* as applicable.

400.4.6 EXECUTION OF WORK

The contractor must follow all CIPP manufacturers and installation equipment recommendations. If these Standards conflict with the manufacturer's recommendations, notify SacSewer immediately in writing. Do not proceed with the work in areas of the discrepancy until all conflicts have been resolved. All work must be supervised by personnel experienced in liner installation.

The contractor must verify and certify that the pipeline to be lined is suitable for rehabilitation by the CIPP method. All lining work performed by the contractor after the pre-installation TVI is considered the contractor's certification that the method is applicable and that the pipeline is suitable for lining.

The contractor will determine if spot repairs are required for proper installation of the liner as required by the lining manufacturer prior to wet-out. The contractor will provide written notification for all repairs requiring excavation prior to construction activities.

Liner Tube Installation

Install the liner tube in accordance with the manufacturer's instructions and recommendations. Do not damage the impregnated liner tube while inserting the tube into the rehabilitated pipeline. Pull in or invert the liner tube through a manhole or approved

access point and fully extend it to the next designated manhole or approved access point in one uniform piece.

Resin Impregnation

Use enough resin to permeate the liner tube and fill the volume of air voids in accordance with the manufacturer's specifications.

Ensure that the liner tube is fully saturated with resin by vacuum or other means before installation.

Curing

The contractor will provide a heating source that is capable of raising the temperature above the manufacturer's recommendation based on the resin-catalyst system employed for curing.

The contractor will place a temperature gauge between the tube and the host pipe's invert within 5 feet from the termination to monitor the temperatures during the curing process.

The contractor will allow a cool-down period that is in accordance with the manufacturer's specifications prior to returning flow back into the system.

Curing with Hot Water or Steam

The contractor must ensure that the heat source piping is fitted with suitable monitors to gauge the temperature of the incoming and outgoing hot water or steam.

The contractor will supply all distribution equipment necessary to uniformly cure the resin in accordance with the manufacturer's recommendations in order to meet the minimum design properties.

Curing with UV Light

The contractor must follow a step cure or similar approach recommended by the manufacturer.

Nothing contained in these Standards relieves the contractor from completing the rehabilitation of a pipeline by the CIPP method in the most feasible, efficient, highest quality, and safe manner, using the required materials installed in accordance with the manufacturer's instructions and to the requirements of this specification.

400.4.7 REINSTATEMENT OF LOWER LATERALS

The contractor must use robotic cutting equipment to reinstate all existing lateral connections. Reinstatement by open-cut excavation is not allowed without SacSewer's approval.

400.4.8 INSPECTION AND TESTING

SacSewer will assess all liners based on the guidelines shown in Table 400-3. SacSewer's representative's assessment and remedy are final. All repairs must meet the original specifications for the finished liner and be performed by the contractor at no additional cost.

Table 400-3: CIPP Defects and Remedies

Defect	Host Pipe Diameter (in)	Tolerance	Remedy
Wrinkles, fins, or folds along the top of CIPP from the 10 to 2 clock position	≤ 8	Repair if exceeding $^1/_2$"	Trim CIPP flush with liner wall
	> 8	Repair if exceeding 5% of host pipeline diameter	
Wrinkles, fins, or folds along the bottom of CIPP from the 2 to 10 clock position	≤ 8	Repair if exceeding $^3/_8$"	Trim CIPP flush with liner wall
	> 8	Repair if exceeding 3% of host pipeline diameter	
Bubbles, blisters, dimples, lumps, lifts, or foreign inclusions along the top of CIPP from the 10 to 2 clock position	≤ 8	Repair if exceeding $^1/_2$"	Trim CIPP flush with liner wall and patch with epoxy
	> 8	Repair if exceeding 5% of host pipeline diameter	
Bubbles, blisters, dimples, lumps, lifts, or foreign inclusions along the bottom of CIPP from the 2 to 10 clock position	≤ 8	Repair if exceeding $^3/_8$"	Trim CIPP flush with liner wall and patch with epoxy
	> 8	Repair if exceeding 3% of host pipeline diameter	
Cracked, delaminated, dry spots, burst or collapsed CIPP	All pipeline sizes	Repair all	Remove and patch with epoxy

Submit a remedial repair and replacement action plan to SacSewer for review and approval for any defects prior to any corrective action.

For each installation, obtain one sample from the cured liner, adequate for three tests, at an intermediate manhole or at the termination manhole that has been installed through a like diameter pipe that has been held in place by a suitable head sink, such as sandbags. SacSewer will designate manhole locations for samples. All materials testing will be performed, at the contractor's expense, by an independent third-party laboratory

recommended by the manufacturer and approved by SacSewer. The testing must be in accordance with applicable *ASTM F1216*.

The contractor must submit the test results, including verification of chemical resistance and physical testing requirements, along with a written report from the third-party testing laboratory.

Submit the volume of resin required per unit length (gal per foot or liters per meter) to fill the volume of air voids in the tube, plus the additional allowance for polymerization shrinkage required to meet the finished CIPP strength requirements for each pipeline diameter to be lined.

Submit a process record verifying that the resin impregnation yield matches the manufacturer's required quantity for the specific diameter and thickness within seven calendar days of installation after the impregnation of a tube.

Submit documentation describing the grout or epoxy to be used for the reinstatement of lateral connections after CIPP installation.

If any properties tested, do not meet all minimum requirements specified, remove and replace the liner, and re-test it at no additional cost to SacSewer.

400.4.9 MEASUREMENT AND PAYMENT

If the liner fails to reform or cure, the contractor is required to remove the failed liner at no additional cost. SacSewer will not pay for the liner until the installed liner samples meet the required physical properties.

Pipe lining is paid per lineal foot based on pipe diameter, in accordance with the unit prices contained in the Contract Documents. Measurement is made from one sealed end of the CIPP installation to the other.

Payment includes all the following items:

- All bypass pumping and diversion
- Cleaning, removal of any debris, and pre- and post-construction TVI
- Labor, equipment, material, and installation
- Testing
- Site restoration

- All other work specified or not which is reasonably required to provide a completed installation

SacSewer considers any item not specified to be incidental to the work and includes it in the unit price for the work.

400.5 INDIVIDUAL JOINT TESTING

Test each joint indicated in the project-specific plans by isolating the area to be tested within the testing device and applying positive pressure into the joint and void area created by the test device. The contractor will then introduce pressurized air into the isolated void created by the testing device. Apply pressure until it is determined that the pressure cannot be built in the void or until the test pressure of $^1/_2$ psi per foot of depth plus 4 psi to a maximum of 10 psi is reached as recorded by the void pressure monitor. The contractor will shut off the air supply when either of these conditions is reached.

The joint fails the test if the required pressure cannot be achieved. If the required test pressure in the void was increased to 1.2 psi per foot of depth plus 4 psi, rate of decay of this pressure must not exceed 1 psi in 30 seconds. The joint will also fail if the pressure drops more than 1 psi in 30 seconds. Seal the joint if it fails testing.

400.6 PIPE BURSTING

Pipe bursting is a trenchless method for replacing an existing pipeline. This method uses either a static or pneumatic bursting head to slipstream the existing pipeline while simultaneously installing a new pipe . Reconnecting the existing lower laterals is required to complete the installation. Pipe bursting uses the existing pipe grade and alignment for control. Polyethylene pipe is the preferred material for pipe bursting installations; other materials may be allowed if approved by SacSewer. This method is best suited for replacing pipes made of brittle materials such as VCP, non-reinforced concrete, asbestos cement, and cast iron pipe.

Design pipe bursting based on the Southern California APWA and the AGC of California *Standard Specification for Public Works Construction* and *Synthesis of Highway Practice 242* (latest edition). This specification covers the rehabilitation of existing pipelines using the static pipe bursting method.

400.6.1 PREVIOUS EXPERIENCE

The contractor must be trained by the particular pipe bursting system manufacturer and experienced in its use.

Polyethylene pipe jointing must be performed by personnel trained in the use of butt-fusion equipment and recommended methods for new pipe connections. Personnel directly involved with installing the new pipe must receive training in the proper methods for handling and installing the polyethylene pipe. Qualified representatives must also perform training.

400.6.2 PRODUCT

Transport, handle, and store pipe and fittings as recommended by manufacturer.

If new pipe and fittings become damaged before or during installation, repair as recommended by the manufacturer or replace as required by SacSewer at the contractor's expense before proceeding further.

Deliver, store and handle other materials as required to prevent damage.

Use HDPE that meets the applicable requirements of *ASTM F714*. The pipe must be homogenous throughout and free of visible cracks, holes, foreign materials, blisters, or other deleterious faults. The minimum wall thickness of the polyethylene pipe for pipe bursting installations is SDR 17. Use white, black, or a light reflective pipe color to allow better viewing for TVI.

400.6.3 EQUIPMENT

The pipe bursting tool is designed and manufactured to force its way through existing pipeline materials by fragmenting the pipeline and compressing the old pipe sections into the surrounding soil as it progresses. The bursting unit must generate sufficient force to burst and compact the existing pipeline.

Pull the pipe bursting tool through the pipeline by a pulling unit located at the receiving excavation or manhole. The bursting unit pulls the polyethylene pipe with it as it moves forward. The pipe bursting unit is remotely controlled. At no time will personnel be allowed in excavations during pipe bursting operations.

The bursting action of the tool must increase the external dimensions according to the manufacturer's recommendations.

Static Bursting

Equip the pulling unit with a cable gripping system that does not leave indentations in the pulling cable. Pulling units that pull chains are not allowed. Equip the pulling unit with a

single hydraulic cylinder that actuates the pulling grip. Pulling units with more than one hydraulic cylinder are not allowed.

Pneumatic Bursting

Attach a winch to the front of the bursting unit, connecting to or through the advanced guide head technology. The winch must provide a constant tension to the burster to operate in an efficient manner. The winch must have a twin capstan with twin hydraulic drive motors and twin gearboxes for independent operations. Use a constant tension type winch fitted with a direct reading load gauge to measure the winching load. The winch must automatically maintain a constant tension at a set tonnage reading.

The winch, cable, and cable drum must be provided with a safety cage and supports so that it may be operated safely without injury to persons or property.

400.6.4 EXECUTION OF WORK

The contractor will conduct pipeline locations on all utility lines to ensure no damage results to the utilities during pipe bursting. The contractor will pothole to verify all utilities within 2 feet of the proposed pipe bursting operation.

To minimize the noise impact, locate equipment used to perform the work away from buildings. Provide a silent engine compartment with the winch to reduce machine noise as required to meet jurisdictional agency requirements.

Place launching and receiving pits at each end of the pipeline to be replaced. Other excavations may be necessary to accommodate changes of direction in the lateral service or to expose other utilities that may be near the pipe bursting operation.

After completion of pipe bursting installation, backfill and compact all excavation, and restore all surfaces.

Assemble and joint the polyethylene pipe at the site using the butt-fusion method to provide a leak-proof joint. Threaded or solvent-cement joints and connections are not permitted.

The butt-fusion joint must be in true alignment and have uniform roll-back beads resulting from the use of proper temperature and pressure. The joint must be allowed adequate cooling time before the removal of pressure. The fused joint must be watertight and have tensile strength equal to that of the pipe.

Reinstatement of Lower Laterals

Lower laterals must be connected to the new pipe by various methods:

- Connection types: Electrofusion or PVC saddle
- Access pits (typical) pipe entrance and equipment termination pit. Pit size 3-foot by 4-foot to invert depth

Inspection and Testing

All pipe connections must be inspected prior to backfilling and resurfacing.

All joints are subject to SacSewer's acceptance prior to insertion. Cut out and replace all defective joints at no cost to SacSewer.

Sections of the pipeline with gashes, blisters, abrasions, nicks, scars, or other deleterious faults greater in-depth than 10% of the wall thickness must not be used and must be removed from the site. A defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. In addition, any section of the pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness, or any other defect of manufacturing or handling as determined by SacSewer must be discarded and not used.

Tests for compliance with this specification will be made in accordance with the applicable ASTM specifications. Defects that affect the integrity or strength of the pipe, in SacSewer's opinion, must be repaired or the pipe replaced at the contractor's expense.

400.6.5 MEASUREMENT AND PAYMENT

The contractor will receive payment for this work on a unit price per vertical linear foot based on completed installation per structure diameter.

Payment includes all the following items:

- All flow control
- Safety
- Cleaning and surface preparation
- Pre- and post-construction inspection and photography
- Labor, equipment, material, and installation
- Testing

- Site restoration
- All other work specified or not which is reasonably required to complete installation.

SacSewer considers any item not specified to be incidental to the work and included in the unit price for the work.

400.7 PUSH BURSTING

This section specifies the equipment and method type approved by SacSewer when applying the push bursting method employed by the Tenbusch TIM system.

400.7.1 CERTIFICATION

The licensee must be certified by Tenbusch as a licensed installer of Tenbusch systems.

Personnel directly involved with installing the pipe must receive training in the proper methods for handling and installing the VCP. Training must be performed by a qualified representative of the manufacturer or other qualified representative approved by SacSewer.

400.7.2 PRODUCT

The replacement pipe must be manufactured of vitrified clay according to *ASTM C1208* and *British Standards Institution EN 295-7.*

400.7.3 SUBMITTALS

In detail, the contractor must submit information on the procedure and the steps to be followed for the installation of the push bursting method selected, even if the process is named in the Contract Documents. All proposed changes in the installation procedures require the submittal of revised procedures and acceptance by SacSewer. Under no circumstances will the contractor use pneumatically operated equipment. If the contractor uses vibratory equipment in any pit or shaft, the contractor must provide SacSewer with data measuring vibrations from any such vibratory equipment during installation.

If such vibratory equipment is used, the contractor is fully responsible for all damage that results to existing infrastructure.

400.7.4 SCOPE OF WORK

If pre-installation video inspection reveals a sag in the existing pipeline that is greater than what is acceptable in accordance with Section 331, "Television Inspection" of these Standards, it is the contractor's responsibility to install the replacement pipe to result in an acceptable grade without the sag. The contractor must take necessary measures to eliminate those sags, as directed by SacSewer. Pipeline replacement, digging a sag elimination pit, and bringing the bottom of the pipe trench to a uniform grade in line with the existing pipeline invert must be acceptable to SacSewer.

The replacement pipe must be installed with a tight-fitting seal with the existing or new manhole. A Fernco CMA waterstop gasket or approved equal must be placed circumferentially on the replacement pipe and encased with a flexible nonshrink grout per Section 308.30, "Nonshrink Grout" of these Standards to prevent inflow at the manhole and maintain flexibility of the new pipe at the entrance to the manhole. The top half of the pipe within the manhole must be neatly cut off (not broken or sheared off) at least 4 inches away from the manhole walls. The channel in the manhole must be a smooth continuation of the pipe(s) and be merged with other pipelines or channels.

Before insertion of the new pipe and to prevent damage to the existing manhole structure, the entry point of the new pipe into the manhole must be increased to allow for the new pipe and the expanding head to enter the manhole without damage. Reinstate the manhole to a condition equal to or better than before the modifications.

Existing lower laterals must be located before initiating work. Lower laterals will not be reconnected until replacement and testing are completed. Connection of the lower lateral to the new main line will be accomplished by use of an epoxy-attached saddle on a drilled hole or by cutting and removing a section of the main line, followed by inserting a wye with approved couplings on each end.

400.7.5 INSPECTION

All work will be inspected by SacSewer and requires a TVI.

400.7.6 TESTING

Testing is required after the replacement pipe has been installed. The test must be in accordance with *ASTM C828*. The test of the replacement pipe must be made before it has been sealed in place at the manhole and before any service reconnections have been made. This test checks the integrity of the joints that have been made and verifies that the replacement pipe has not been damaged.

400.7.7 Measurement and Payment

The contractor will receive payment for this work on a unit price per vertical foot based on completed installation per structure diameter.

Payment includes all the following items:

- All flow control
- Safety
- Cleaning and surface preparation
- Pre- and post-construction inspection and photography
- Labor, equipment, material, and installation
- Testing
- Site restoration
- All other work specified or not which is reasonably required to complete installation

SacSewer considers any item not specified to be incidental to the work and included in the unit price for the work.

400.8 Chemical Grouting

For chemical grouting, refer to project specific plans and specifications.

400.9 Sliplining

This section provides for the rehabilitation of pipelines 24 inches in diameter and greater via the installation of fiberglass, HDPE, or PVC sliplining pipe. When completed, the liner pipe must extend from one manhole to the next manhole in a continuous, watertight length.

400.9.1 Design

Sliplining pipe provided under this Specification must provide the maximum conveyance capacity possible and in no case provide less capacity than what currently exists.

Calculate and provide liner structural properties to SacSewer prior to construction based on the following:

- Consider all existing pipelines
- Locate the water table

- Assume 5% ovality for the new pipe and 5% deflection at the end of the installation
- Use a safety factor of 2 for bending and wall crush, and 2.5 for buckling
- State the modulus of soil reaction and the soil weight

400.9.2 MATERIALS

Use centrifugally cast Fiberglass pipe with glass fiber reinforcement in a cured thermosetting resin manufactured in accordance with *ASTM C2310* cell classification Type 1, Liner, Grade 3. Pipe stiffness must be a minimum of 46 psi. Testing must show the fiberglass pipeline to be resistant to long-term corrosion. Perform testing in accordance with *ASTM D3681* using 1.0N sulfuric acid for residential and commercial sewage and *ASTM C581* for industrial sewage.

PVC must have a minimum cell classification of 12364 B or C as defined in *ASTM D1784*. Use a closed profile pipe in accordance with *ASTM F1803* with a tongue and groove gasketed joint. The joint cannot allow the outside diameter of the pipe to be increased or allow the internal diameter of the pipe to be decreased at the joint. The joint must meet the requirements of *ASTM D3212*. PVC liner pipe must have a minimum pipe stiffness of 46 psi when tested in accordance with *ASTM D2412*. Gaskets must meet the requirements of *ASTM F477*.

Polyethylene pipe and fittings must be manufactured from high-density compounds in accordance with *ASTM D3350*. All HDPE pipes must be closed profile and have a minimum SDR rating of 32.5 and a minimum pipe stiffness of 46 psi.

All pipe joints must not allow the outside diameter of the pipe to be increased or the internal diameter of the pipe to be decreased at the joint.

Cellular concrete grout provided under this specification for annular space must meet the manufacturer's recommendations.

400.9.3 SUBMITTALS

The contractor must submit the manufacturer's literature for materials used in the liner, including all the following information:

- Gaskets and fittings
- Proposed grout mixture and pressures
- Test results and certification of compliance for materials
- Manufacturer's design analysis

- Proposed installation method, equipment, and location of access shaft, pit or approach tunnel

400.9.4 EXECUTION OF WORK

The contractor must inspect the interior of the pipeline to determine the location of any conditions which may prevent the proper installation of the liner into the pipelines.

The contractor must locate excavation(s) for insertion of slip liner to cause the least disruption to existing utilities, traffic, and area business. Expose the existing pipeline from crown to spring line for the length necessary to accommodate the maximum length of liner pipe plus an auxiliary pushing or pulling length for equipment. The contractor must carefully remove the upper half of the existing pipeline necessary for installation of the liner. Do not disturb the lower half of the existing pipeline. If the contractor locates an insertion pit and an existing manhole location, the contractor will remove the manhole, frame, cover cone, riser, and manhole sections as necessary and store them for reinstallation on completion.

Sections of the liner must be field connected in the insertion point using low profile bell and spigot joints, butt-fused joints, screw-type joints, or jacking pipe sleeve joints. Equip bell and spigot and jacking pipe sleeve joints with an elastomeric gasket meeting the requirements of *ASTM F477* to provide a watertight seal at each joint. The maximum allowable deflection is 2 degrees. The contractor must take precautions to prevent ragged edges of broken pipelines from scoring slip liner as it is being pushed or pulled into the pipeline.

The contractor must seal the annular space between the slip liner and the existing pipeline with cellular concrete as specified by the manufacturer. The contractor must take appropriate precautions to avoid over-pressuring, buckling, and floating the slip liner during the grouting process. The contractor must comply with the manufacturer's recommendations for grouting procedures for placement of grout, grout pressures, and grout quantity. Multiple grout lift installations may be required to avoid buckling of the liner pipe. The contractor must also take precautions to avoid the movement of the liner during the grouting process. Do not place grout until lower lateral connections have been reinstated.

Prior to the installation of the liner, the contractor must install gasket waterstops to the interior circumference of the pipe at the inlet and outlet of each manhole. The waterstop material must be a "Duraseal," Type W modified vinyl copolymer gasket or an approved equal.

The contractor must cut the upper half of the liner out at manholes, as required to accommodate lower lateral connections at manholes.

Where existing manhole locations have been used as access pit sites, the contractor must reconstruct manholes using salvaged materials. If existing manhole materials are not suitable for salvage, the contractor must reconstruct the manhole utilizing new manhole elements. All construction must comply with these Standards.

400.9.5 Inspection and Testing

The contractor must employ an independent testing agency to conduct and report compressive strength testing of the grout used in the construction. The contractor must prepare and submit for testing four cellular concrete cylinders from each day's grouting activities. Test at one and 28 days. Submit all test results to SacSewer.

400.9.6 Measurement and Payment

The contractor will receive payment for this work on a per linear foot per pipe diameter in accordance with the unit prices contained in the proposal. Measurement is made from the entrance to the inlet pipe of the upstream manhole to the discharge end of the pipe on the downstream manhole of the pipeline receiving chemical grouting.

Payment includes all the following items:

- All bypass pumping
- Cleaning
- TVI
- Labor, equipment, material, and installation
- Safety
- Dust and erosion control
- Testing
- Site restoration
- All other work specified which is reasonably required to provide a completed installation

SacSewer considers any item not specified to be incidental to the work and included in the unit price for the work.

401 CONCRETE STRUCTURES

401.1 GENERAL

401.1.1 ACCESS

Secure safe access to the structure using appropriate traffic control devices. Check within the structure and associated pipelines for hazardous gases. Install a positive flow ventilation system to ventilate the structure during construction.

401.1.2 DEBRIS

Debris is not allowed to enter the collection system.

401.1.3 FRAMES AND COVERS

Existing frames and covers which must be removed to facilitate replacement must be salvaged by the contractor for replacement by the contractor unless determined to be defective by SacSewer. Where existing frames and covers have been determined to be defective by SacSewer, the contractor must replace them with new frames and covers. Supply and install replacement frames and covers in accordance with these Standards.

401.2 PATCHING

The contractor must patch structure walls and benches in areas where directed by SacSewer. Items to be grouted could include large voids, cracks in the structure walls, or slabs on grade.

Evaluate the area to be repaired to determine whether the concrete repair should be made with concrete, mortar (dry pack), epoxy, nonshrink grout, shotcrete, or topped with an overlay.

To grout channels in the manhole bases, use nonshrink grout material per Section 308.30, “Nonshrink Grout,” of these Standards.

401.2.1 SUBMITTALS

The contractor must submit the product data to use the product, including all the following items:

- Storage and handling requirements
- Surface preparation and installation requirements
- Product manufacturer information, including contact information

- All safety data sheets (formerly known as material safety data sheets or SDS)
- Cleanup requirements
- Setup and curing requirements

401.2.2 EXECUTION OF WORK

Unsuitable concrete (cracked or disintegrated material) must be chipped away to a minimum of 1 inch to expose sound and clean concrete. Areas to receive the patch must be roughed with a nonmechanical device such as a steel wire brush. Clean the patched surface of all loose or foreign material that would in any way prevent a bond between the patching material and the concrete surface. Flush the patched areas with water to remove all deleterious materials and allow them to dry to a surface dry condition.

Concrete

Square all sides; forming may be required. Concrete for the repair must be similar to the original in cement-water ratio and aggregate size.

Patch voids with concrete with a minimum compressive strength of 4,000 psi at 28 days (*ASTM C109*), gaining 85% of its compressive strength within seven days.

Mortar (Dry Pack)

This method is suitable for snap-tie holes, spalls, and cavities (rock pockets) with a relatively high ratio of depth to width. Coat surface with epoxy compound or acrylic bonding compound and allow to dry until tacky to the touch. Mix mortar composed of Portland cement, sand, and water. The proportion of cement to sand, by volume, must be no more than 1:2. Add only enough water to permit placing and packing. The mortar must be rammed into place in thin layers and leveled to the plane of the surrounding concrete. Cure with liquid-membrane cure, wet burlap, or water. Fast-setting, cementitious, pre-mixed packing materials may be used when approved by SacSewer and must be applied in accordance with the manufacturer's instructions.

Patch voids with a high early strength cementitious patching mortar, such as Strong-Seal QSR, Parson RPM, or equivalent, with all the following characteristics:

- Designed for patching openings in horizontal, vertical, and overhead concrete and masonry surfaces
- Maximum initial set time of 60 minutes at 70 degrees Fahrenheit

- Minimum compressive strength of 4,000 psi at 28 days (*ASTM C109*), gaining 85% of its compressive strength within seven days
- Shear bond to the concrete of 145 psi at 28 days
- No expansion after a minimum of 300 freeze-thaw cycles

401.2.3 SHOTCRETE

Shotcrete is suitable for repairs to overhead or vertical surfaces and must be placed according to *ACI 506R*.

401.2.4 NONSHRINK GROUT

Use nonshrink grout in accordance with Section 308.30, "Nonshrink Grout," of these Standards.

401.2.5 TOPPING

Topping may be placed on a pre-existing base slab with or without surface hardener. Prior to placing, the entire area to be topped must be cleaned and free of all loose and unsound materials by abrasive blasting or machine scarifying, and clean aggregate exposed. The cleaned base must be kept wet for a period of 24 hours prior to the application of topping. Remove excess water and apply a neat cement bonding grout. It must be of equal parts cement and sand and enough water to make a creamy mixture. Do not allow the cement bonding grout to dry or set before placing the topping. Bonding agents other than cement grout may be used with prior SacSewer's approval. The contractor must check for trueness of the surface with a 12-foot straightedge when required by SacSewer. Apply a surface hardener according to the manufacturer's instructions when specified. Trowel or broom finish as specified in the contract documents.

401.3 LEAK CORRECTION

To stop all visible points of leakage into or out of the structure, use a rapid setting hydraulic cement-based product that has all the following minimum characteristics:

- Designed to stop leakage of water under pressure and slow seepage of water through openings in concrete and masonry surfaces
- Maximum initial set time of 2 minutes at 70 degrees Fahrenheit
- Minimum compressive strength of 4,000 psi at 28 days (*ASTM C109*)
- 0% length change at seven days (*ASTM C157*)

The product must be applied in accordance with the manufacturer's specifications.

401.3.1 SUBMITTALS

The contractor must submit the product data to use the product, including all the following information:

- Storage and handling requirements
- Surface preparation and installation requirements
- Product manufacturer information, including contact information
- All SDS sheets
- Cleanup requirements
- Setup and curing requirements

401.4 REPLACEMENT

This section provides for the reconstruction of the upper portion of structures that have incurred significant deterioration or offset (greater than 6 inches) in the frame, ring, barrel, cone, or other portions of the structure such that internal rehabilitation methods are insufficient to restore the structure. Replacement of the entire structure must be in accordance with these Standards.

401.4.1 EXECUTION OF WORK

The contractor must excavate and remove the existing rings where replacement is designated. The contractor must thoroughly clean the concrete cone or top slab with a whisk broom, wire brush, chisel, or other methods to ensure a flat seating surface free of rocks, gravel, asphalt, and protruding concrete, dirt, and other material and debris.

Do not use brick or block in the construction of a manhole or to adjust the elevation of the frame and cover.

The contractor must replace existing, deteriorated rings in accordance with these Standards.

401.4.2 INSPECTION

SacSewer must visually inspect all work prior to backfilling and at the time of final inspection. The contractor must repair all defects at no additional cost to SacSewer.

401.4.3 MEASUREMENT AND PAYMENT

Payment for reconstruction is to be made on a per vertical foot basis.

401.5 CURED-IN-PLACE FIBERGLASS INSERT LINER

Cured-in-place fiberglass insert liners consist of multiple structural fiberglass layers with a non-porous membrane bonded between layers of fiberglass, with a minimum fabric weight of 56 ounces per square yard, saturated with 100% solids epoxy, cured-in-place, and bonded to the existing structure. The liner must be a vinyl ester liner.

401.5.1 PRODUCT

The fiberglass insert liner must have the minimum requirements shown in Table 401-1.

Table 401-1: Chemical Resistance Requirements

Property	Minimum Requirement
Flexural Strength	24.8 kpsi
Flexural Modulus	9.41 Mpsi
Compressive Strength	11.5 kpsi
Compressive Modulus	11.11 Mpsi
Tensile Strength	9.8 kpsi
Tensile Modulus	9.52 Mpsi
% Elongation at Maximum Load	1.54%
Minimum Thickness	0.16 inches

After seven days, the liner must have the following minimum requirements: hardness, Shore D of 80, and ultimate elongation of 6%.

The corrosion resistance of the resin system must be tested by the resin manufacturer in accordance with ASTM Standards. The result of exposure to the chemical solutions listed below must produce a loss of not more than 20% of the initial physical properties when tested in accordance with ASTM Standards for a period of not less than one year at a temperature of 73.4 degrees Fahrenheit plus or minus 3.6 degrees Fahrenheit. Please refer to Table 401-2.

Table 401-2: Chemical Resistance Requirements

Chemical Solution	Concentration, %
Tap Water (pH 6-9)	100
Nitric Acid	5
Phosphoric Acid	10
Sulfuric Acid	25
Petroleum Hydrocarbon-Based Fuels	100
Vegetable Oil	100
Detergent	0.1
Soap	0.1
Domestic Sewage	100

401.5.2 SUBMITTALS

The contractor must submit the product data, including all the following information:

- Storage and handling requirements
- Surface preparation and installation requirements
- Product manufacturer information, including contact information
- All SDS sheets
- Cleanup requirements
- Setup and curing requirements

401.5.3 EXECUTION OF WORK

The contractor must remove all foreign materials and matter from the interior of the structure. Cleaning, surface preparation, and material removal activities must be accomplished in strict accordance with the written instruction of the manufacturer of the product. Unless otherwise specified by the manufacturer, cleaning must be accomplished by abrasive methods. Once the surface is prepared and prior to the application of the patching and lining materials, the contractor must stop all visible points of infiltration by applying a rapid setting hydraulic cement-based product as specified in Section 401.3, "Leak Correction" of these Standards. This product must be applied in strict accordance with the manufacturer's specifications.

The contractor must install the approved liner system in strict accordance with the manufacturer's application instructions.

401.5.4 Inspection and Testing

SacSewer will visually inspect all work before application of the liner and at the time of final inspection. The contractor will repair all defects at no additional cost to SacSewer.

The contractor must employ an independent testing company. Conduct a visual inspection of the completed work before completing and curing the lining.

401.5.5 Measurement and Payment

The contractor will receive payment for this work per vertical foot based on the completed installation of the liner per structure diameter.

Payment includes all the following items:

- All flow control
- Safety
- Cleaning and surface preparation
- Pre- and post-construction inspection and photography
- Labor, equipment, material, and installation
- Testing
- Site restoration
- All other work specified or not which is reasonably required to complete installation.

SacSewer considers any item not specified to be incidental to the work and included in the unit price for the work.

401.6 Epoxy Lining

This section provides for installing an epoxy liner to rehabilitate existing structures. This method is generally used for rehabilitation of structures suffering from excessive corrosion damage, permitting infiltration or exfiltration and structural deterioration.

401.6.1 Minimum Qualifications

The contractor must provide SacSewer with a certification from the lining material manufacturer that the contractor's personnel have been trained in the application of the manufacturer's product. Such certification describes the manufacturer's training program

and, if applicable, licensing policies and procedures for installers. The manufacturer must have a minimum of five years of experience manufacturing products for rehabilitation structures. The contractor must have a minimum of two years of experience or three projects applying the manufacturer's product. All materials must comply with Sacramento Metropolitan Air Quality Management District requirements and restrictions.

401.6.2 PRODUCT

High strength epoxy lining system such as Raven 405 or Neopoxy 5300 series with all the following minimum characteristics:

- 100% solids with 0% volatile organic compounds
- 6,000 psi minimum compressive strength
- 6,000 psi minimum tensile strength
- 1.5% minimum elongation
- 4,000 psi minimum flexural strength
- 80 minimum hardness
- Bond to failure of substrate

The contractor must keep materials dry, protected from weather, and stored under cover until used for application.

401.6.3 SUBMITTALS

The contractor must submit the product data for the epoxy lining product, including all the following information:

- Storage and handling requirements
- Surface preparation and installation requirements
- Product manufacturer information, including contact information
- All SDS sheets
- Clean up requirements
- Setup and curing requirements

401.6.4 Execution of Work

The contractor must remove all foreign materials and matter from the interior of the structure. Cleaning, surface preparation, and material removal activities must be accomplished in strict accordance with the written instruction of the manufacturer of the product. Unless otherwise specified by the epoxy manufacturer, cleaning must be accomplished by abrasive methods. Once the surface is prepared and prior to the application of the patching and lining materials, the contractor must stop all visible points of infiltration by applying a rapid setting hydraulic cement-based product as specified in Section 401.3, "Leak Correction" of these Standards. This product must be applied in strict accordance with the manufacturer's specifications.

The contractor must apply a minimum 100 mil thickness, a monolithic, high-build epoxy liner to the interior surfaces of the structures with the minimum characteristics specified in the product section in accordance with the manufacturer's application instructions.

401.6.5 Inspection and Testing

SacSewer must visually inspect all work prior to the application of the liner and at the time of final inspection. The contractor must repair all defects at no additional cost to SacSewer.

The contractor must employ an independent testing company to measure the applied thickness of the epoxy lining material during and immediately following the application process utilizing either a wet or dry film thickness gauge. Upon completion of curing, a visual inspection of the completed work must be conducted and additional gauge measurements taken as deemed necessary.

401.6.6 Measurement and Payment

The contractor will receive payment for this work on a unit price per vertical foot based on the completed installation of the liner per structure diameter.

Payment includes all the following items:

- All flow control
- Safety
- Cleaning and surface preparation
- Pre- and post-construction inspection and photography
- Labor, equipment, material, and installation
- Testing

- Site restoration
- All other work specified or not which is reasonably required to complete installation

SacSewer considers any item not specified to be incidental to the work and included in the unit price for the work.

401.7 POLYVINYL CHLORIDE LINING

This section provides for rehabilitation of existing structures by installing a PVC liner. This method is generally used for rehabilitation of structures suffering from excessive corrosion damage permitting infiltration or exfiltration and structural deterioration.

401.7.1 MINIMUM QUALIFICATIONS

The contractor must provide SacSewer with a certification from the lining material manufacturer that the contractor's personnel have been trained in the application of the manufacturer's product. Such certification describes the manufacturer's training program and, if applicable, licensing policies and procedures for installers.

401.7.2 PRODUCT

Deliver all materials specified by name, brand, or manufacturer to the job site in original unopened containers with labels designating the project name and contract number, name of the manufacturer, product name, batch number, date of manufacture, and product preparation, the quantity of contents and storage life. Store materials as recommended by the manufacturer. Protect stored materials from excessive heat and cold. Do not use materials exceeding the storage life.

Materials for the protective lining system include a primer, two-component epoxy mastic, and extruded PVC liners with locking extensions by Ameron Protective Lining Products or approved equal.

The primer must be Arrow-Lock Mastic Primer No. 5101 or approved equal.

Mastic must be a two-component epoxy gel mastic and resistant to weathering, aging, dilute acids (10% sulfuric acid solution or acid conditions generating pH levels of 1.0), and dilute alkalis. The mastic must be Arrow-Lock Mastic No. 9912 or an approved equal.

The PVC liner must be a white homogenous thermoplastic sheet material with arrow-shaped locking extensions. The PVC liner must exhibit the minimum physical properties

when tested at 77 degrees Fahrenheit plus or minus 5 degrees Fahrenheit (25 degrees Celsius plus or minus 5 degrees Celsius) shown in Table 401-3.

Table 401-3: PVC Properties

Property	Specification	Minimum
Specific Gravity	ASTM D792	1.28
Hardness, Shore 0	ASTM D2240	50-60 @ 1 sec
Tensile	ASTM D412	2,200 psi
Elongation	ASTM D412	200%
Brittle Point	ASTM D746	5 degrees Fahrenheit
Thickness		65 mils

401.7.3 SUBMITTALS

The contractor must submit all the following information for approval:

- Confirmation of training by the manufacturer for each applicator installing the lining system
- A materials list for the lining system, including material safety data sheets
- Laboratory test data
- A complete description of the concrete surface preparation procedure, including equipment and setup
- A complete description of the lining system, including written instructions for application, inspection, and testing, and the size of the PVC liner sheets to be used

401.7.4 EXECUTION OF WORK

Thoroughly clean surfaces receiving the protective lining system by wash-down or water blast to remove grease, sludge, dirt, and other foreign deposits. This activity is followed by high-pressure water blasting (minimum 10,000 psi at a flow rate of not less than 5 gpm). Trap, collect, and dispose of all material removed during the surface preparation off-site; no material will be allowed to enter the collection system at any time. Wet or dry sandblasting may be used instead of high-pressure water blasting. If sandblasting is used, the contractor must submit information on the blasting materials and the method for collecting blasting materials to SacSewer for review and approval.

Remove concrete substrates with hydrogen sulfide damage to a depth where the entire white calcium sulfate is removed, and only hard grey concrete with a surface pH of 8.0 or greater remains. After the deteriorated concrete is removed, the contractor must

thoroughly clean the surface' including vacuuming and air drying, to remove all fines and deleterious materials that will adversely affect the bonding of the lining system.

If reinforcing steel is exposed, including those exposed after removing deteriorated concrete, it must be thoroughly cleaned by sandblasting to remove all contamination and rust particles. Immediately after the cleaned reinforcing steel is inspected and accepted by SacSewer, the contractor must place a protective coating on the exposed reinforcing steel. The protective coating used must be 40 mils of Sikatop 108 Armatec, Master Builders Emaco-P124, or approved equal. Where more than 50 % of the cross-sectional area of reinforcing steel is missing, the contractor must replace the reinforcing steel. Clean, sandblast and coat the replacement reinforcing steel as specified above.

Prior to installing the protective lining system, the contractor must rebuild the concrete surfaces to their original lines and shapes. All surface areas with depressions greater than 0.375 inches must be filled in with a polymer cement-patching compound. The polymer patching compound to be used must be compatible with the specified protective lining system and must be Sika Corporation, Sikatop 122 or 123; Master Builders, Master Emaco T240, or approved equal. The contractor must follow the instructions and recommendations of the patching compound manufacturer as to application, curing time requirements, depth of repair, and surface preparation procedures. The repaired concrete surface must generally have a finish that matches the uncorroded concrete surface. All repaired concrete surfaces receiving the protective lining system must have a light sweep sandblast to remove laitance from the repaired areas. Follow the sandblast operation with a thorough cleanup operation, including air drying and vacuuming to provide a clean, dry surface for the application of the protective lining system.

The contractor must not start the lining application until the surface pH, moisture content, and temperature are within the recommended limits and the prepared surfaces have been accepted by SacSewer.

The contractor must retain the services of a qualified and authorized technical representative of the lining manufacturer to provide field inspection and recommendations at the beginning of installation and to make periodic visits to ensure that the work, including the surface preparation, drying times, mixing, and application procedures are performed in accordance with the manufacturer's recommendations. All parts of the work must be made accessible to SacSewer for inspection. Conformance of the work to the specifications will be determined solely by SacSewer.

The primer must be rolled on or spray applied to the prepared concrete surface at a rate of 1 gallon of primer per 200 square feet of the surface. Allow the primer to cure for 20

minutes or until dry before applying the mastic. Apply the epoxy mastic by troweling to a minimum DFT of 250 mils.

The contractor must use the maximum size PVC liner sheet as practical to minimize the number of seams. Seams, both vertical and horizontal, must overlap a minimum of 0.5 inches and be welded with 1 inch wide weld strip. Corner strips may be used at the interior, and exterior corners or liner may be wrapped around corner and lapped on to adjacent sheet, and be welded with 1 inch wide weld strip. The existing PVC must be mechanically abraded and cleaned with "Formula 409" or a similar product, 1 inch beyond the weld area to ensure proper welding.

Properly align and install the liner sheets with the arrow ribs in the vertical direction to prevent moisture from accumulating behind the liner. Protect PVC liners from debris contamination prior to placing them onto the mastic. Place the PVC liner while the wetting ability of the base coat is at its optimum and press it into the mastic and roll it to remove trapped air and ensure the best possible embedment. The rolling process must occur immediately after the liner is placed. Keep the mastic surface and the PVC liner surface clean and free of dust and debris. The contractor must coordinate the application of the mastic and the placement of the PVC liner so that the mastic is still pliable when the sheet is rolled in place.

Installation of the lining system must generally conform to the details shown on the contract documents. Allow the lining system to cure for the amount of time recommended by the manufacturer. The minimum DFT of the cured lining system must not be less than 315 mils.

401.7.5 INSPECTION AND TESTING

SacSewer must visually inspect all work before the application of the liner and at the time of final inspection. The contractor must repair all defects at no additional cost to SacSewer.

In addition to periodic inspection by the manufacturer's representative, after installation of the protective lining system, clean and prepare the surface of the liner for visual inspection by SacSewer. In addition to the visual inspection, test the installation of the protective lining system in accordance with Section 311-1.10 of the *Standard Specification for Public Works Construction*. The testing must be performed by an independent testing laboratory hired by the contractor.

All surfaces of the liner will be visually inspected for areas that show poor embedment, edge and seam defects, and all other liner damage.

To ensure proper embedment of the PVC liner sheets to the mastic and the mastic to the prepared concrete surface, the protective lining system must have a "pull test" performed at a location designated by SacSewer and prepared by the contractor. The minimum pull strength test value must not be less than 16 pounds per linear inch after seven days of curing at a minimum ambient temperature of 55 degrees Fahrenheit.

401.7.6 Measurement and Payment

The contractor will receive payment for this work on a unit price per vertical foot based on the completed installation of the liner per structure diameter.

Payment includes all the following items:

- All flow control
- Safety
- Cleaning and surface preparation
- Pre- and post-construction inspection and photography
- Labor, equipment, material, and installation
- Testing
- Site restoration
- All other work specified or not that is reasonably required to complete installation

SacSewer considers any item not specified to be incidental to the work and included in the unit price for the work.

401.7.7 Cementitious Lining

This section provides for the rehabilitation of collection system structures by installing a cementitious liner. This method is generally used for rehabilitation of structures suffering from minor structural deterioration, infiltration, and exfiltration. If the structural integrity of the structure has been severely compromised, and in the opinion of the contractor has lost its structural integrity, in whole or in, part, the contractor must immediately notify SacSewer who will then assess the condition of the structure and provide written instruction to the contractor on how to proceed.

401.7.8 Minimum Qualifications

The contractor must provide to SacSewer certification from the lining material manufacturer that the contractor’s personnel have been trained in the application of the manufacturer’s product. Such certification must describe the manufacturer’s training program and, if applicable, licensing policies and procedures for installers.

401.7.9 SUBMITTALS

The contractor must submit the product data for the cementitious lining product, including all the following information:

- Storage and handling requirements
- Surface preparation and installation requirements
- Product manufacturer information, including contact information
- All SDS sheets
- Cleanup requirements
- Setup and curing requirements

401.7.10 PRODUCT

The liner product such as Master EMACO S 487SP by BASF or approved equal must have all the following minimum characteristics:

- Designed for application on horizontal, vertical, and overhead concrete and masonry surfaces
- Traffic bearing within 25 hours of application
- Water resistant or waterproof
- Minimum compressive strength of 4,000 psi at 28 days (*ASTM C109*)
- Minimum flexural strength of 600 psi at 28 days (*ASTM C78*)
- 0% length change (*ASTM C157*) and shrinkage at 90% relative humidity (*ASTM C596)*

Stored and maintain all products so as not to expose them to adverse conditions.

401.7.11 EXECUTION OF WORK

The contractor must remove all foreign materials and matter from the interior of the structure. Cleaning, surface preparation, and material removal activities must be accomplished in strict accordance with the written instruction of the manufacturer of the product. Once the surface is prepared and prior to the application of the patching and lining materials, the contractor must stop all visible points of infiltration by applying a rapid setting hydraulic cement-based product as discussed in the product section. This product must be applied in strict accordance with the manufacturer's specifications.

The contractor must patch structure walls in areas where large voids exist. The contractor must remove steps.

The contractor must apply a high-density cement-based coating to the interior surfaces of the structures with the minimum characteristics specified above in the product section.

Spray equipment must accurately ratio and apply the coating product(s) and be in working order. Prepared surfaces must be coated by spray application of the coating product(s) to a minimum wet film thickness of 125 mils. Termination points of the coating product(s) must be made at the manhole chimney joint, 1 inch below normal flow levels at the bench, and a minimum of 1 inch interfacing with each pipeline penetration.

401.7.12 Inspection and Testing

SacSewer must visually inspect all work before the application of the liner and at the time of final inspection. The contractor must repair all defects at no additional cost to SacSewer.

The contractor must employ an independent testing company to test the structure lining for acceptance by wet gauge. Tested structures must receive the minimum thickness as specified with an allowable variance of plus or minus 10% of the specified thickness. Multiple gauge readings in each randomly selected structure will be averaged. A minimum of 10% of the manholes coated must be tested for adhesion and bond of the coating to the structure. Testing must be conducted in accordance with *ASTM D4541* as specified in the plans. SacSewer's representative must select the structures to be tested. A minimum of three 20 mm dollies must be affixed to the coated structure. Failure of the dolly adhesive must be deemed a non-test and require retesting. Prior to performing the pull test, the coating must be scored within 30 mils of the substrate by mechanical means without disturbing the dolly or bond within the test area. Two of the three adhesion pulls must exceed 200 psi or concrete failure with more than 50% of the subsurface adhered to the coating. Should a structure fail to achieve two successful pulls as described, additional testing must be performed at the discretion of SacSewer.

SacSewer must complete a visual inspection. Mark and repair all deficiencies in the finished coating.

401.7.13 Measurement and Payment

The contractor will receive payment for this work on a unit price per vertical foot based on the completed installation of the liner per structure diameter.

Payment includes all the following items:

- All flow control
- Safety
- Cleaning and surface preparation
- Pre- and post-construction inspection and photography
- Labor, equipment, material, and installation
- Testing
- Site restoration
- All other work specified or not which is reasonably required to complete installation

SacSewer considers any item not specified to be incidental to the work and included in the unit price for the work.

401.8 CAST-IN-PLACE CONCRETE LINER

For cast-in-place concrete, liner refers to project-specific contract documents.

401.9 CHEMICAL GROUTING

For chemical grouting, refer to project specific contract documents.

401.10 MANHOLE FRAME SEALING

Manhole frame sealing includes sealing the frame adjustment area with a corrosion-resistant aromatic flexible urethane resin coating. The sealing system must be Flex-Seal Utility Sealant by Sealing Systems, Inc. or approved equal. It must prevent the leakage of water into the manhole through this area. The sealing system must remain flexible and allow vertical movement of the frame from 0.0 to 0.5 inches.

401.10.1 MATERIALS

Prior to applying the sealant, a flexible aromatic urethane resin liner primer must be applied to the surface area that meets the minimum requirements shown in Table 401-4.

Table 401-4: Manhole Sealant Primer Properties

Property	Standard	Minimum Requirement
Hardness	ASTM D2240	85
Elongation	ASTM D1456	400%
Tensile Strength	ASTM D412	3,200 psi
Adhesive Strength	ASTM D903	400 lb/inch
Tear Resistance	ASTM D1004	210 lb/inch

The flexible aromatic urethane resin applied must meet the minimum requirements shown in Table 401-5.

Table 401-5: Manhole Sealant Resin Properties

Property	Standard	Minimum Requirement
Hardness	ASTM D2240	75
Elongation	ASTM D1456	800%
Tensile Strength	ASTM D412	1,150 psi
Adhesive Strength	ASTM D903	175 lb/inch
Tear Resistance	ASTM D1004	155 lb/inch

401.10.2 SUBMITTALS

The contractor must submit the product data for chemical grouting product, including all the following information:

- Storage and handling requirements
- Surface preparation and installation requirements
- Product manufacturer information, including contact information
- All SDS sheets
- Cleanup requirements and
- Setup and curing requirements

401.10.3 EXECUTION OF WORK

The contact surfaces must be clean, smooth, circular, and free of excessive voids. Remove all loose and protruding mortar. If the masonry surface is rough, irregular, or contains excessive voids and will not provide an adequate seal, prepare the area using the material specified in Section 401.2, “Patching” of these Standards. Correct all infiltration as specified in Section 401.3, “Leak Correction” of these Standards. Prepare the internal surface by

sandblasting the casting section to a white metal with sand. After sandblasting, check the entire area to remove all loose sand, debris, dust, dirt, oil, grease, or chemical combination. Sand is to be captured and not allowed to enter the collection system.

Use of a blower may be required to completely dry the surface as recommended by the manufacturer. Surface of the structure must be completely dry prior to primer application.

Mix and apply adhesive primer to the clean, dry surface according to the manufacturer's recommendations. Cover the ring adjustment area, the lower 3 inches of the casting frame, and the top 8 inches of the cone section. Allow for proper drying of the adhesive primer, then apply sealant by brush as evenly as possible over the entire area and allow to cure in accordance with the manufacturer's recommendations.

401.10.4 Inspection and Acceptance

The minimum thickness of sealant is 120 mils.

401.10.5 Measurement and Payment

The contractor will receive payment for this work on a unit price for each manhole frame sealed and approved.

401.11 Manhole Channeling

All loose and broken concrete will be removed from the manhole prior to shaping. The contractor must construct the manhole channel with smooth semicircular bottoms matching the inside diameters of the connecting pipeline. Change the direction of flow with a smooth curve of as large a radius as the manhole size will permit. Change the size and grade of channels gradually. Shape the manhole channel in accordance with these Standards.

At a minimum, the material used for the channel rehabilitation must be mortar or grout consisting of one part type II Portland cement and two parts of fine, clean sand. Only add sufficient water to provide a stiff, workable cement mixture for proper troweling. Do not use hydrated lime or masonry cement. A rapid-setting, cementitious patching material, such as All-Crete 5, All-Crete 20, Speed Crete, or an approved equal, may be used as an alternative for manhole channeling construction or repair with the approval of SacSewer.

Use All-Crete, by MBT/BASF or the concrete, Speed Crete by W.R. Meadows, or an approved equal for resurfacing manhole benches.

401.11.1 TESTING

SacSewer will visually inspect all work at the time of final inspection. The contractor must repair all defects at no additional cost to SacSewer.

401.11.2 MEASUREMENT AND PAYMENT

The contractor will receive payment for this work on a unit price for each bench and channel repaired and approved.

401.12 RAISING OF MANHOLE FRAME AND COVER

The contractor will adjust all manholes designated to receive casting adjustment and alignment in accordance with these Standards. Such adjustment is to meet the finished grade. The adjustment may be made by the following methods.

401.12.1 GRADE RINGS

The contractor will remove the existing frames and covers specified. Remove the existing pavement or other surface area adjacent to the manhole and excavate to expose the entire frame and a minimum of 16 inches of the existing manhole cone. Remove the grade rings and clean all joint surfaces between the frame, grade rings, and existing manhole wall to ensure a watertight seal. Obtain proper grade by using not less than 3 inches or more than 12 inches of solid precast concrete grade rings. The fewest number of grade rings must be used to achieve the proper grade. The grade rings are to be set in full beds of Type S mortar no less than $^{1}/_{4}$ inch thick or greater than $1\text{-}^{1}/_{4}$ inch thick. Furnish and install new frame and cover, or reuse the existing ones, as directed by SacSewer.

401.12.2 BARREL RINGS

The contractor will remove existing frames and covers as specified. Remove the existing pavement or other surface area adjacent to the manhole and excavate to expose the entire frame and a minimum of 16 inches below the existing manhole barrel. Remove the grade rings and cone and clean all joint surfaces between the frame, grade rings, and existing manhole wall to ensure a watertight seal. Obtain proper grade by using solid precast concrete barrel rings. The precast concrete barrel rings must be set with RAM-NEK, QUIKSEAL, or approved equal. Grade rings are to be set in full beds of Type S mortar no less than $^{1}/_{4}$ inch thick or greater than $1\text{-}^{1}/_{4}$ inch thick. Furnish and install new frame and cover, or reuse the existing ones, as directed by SacSewer.

402 PRESSURIZED SYSTEMS

402.1 PRESSURIZED PIPELINES

402.1.1 POINT REPAIRS

Point repairs on pressurized pipelines are defined as the work required to repair or replace defective sections of existing pressurized pipelines that are less than 50 feet in length.

Point repair locations shown on the plans cannot always be exactly determined before exposing the pipeline. The location shown on the plans is considered to be within the scope of the project if within 10 feet of the actual location.

402.1.2 CONVENTIONAL EXCAVATION AND REPLACEMENT

Materials

Whenever possible, use the same pipeline material, size, and dimension ratio or pressure class as that of the existing pressurized *pipeline*, with the exception that HDPE with pipe stiffeners or PVC will replace ACP or cast iron pipe.

Execution of Work

Excavation must be in accordance with these Standards. Excavate the pressurized pipeline a minimum of 1 foot around the section to be repaired or as directed by SacSewer. Remove the damaged pipe to provide a flat surface by cutting or snapping. Reshape, bed, and compact the bottom of the trench as necessary so that the grade of the new pipe matches that of the existing pressurized pipeline. Replace the section of the damaged pipe.

Materials used in the repair must be in accordance with the applicable section of these Standards. Connect the newly installed pipe to the existing pipeline with a solid sleeve coupling rated at 150 psi minimum operating pressure to provide a watertight connection. The coupling must be installed in accordance with the manufacturer's recommendations. Type 316 stainless steel must be used with HDPE pipe. After the pipe is put back into operation and it is verified there are no leaks, wrap the couplings and any exposed ferrous material with two layers of 8-mil LDPE film, backfill, and compact.

402.1.3 CURED-IN-PLACE PIPE

The liner must meet *ASTM F1216*, Appendix X1.3.1. It must withstand repeated loading at the peak operating pressures for its entire service life. SacSewer will determine peak

operating pressures. The lining must withstand vacuum occurrences based on Eq. X1.1 of *ASTM F1216*, using factors recommended by the manufacturer and a factor of safety of 2.0.

Testing

Test pipelines in accordance with the manufacturer's specifications.

402.1.4 ABANDONMENT

Abandon existing facilities in accordance with Section 302.9, "Facilities Abandonment" of these Standards.

SECTION 500: STANDARD PLANS

501 STANDARD PLAN ABBREVIATIONS

The Standard Plans are separated into the following categories based on their association with the sewer collection system:

G	General Plans
P	Pipeline Plans
MH	Manhole Plans
LL	Lower Lateral Plans
FM	Force Main Plans
PS	General Pump Station Plans
M	Pump Station – Mechanical Plans
E	Pump Station – Electrical Plans
I	Pump Station – Instrumentation Plans

502 STANDARD PLANS

	General Plans
G-01A	Signature Block For Collector Plans in Unincorporated County
G-01B	Signature Block For Trunk and Collector Plans in City Jurisdictions
	Pipeline Plans
P-01	Pipe Bedding and Initial Backfill
P-02	Trench Dam
P-03	Trunk Connection to Interceptor
P-04	Conductor Casing Detail
P-05	Cathodic Protection – Steel Casing
P-06	Cathodic Protection – Ductile Iron Pipe
P-07	Turn-Around and Hammer-Head for Access Roads
P-08	Utility Crossing

	Manhole Plans
MH-01	Manhole Location Restriction
MH-02A	Flusher Branch for Pipe Diameters of 8”
MH-02B	Flusher Branch for Pipe Diameters 10” and Greater
MH-03	Standard Precast 48”, 60”, or 72” Manholes
MH-04	Manhole Base
MH-05	90° Manhole Base
MH-06	Standard Precast 48” , 60”, or 72” Manhole Flat Slab Top Detail
MH-07	Inside Drop Connections
MH-08	Drop Connection Adjustable Pipe Bracket
MH-09	Standard Flusher Branch Frame and Cover
MH-10	Grey Iron Double Cover 36” Manhole Frame and Cover
MH-11	Grey Iron Standard 24” Manhole Frame and Cover
MH-12	Marker Bollard Detail
	Lower Lateral Plans
LL-01A	Lower Lateral
LL-01B	Lower Lateral Connection Plan View
LL-02	Standard Cleanout to Grade
LL-03	Private Backwater Valve to Grade
LL-04	Lower Lateral Alternative Connection to Existing Main Line
LL-05	Lower Lateral Replacement
	Force Main (Pressurized Pipe) Plans
FM-01A	Force Main Tie-in at Base Manhole
FM-01B	Force Main Tie-in Drop Connection
FM-02	Standard 60” Air Release Valve Manhole
FM-03	Thrust Block Details
FM-04	Pipe Locating Wire, Locator Ribbon, and Locator Ball Installation
	General Pump Station Plans
PS-01	Canopy Schematic
PS-02	Removable Bollard Detail
PS-03	Pump Station 10-day Fresh Water Test
	Pump Station – Mechanical Plans
M-01	Circular Wet Well – Plan View
M-02	Circular Wet Well – Section A-A
M-03	Valve Vault
M-04	Bypass Vault
M-05	Odor Control Pad

	Pump Station – Electrical Plans
E-01	Typical Outdoor Electrical Panel Layout
E-02	Instrumentation Mounting Rack and Large Pedestal Mounting Detail
E-03	Junction Box Mounting Detail
E-04	Conduit Riser From Ground and Duct Bank Section
E-05	Grounding Details
E-06	Single Line Diagram Typical for Small/Medium Pump Station
E-07	Single Line Diagram Typical for Large Pump Station
E-08	Pump Control Diagrams Typical for Small/Medium Capacity Pumps
E-09	Pump Control Diagram Typ. for Large Capacity Pump with Soft Starter
E-10	Pump Control Diagram Typ. for Large Capacity Pump with VFD
	Pump Station – Instrumentation Plans
	These drawings are available upon request. Please contact Agustin Lopez at 916-875-6595.

SACRAMENTO AREA SEWER DISTRICT

O.K. TO SUBMIT FOR GRID NUMBERING AFTER ALL SEWER CONSTRUCTION IS COMPLETE

SEWER INSPECTOR **DATE**

SACRAMENTO AREA
SEWER DISTRICT

SIGNATURE BLOCK FOR COLLECTOR PLANS IN UNINCORPORATED COUNTY

DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

G-01A

SACRAMENTO AREA SEWER DISTRICT

PLAN CHECKER	DATE
O.K. TO SUBMIT FOR GRID NUMBERING AFTER ALL SEWER CONSTRUCTION IS COMPLETE	
SEWER INSPECTOR	DATE
BILLING NUMBER:	

BLOCK FOR ALL JURISDICTIONS EXCEPT CITY OF SACRAMENTO

SACRAMENTO AREA SEWER DISTRICT

PLAN CHECKER	DATE
O.K. TO SUBMIT FOR GRID NUMBERING AFTER ALL SEWER CONSTRUCTION IS COMPLETE	
CITY OF SACRAMENTO PUBLIC WORKS INSPECTOR	DATE

BLOCK FOR CITY OF SACRAMENTO

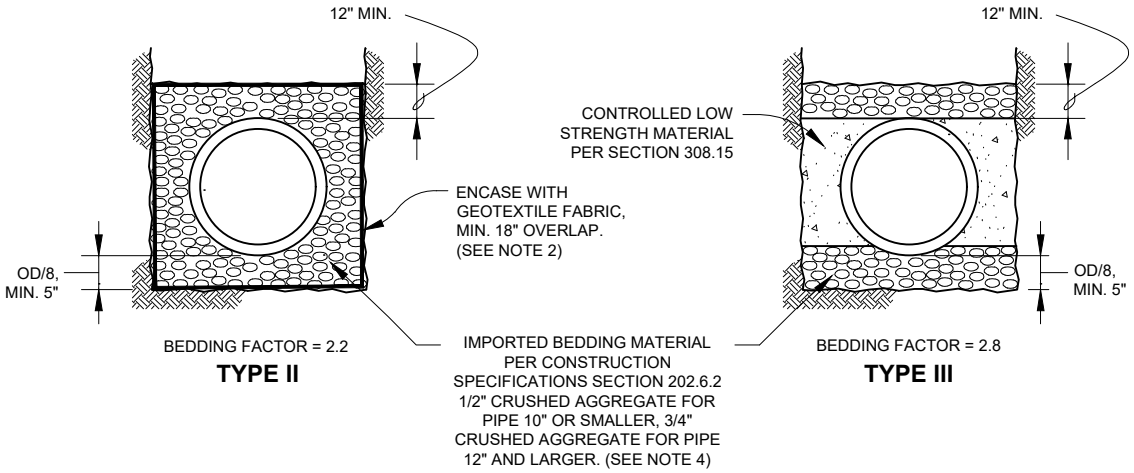
SACRAMENTO AREA
SEWER DISTRICT

SIGNATURE BLOCK FOR TRUNK AND COLLECTOR PLANS IN CITY JURISDICTIONS

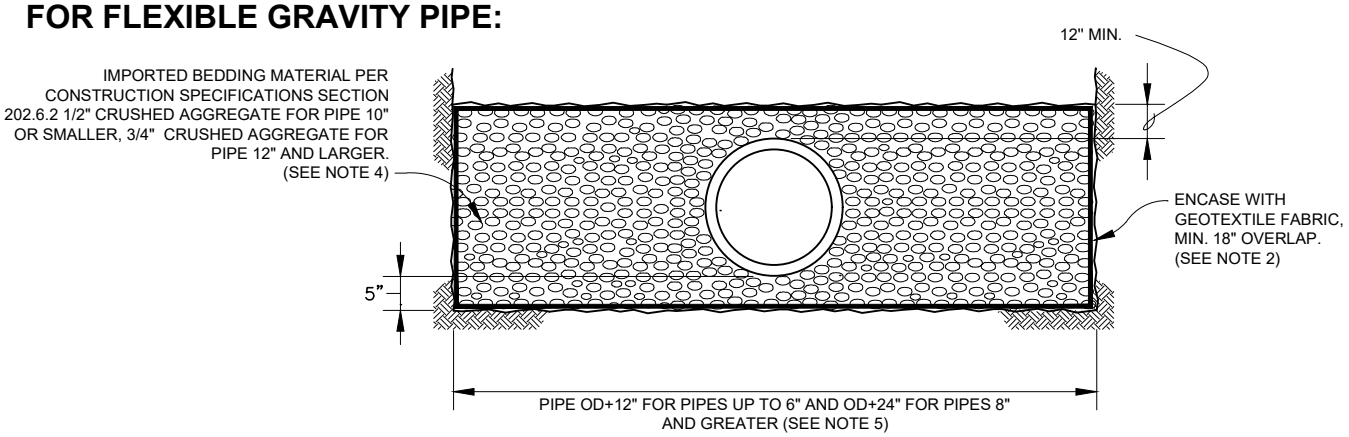
DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

G-01B

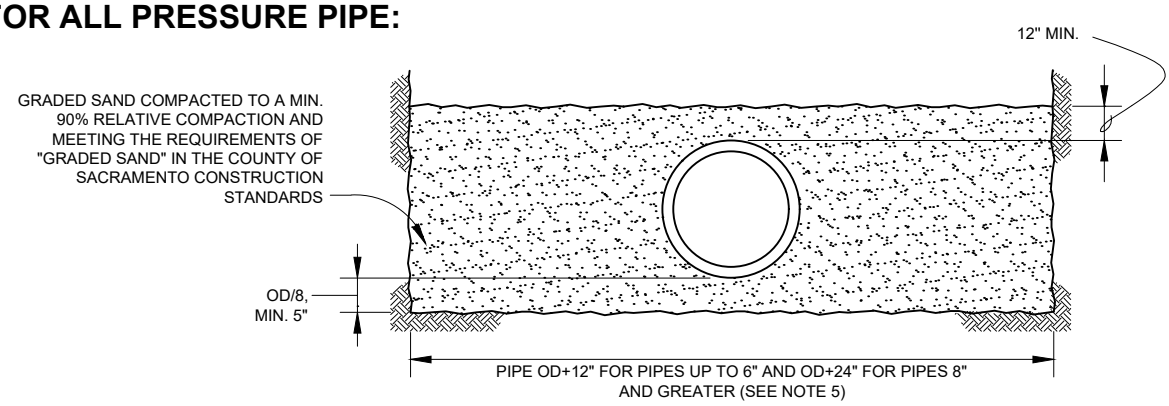
FOR RIGID GRAVITY PIPE:



FOR FLEXIBLE GRAVITY PIPE:



FOR ALL PRESSURE PIPE:



NOTES:

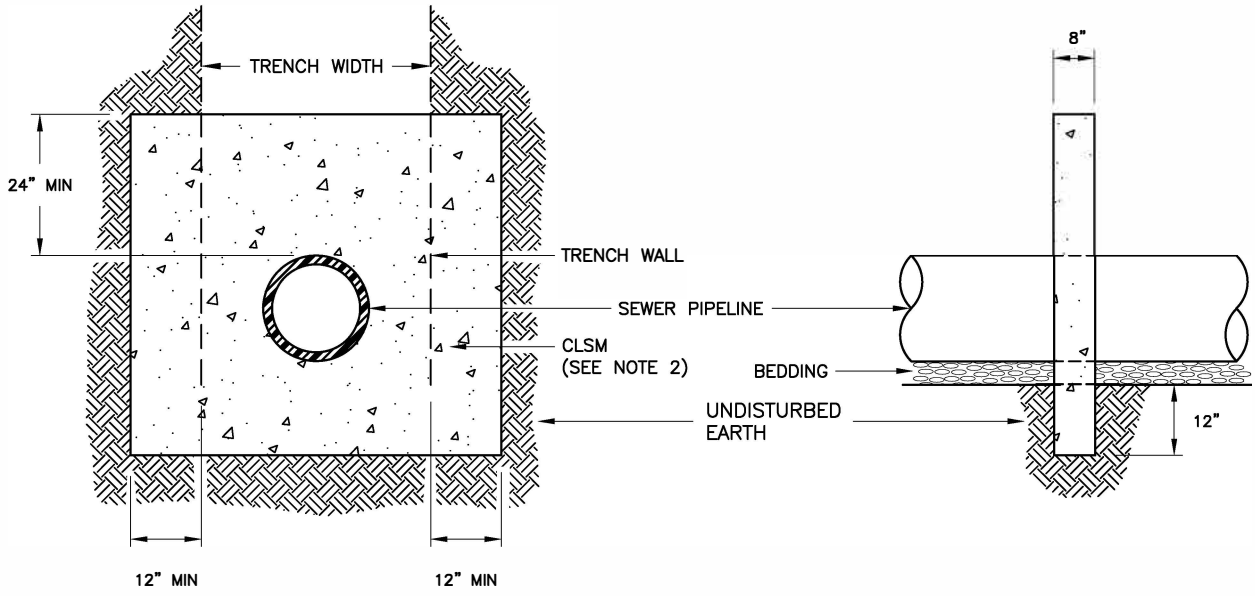
1. BEDDING FACTORS ARE PER NATIONAL CLAY PIPE INSTITUTE.
2. IN AREAS WHERE TRENCHES ARE LOCATED IN FINE TO MEDIUM SANDS OR THERE IS PRESENCE OF GROUND WATER GEOTEXTILE FABRIC MUST BE USED.
3. WRAP ALL DUCTILE IRON PIPE AND DUCTILE IRON FITTINGS WITH LOW-DENSITY POLYETHYLENE WRAPPING SLEEVE PER SECTION 316.2.
4. PLACE AND WORK BY HAND OR SACSEWER APPROVED METHOD TO ENSURE ALL EXCAVATED VOIDS AND HAUNCH AREAS ARE FILLED AND PROVIDE UNIFORM SUPPORT. BELLS OR COUPLING HOLES MUST BE DUG TO ENSURE THE PIPE BARREL SUPPORT THE TRENCH LOAD. INSTALL IN 6" MAXIMUM LAYERS.
5. IN AREAS WHERE TRENCHES ARE LOCATED IN UNSTABLE SOILS, TRENCH WIDTH MUST BE 5 PIPE DIAMETERS.

SACRAMENTO AREA SEWER DISTRICT

PIPE BEDDING AND INITIAL BACKFILL

DRAWN BY: RAS
SCALE: NONE
DATE: 2/23

P-01



NOTES:

1. TOP OF DAM TO EXTEND INTO BACKFILL 24" MINIMUM OR TOP OF GROUND WATER HGL, WHICHEVER IS LESS.

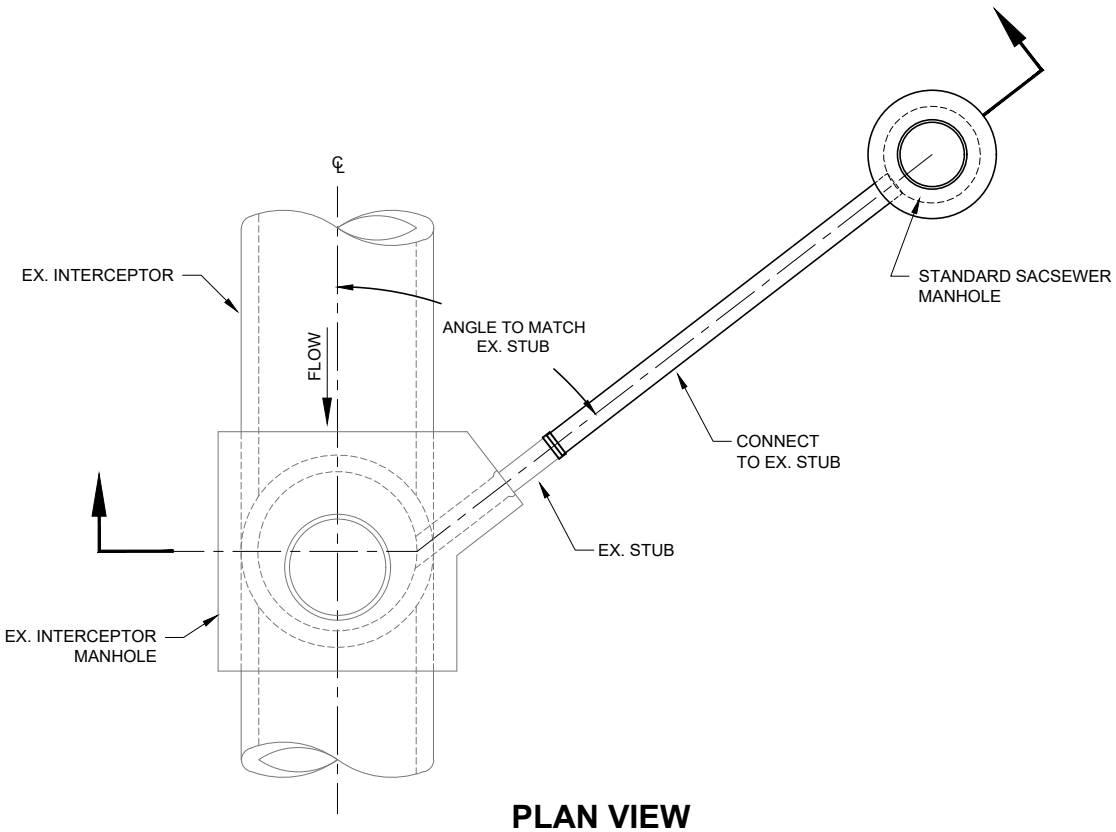
2. CONTROLLED LOW STRENGTH MATERIAL (CLSM)

SACRAMENTO AREA
SEWER DISTRICT

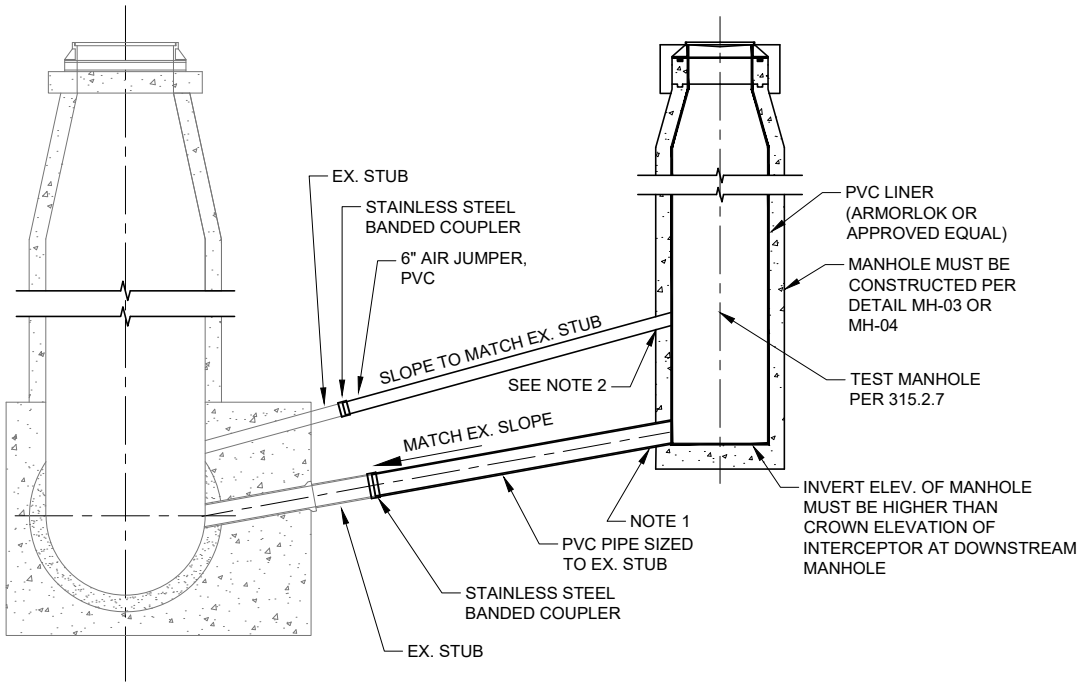
TRENCH DAM

DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

P-02



PLAN VIEW



SECTION

NOTES:

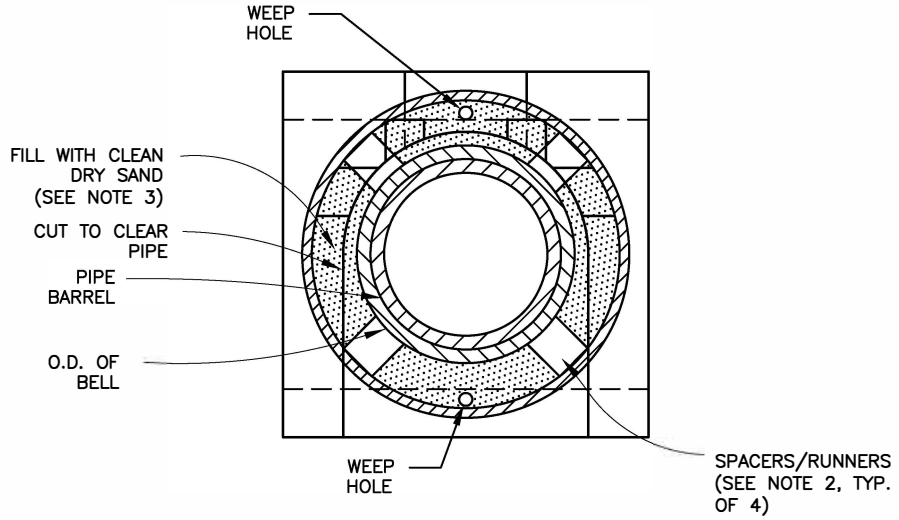
1. SACSEWER MANHOLE MUST HAVE BELL & SPIGOT CONNECTION FOR PVC PIPE. BELL MUST BE CAST BY MANHOLE MANUFACTURER AT THE PLANT.
2. PROVIDE CORE BORE. PACK ANNULUS WITH NON-SHRINK GROUT AND REPAIR PVC PIPE AND MANHOLE LINING WHERE EXISTING.

SACRAMENTO AREA SEWER DISTRICT

TRUNK CONNECTION TO INTERCEPTOR

DRAWN BY: RAS
SCALE: NONE
DATE: 2/23

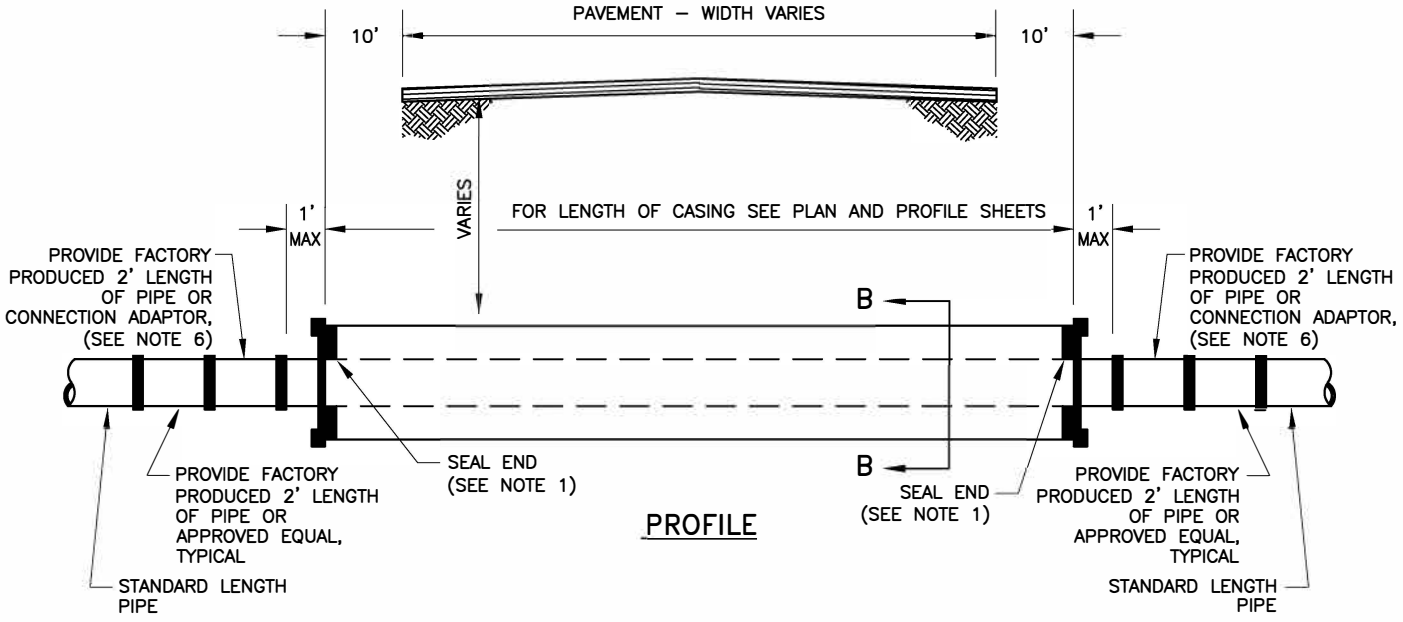
P-03



NOTE:

1. BRICK AND MORTAR WITH A 1" DIAMETER WEEP HOLE AT CROWN AND INVERT OR APPROVED ALTERNATIVE.
2. MANUFACTURED POLYURETHANE SPACERS/RUNNERS OR APPROVED EQUAL MUST BE USED. MANUFACTURED POLYURETHANE SPACERS/RUNNERS OR APPROVED EQUAL MUST BE INSTALLED PER MANUFACTURERS REQUIREMENTS.
3. SAND SHOULD MEET ASTM D448 TABLE 1 – SIZE 89.
4. CASING, SEE TRENCHLESS OPERATION SECTION. (INSTALLATION OF CONDUCTOR PIPE)
5. CENTER CARRIER PIPE IN CASING.
6. FACTORY PRODUCED CONNECTION ADAPTOR NECESSARY FOR TRANSITION FROM STANDARD BELL & SPIGOT PIPE TO VCP JACKING PIPE.

SECTION B–B



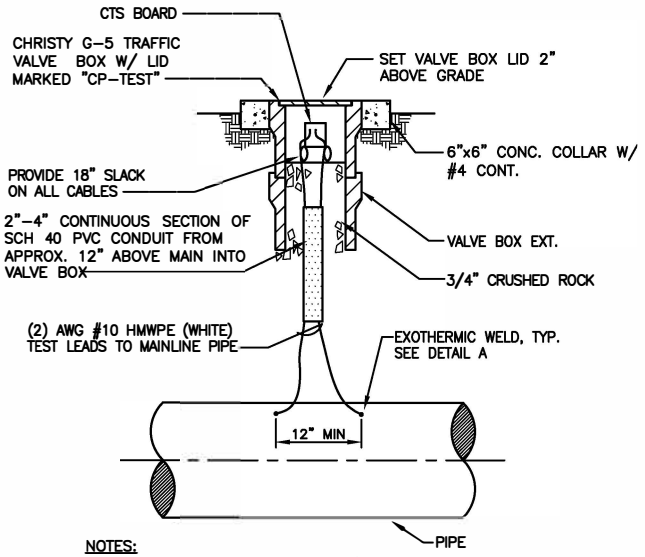
PROFILE

SACRAMENTO AREA **SEWER** DISTRICT

CONDUCTOR CASING DETAIL

DRAWN BY: RAS
SCALE: NONE
DATE: 6/20

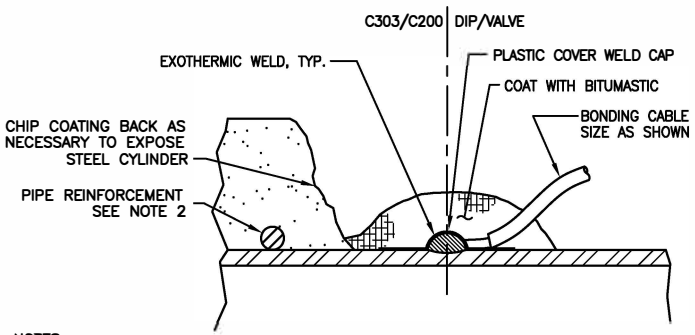
P-04



NOTES:
1. PROVIDE CORROSION MONITORING SCHEDULE.
2. INSTALL TEST LEADS ON SPIGOT END OF PIPE.
3. WELD LEADS TO STEEL JOINT RING.

CORROSION TEST STATION (CTS)

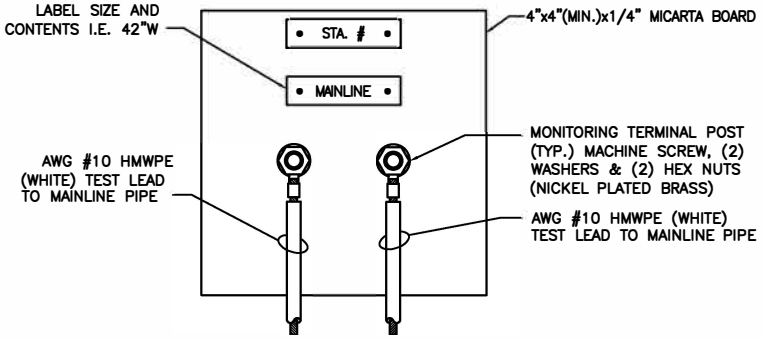
NTS



NOTES:
1. EXOTHERMIC WELDS MUST NOT BE WELDED TO STEEL CYLINDERS OF THICKNESS 10 GA. OR LESS WITHOUT APPROVAL OF THE ENGINEER.
2. PIPE REINFORCEMENT BARS MAY BE PUSHED APART AS NECESSARY TO INSTALL EXOTHERMIC WELD. DO NOT CUT REINFORCEMENT BARS. IF REINFORCEMENT BARS ARE CUT, TACK WELD ALL CUT ENDS TO STEEL CYLINDER.
3. COAT ALL EXPOSED STEEL WITH BITUMASTIC AFTER EXOTHERMIC WELD.
4. WHERE INSTALLING EXOTHERMIC WELD ON EPOXY COATED STEEL, GRIND EPOXY COATING TO EXPOSE STEEL, COMPLETE WELD AND APPLY EPOXY TOUCH-UP TO EXPOSED STEEL.
5. THIS DRAWING ILLUSTRATES MINIMUM CATHODIC PROTECTION FOR A STEEL CASING. CATHODIC DESIGN MUST BE DONE BY A CORROSION ENGINEER.
6. CURB MUST BE STAMPED "CP-FM" PER CONSTRUCTION SPECIFICATIONS SECTION 317.3.

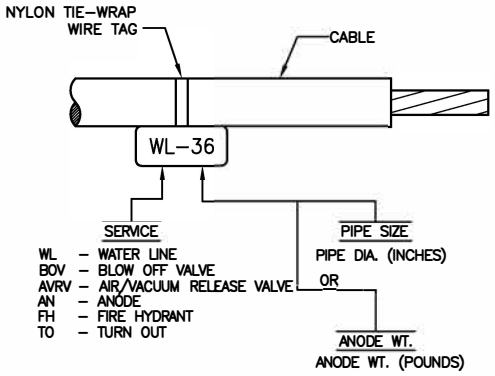
DETAIL A
EXOTHERMIC WELD

NTS



CTS BOARD

NTS



NOTE: MARK TAG WITH BLACK PERMANENT INK MARKER

CABLE ID TAG

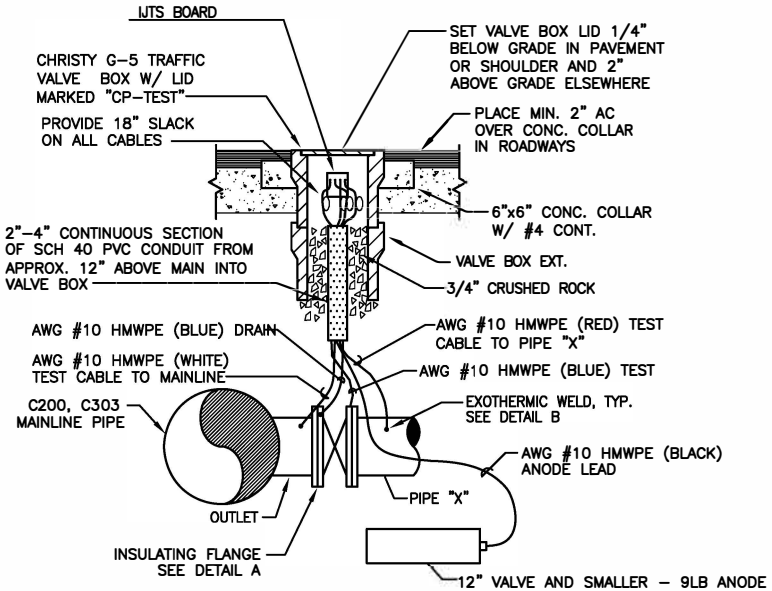
NTS

SACRAMENTO AREA **SEWER** DISTRICT

CATHODIC PROTECTION - STEEL CASING

DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

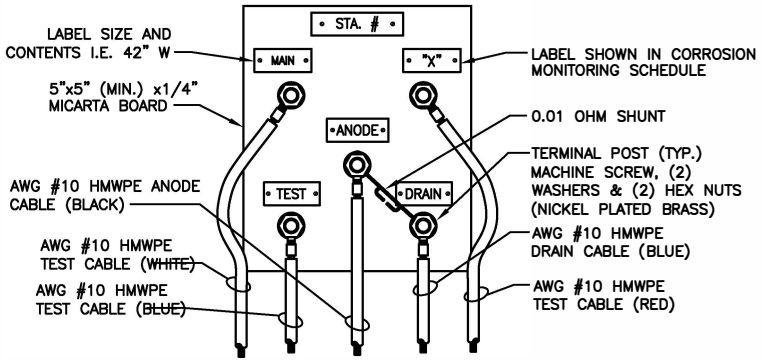
P-05



NOTES:
1. INSTALL ANODE ADJACENT TO VALVE, A MINIMUM OF 5' AWAY, AT OR BELOW INVERT OF PIPELINE.
2. PROVIDE CORROSION MONITORING SCHEDULE.

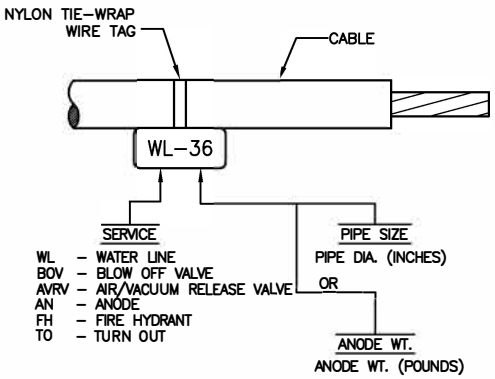
INSULATING JOINT TEST STATION (IJTS)

NTS



IJTS BOARD

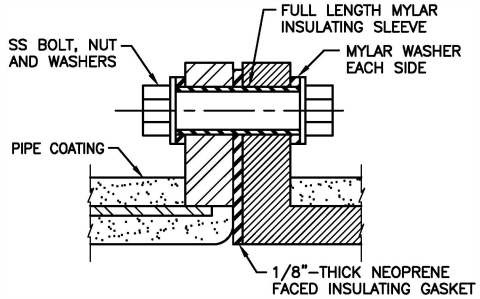
NTS



NOTE: THE LETTERS AND THE NUMBERS SHALL BE PRINTED MIN. 3/16-INCH IN SIZE.

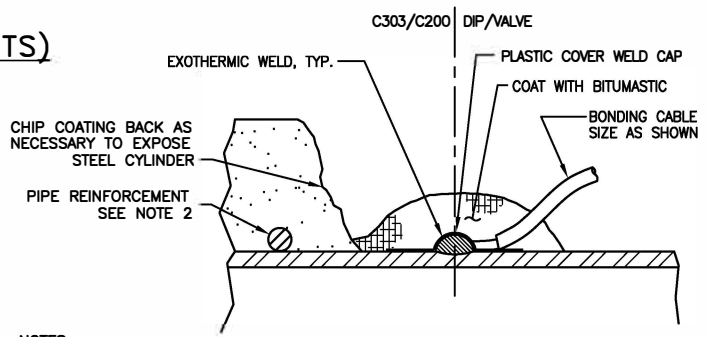
CABLE ID TAG

NTS



DETAIL A
INSULATING FLANGE

NTS



NOTES:
1. EXOTHERMIC WELDS MUST NOT BE WELDED TO DUCTILE IRON (DI) CYLINDERS OF THICKNESS 10 GA. OR LESS WITHOUT APPROVAL OF THE ENGINEER.
2. PIPE REINFORCEMENT BARS MAY BE PUSHED APART AS NECESSARY TO INSTALL EXOTHERMIC WELD. DO NOT CUT REINFORCEMENT BARS. IF REINFORCEMENT BARS ARE CUT, TACK WELD ALL CUT ENDS TO DI CYLINDER.
3. COAT ALL EXPOSED DI WITH BITUMASTIC AFTER EXOTHERMIC WELD.
4. WHERE INSTALLING EXOTHERMIC WELD ON EPOXY COATED DI, GRIND EPOXY COATING TO EXPOSE DI, COMPLETE WELD AND APPLY EPOXY TOUCH-UP TO EXPOSED DI.
5. THIS DRAWING ILLUSTRATES MINIMUM CATHODIC PROTECTION FOR A DI CASING. CATHODIC DESIGN MUST BE DONE BY A CORROSION ENGINEER.
6. CURB MUST BE STAMPED "CP-FM" PER CONSTRUCTION SPECIFICATIONS SECTION 317.3.

DETAIL B
EXOTHERMIC WELD

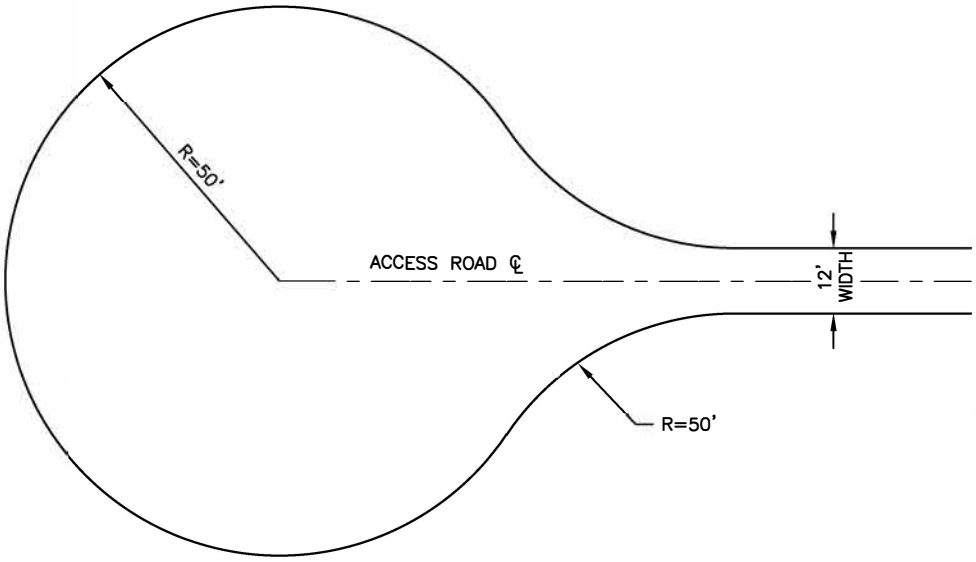
NTS

SACRAMENTO AREA **SEWER** DISTRICT

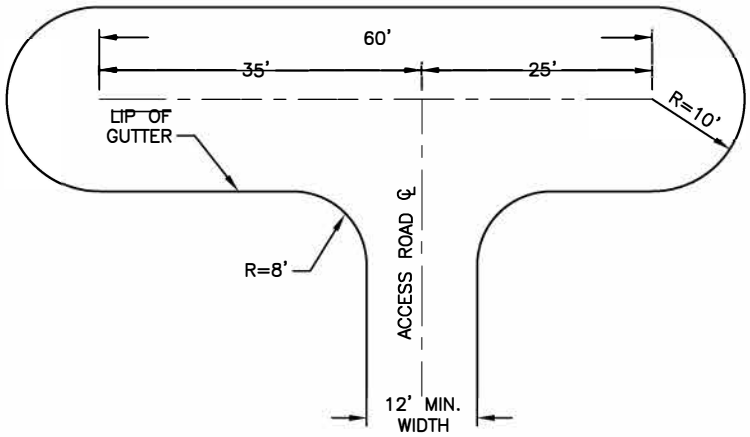
CATHODIC PROTECTION - DUCTILE IRON PIPE

DRAWN BY: GT
SCALE: NONE
DATE: 3/20

P-06



TURN–AROUND



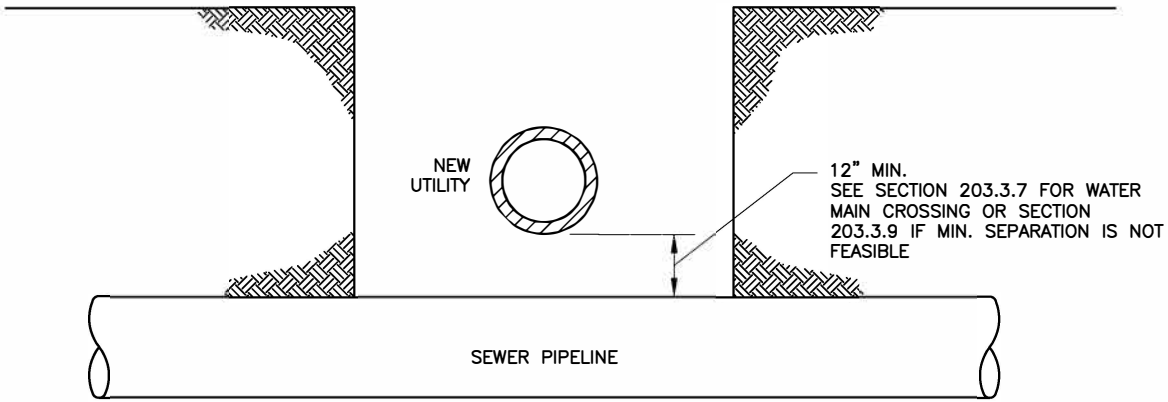
HAMMER–HEAD

SACRAMENTO AREA **SEWER** DISTRICT

TURN-AROUND AND HAMMER-HEAD FOR ACCESS ROADS

DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

P-07



NOTES:

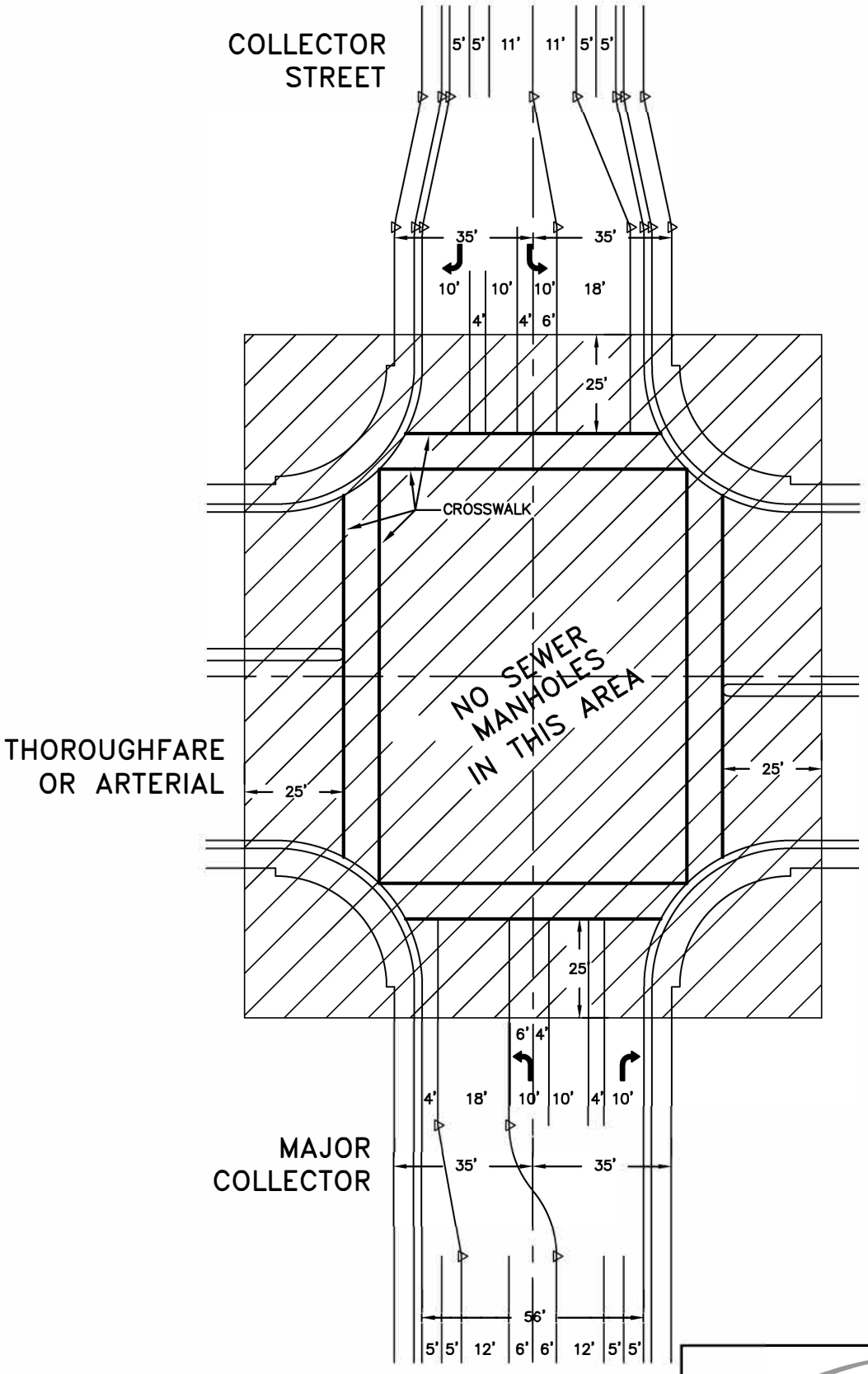
1. ALL SEWER PIPELINES ARE TO BE PROTECTED IN PLACE.
2. ANY NEW UTILITY MUST HAVE A MINIMUM OF 12" CLEARANCE FROM ANY SEWER FACILITY. ANY NEW UTILITY WITH LESS THAN 12" OF CLEARANCE MUST HAVE A COMPRESSIBLE MATERIAL (STYROFOAM OR EQUIVALENT) BETWEEN THE LINES.

SACRAMENTO AREA
SEWER DISTRICT

UTILITY CROSSING

DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

P-08



NOTE

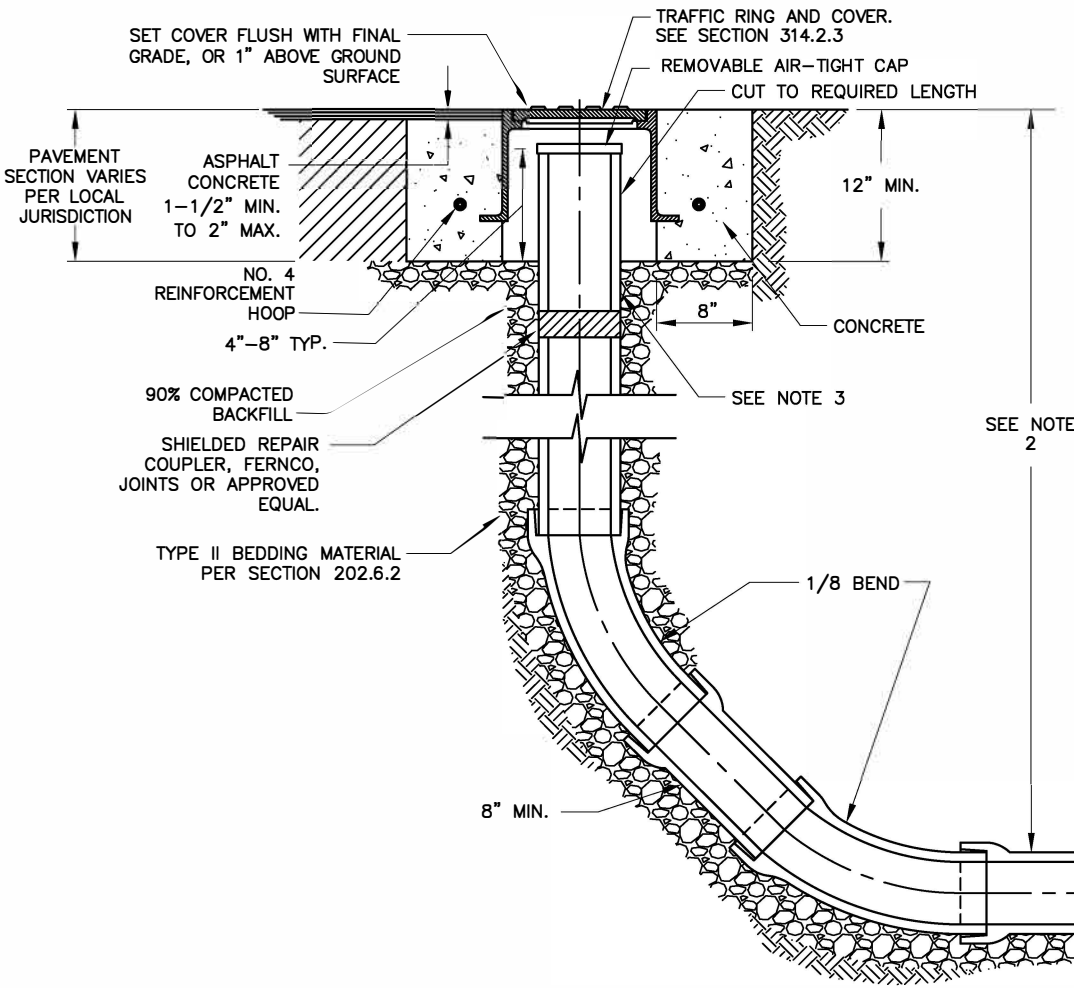
SEWER MANHOLES WILL NOT BE LOCATED WITHIN 25 FEET OF ANY INTERSECTION WHERE EITHER STREET IS GREATER THAN RESIDENTIAL (TYP 50' MAX RIGHT-OF-WAY OR 36' MAX PAVEMENT WIDTH).

SACRAMENTO AREA **SEWER** DISTRICT

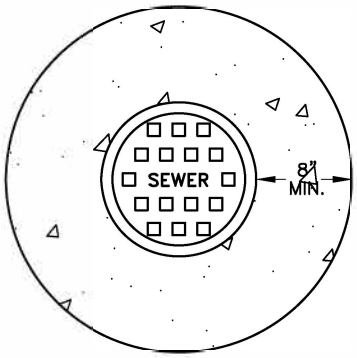
MANHOLE LOCATION RESTRICTION

DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

MH-01



PROFILE



PLAN VIEW

NOTES:

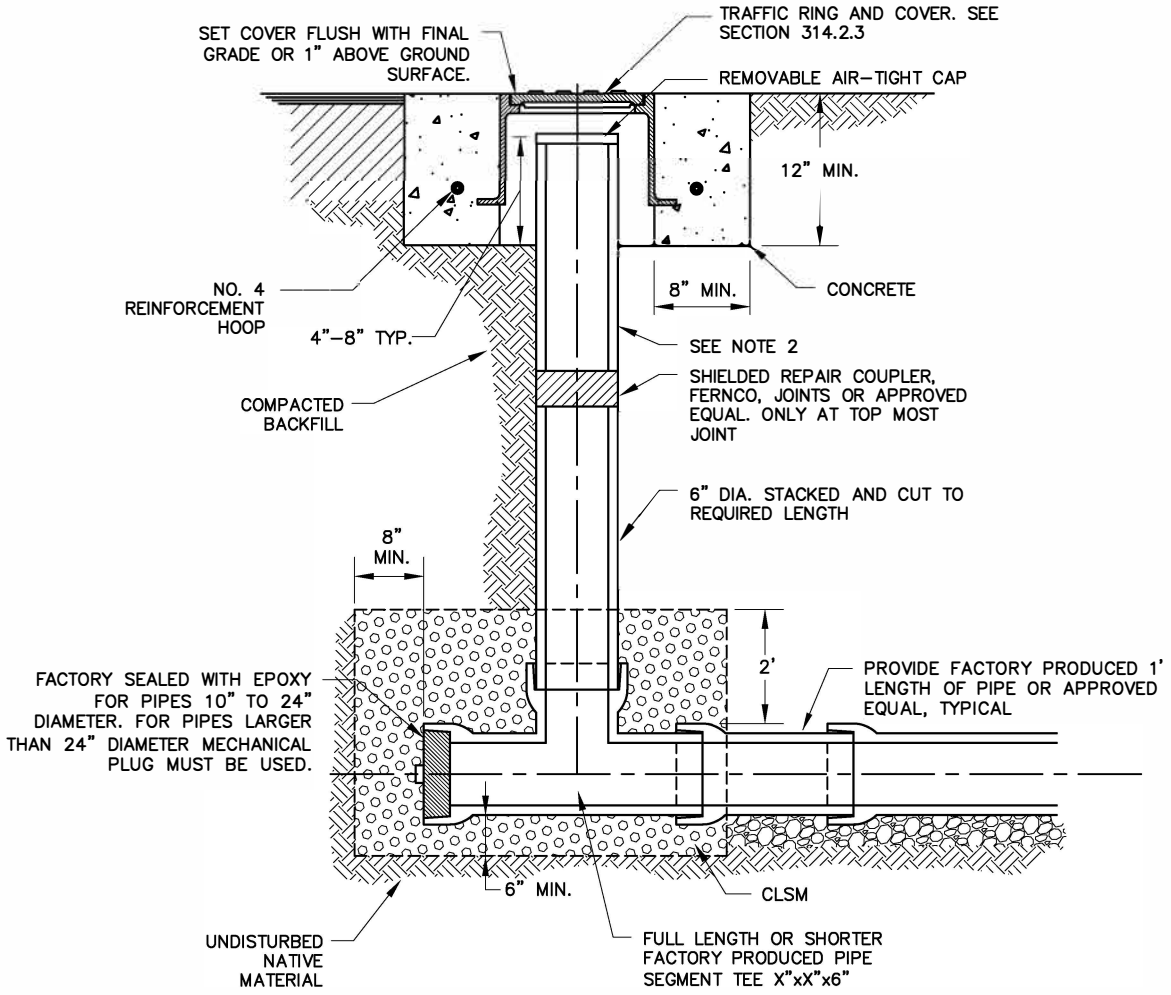
1. ALL PIPE FITTINGS MUST BE THE SAME SIZE AND MATERIAL AS THE HORIZONTAL PIPE TO WHICH THEY CONNECT. JOINT WILL BE AS SPECIFIED FOR THE TYPE OF PIPE USED.
2. 12 INCHES MIN. FROM TOP OF PIPE TO FINISH GRADE.
3. SDR–26 OR C900 MUST BE USED FOR VERTICAL RISER WHEN THE DEPTH TO THE BOTTOM OF THE FLUSHER BRANCH IS MORE THAN 10 FEET.

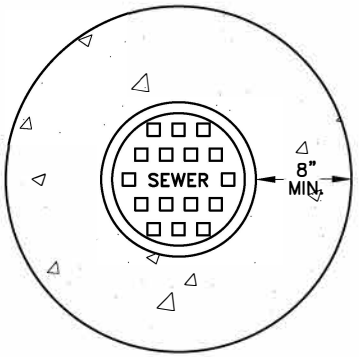
SACRAMENTO AREA **SEWER** DISTRICT

FLUSHER BRANCH FOR PIPE DIAMETERS OF 8"

DRAWN BY: RAS
SCALE: NONE
DATE: 5/20

MH-02A





PLAN VIEW

NOTE:

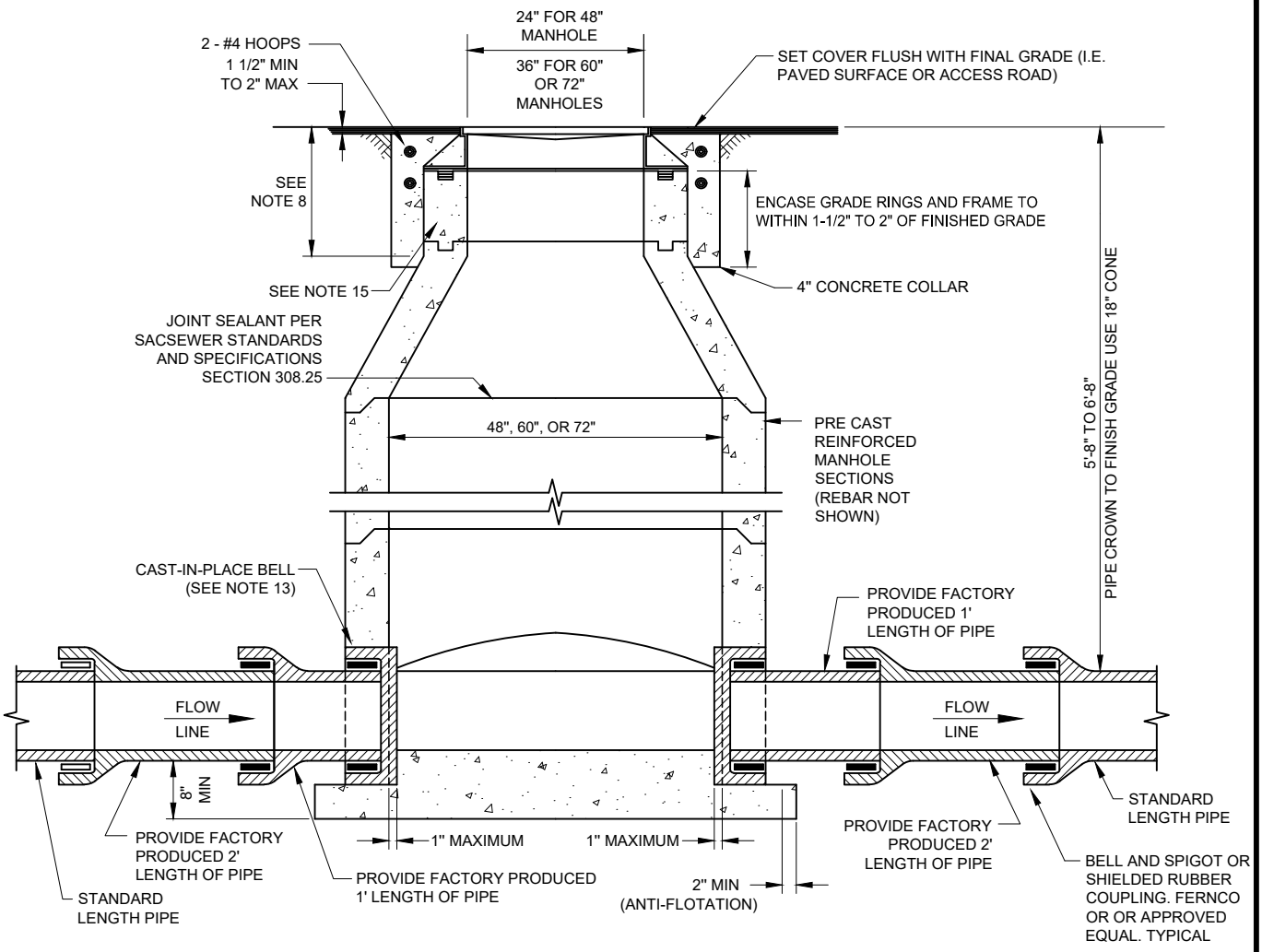
1. EPOXY MUST BE WYN-STIK ES6323 OR APPROVED EQUAL.
2. SDR-26 OR C900 MUST BE USED FOR VERTICAL RISER WHEN THE DEPTH TO THE BOTTOM OF THE FLUSHER BRANCH IS MORE THAN 10 FEET.

SACRAMENTO AREA
ER DISTRICT

FLUSHER BRANCH FOR PIPE DIAMETERS 10" AND GREATER

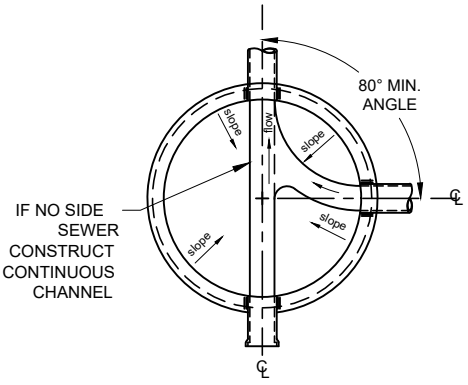
DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

MH-02B



NOTES:

1. CLASS A ASTM C478 CONCRETE MUST BE USED FOR MANHOLE BASES.
2. SPRING LINE OF CAST-IN-PLACE BELL MUST STOP AT INSIDE FACE OF MANHOLE.
3. POURED IN PLACE MANHOLES ARE NOT ALLOWED.
4. JOINTS FOR THE BARREL SECTION WILL BE TONGUE AND GROOVE OR LAP JOINT. ALL LIFTING HOLES MUST BE SEALED WITH NON-SHRINK GROUT.
5. ALL MANHOLE BASES MUST BE PRECAST BASES AND BE PLACED ON 10" MIN. OF 3/4" CRUSHED ROCK PLACED OVER UNDISTURBED MATERIAL. CONNECTION OF THE PIPE TO THE MANHOLE MUST USE A CAST-IN-PLACE BELL. ALL MANHOLE BASES TO INCLUDE AN ANTI-FLOTATION RING PER STANDARD DRAWING MH-05.
6. ANY LOWER LATERAL ENTERING A MANHOLE MUST BE INSTALLED WITH THE INVERT ELEVATION OF THE LOWER LATERAL MATCHING THE CROWN ELEVATION OF THE EXIT SEWER EXCEPT WHEN AN INTERNAL DROP CONNECTION IS USED. FOR MANHOLES AT THE END OF A CUL-DE-SAC OR END OF LINE WITH NO EXTENSION THE INVERT OF ANY LOWER LATERAL MUST BE A MINIMUM OF ONE INCH ABOVE THE INVERT OF THE EXIT PIPE WITH AN INDIVIDUAL SMOOTH TRANSITION CHANNEL.
7. ECCENTRIC CONES REQUIRE APPROVAL FROM SACSEWER.
8. MAXIMUM THROAT DEPTH FOR NEW CONSTRUCTION IS 16 INCHES. MAXIMUM THROAT DEPTH FOR ASPHALTIC CONCRETE OVERLAYS IS 18 INCHES.
9. 5'-8" OR LESS MUST USE 18" CONES OR FLAT TOP.
10. PIPE MUST BE PLACED WITH THE BELLS UPSTREAM.
11. ALL SEWER MANHOLES MUST HAVE 24 HOUR ALL WEATHER ACCESS. (I.E. PAVED SURFACE OR ACCESS ROAD).
12. SEE DRAWING MH-05 / MH-06 FOR BASE DETAIL.
13. SANDED MANHOLE ADAPTER MANUFACTURED BY IPEX USA, LLC OR APPROVED EQUAL WITH CLAMP ON WATERSTOP GROUT RING FOR PVC.
14. MANHOLES MUST BE MANUFACTURED BY JENSEN PRECAST, OLDCASTLE INFRASTRUCTURE, OR RINKER UNLESS OTHERWISE APPROVED BY SACSEWER.
15. FOR EASEMENT AREAS OUTSIDE OF ROADWAYS AND VEHICLE TRAFFIC, CRETEX PRO-RING GRADE RINGS MAY BE USED IN LIEU OF CONCRETE GRADE RINGS.



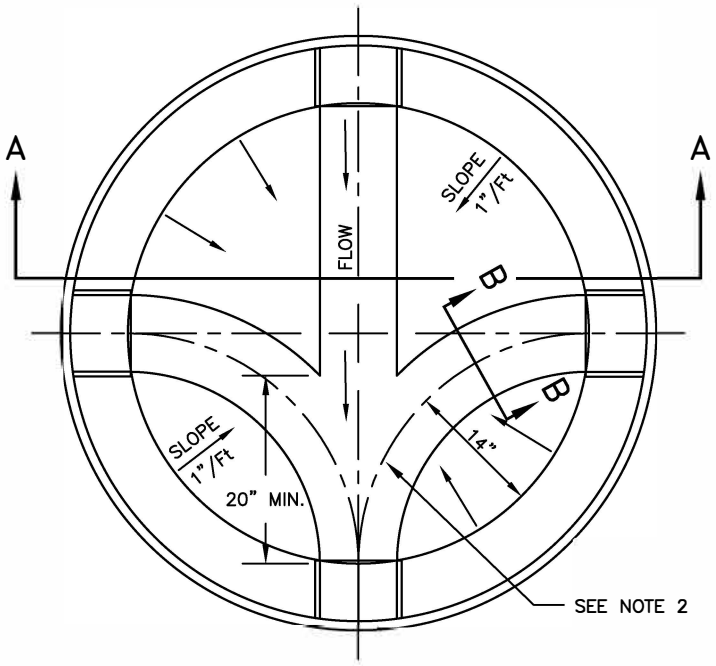
PLAN VIEW OF MANHOLE SHOWING INTERSECTING SEWERS

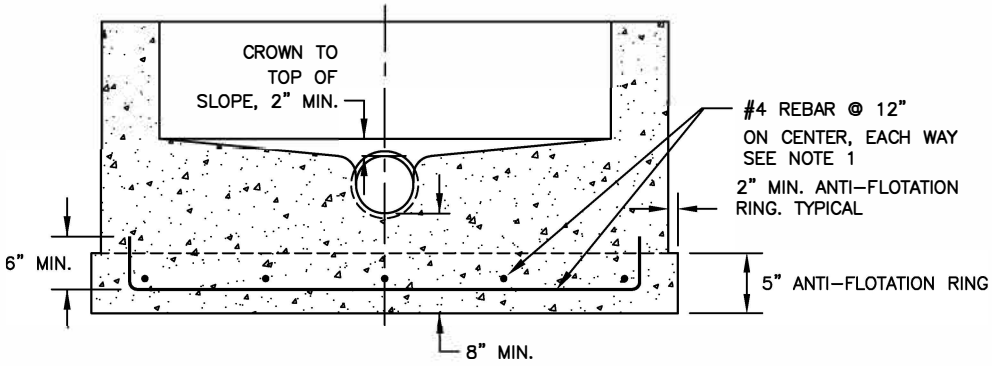
SACRAMENTO AREA SEWER DISTRICT

STANDARD PRECAST 48", 60", OR 72" MANHOLES

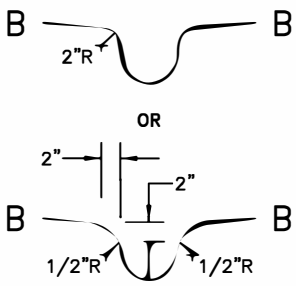
DRAWN BY: RAS
SCALE: NONE
DATE: 5/23

MH-03





SECTION A-A



NOTES:

1. MINIMUM REINFORCEMENT SHOWN. REINFORCEMENT MUST BE DESIGNED BY A CALIFORNIA LICENSED CIVIL OR STRUCTURAL ENGINEER.
2. RADIUS OF THE ARC MUST BE 24".

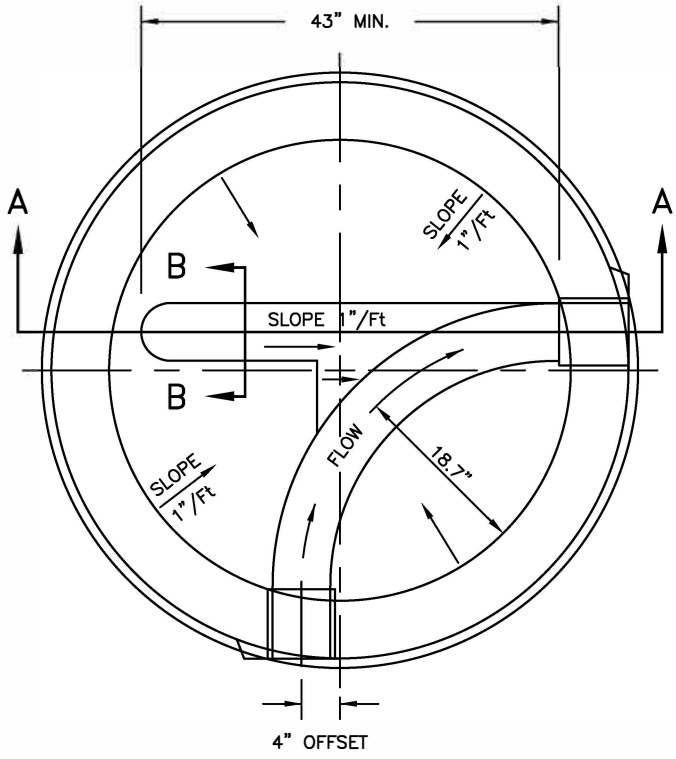
SACRAMENTO AREA **SEWER** DISTRICT

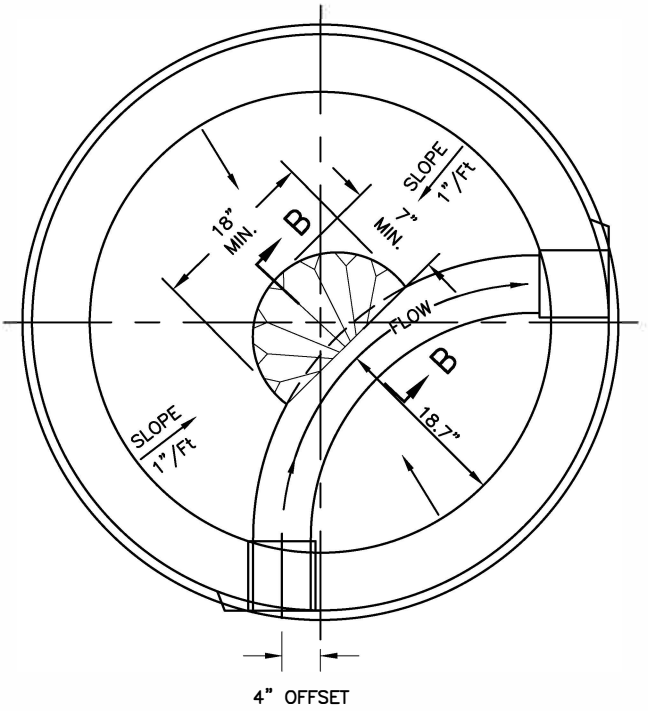
MANHOLE BASE

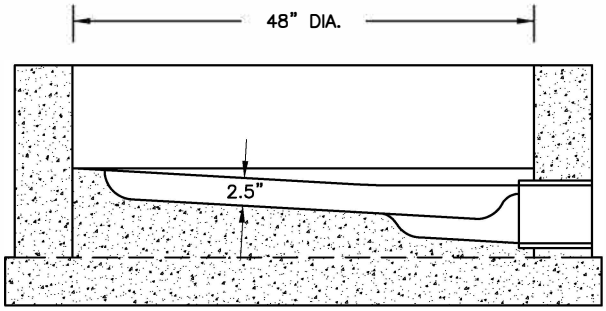
DRAWN BY: RAS
SCALE: NONE
DATE: 5/20

MH-04

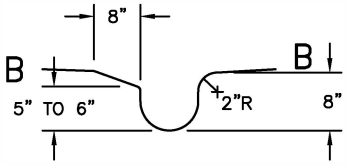
CAMERA CHANNEL REQUIRED FOR COLLECTORS



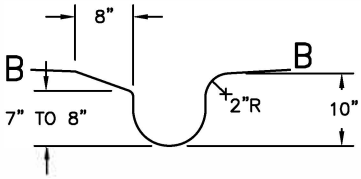




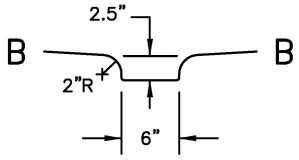
SECTION A–A



SECTION B–B
FOR 8" PIPE BASES



SECTION B–B
FOR 10" PIPE BASES



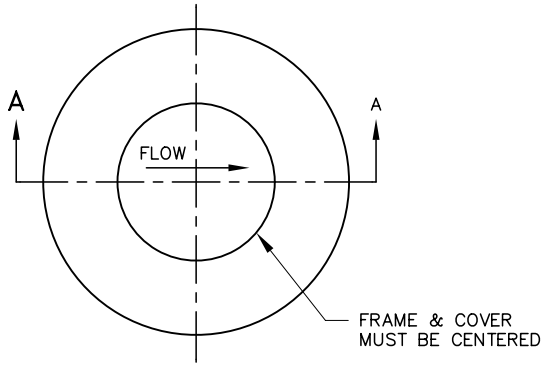
NOTE:
REBAR PATTERN PER MH–05

SACRAMENTO AREA
SEWER DISTRICT

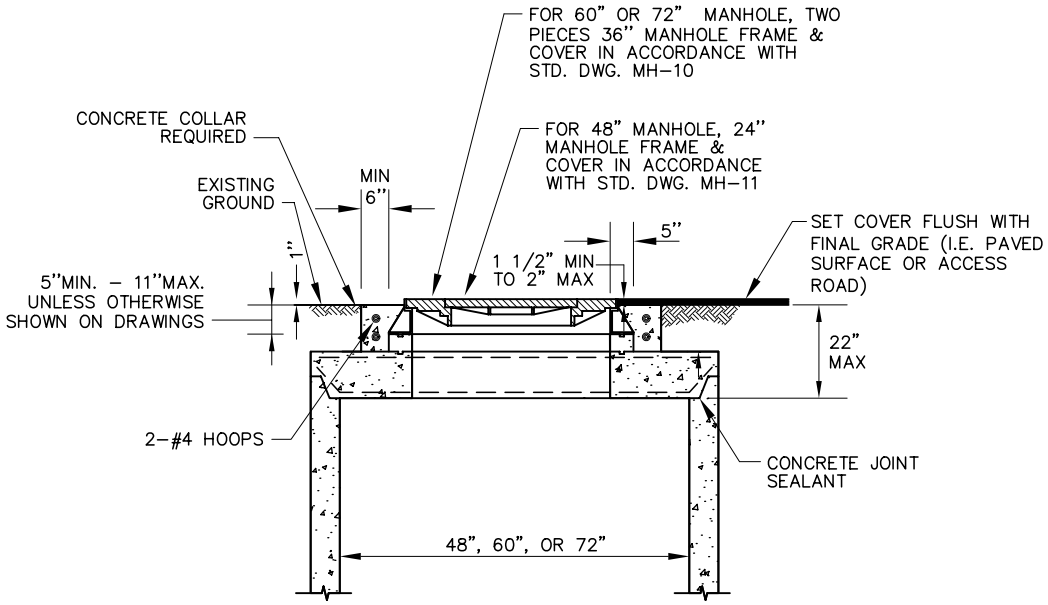
90° MANHOLE BASE

DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

MH-05



PLAN



SECTION A-A

NOTES:

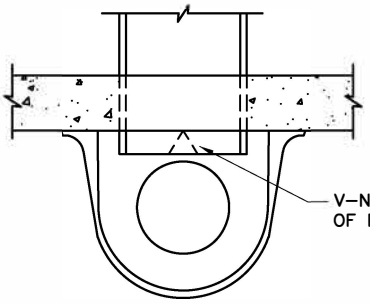
1. JOINTS FOR THE BARREL SECTION WILL BE TONGUE AND GROOVE OR LAP JOINT. ALL LIFTING HOLES MUST BE SEALED WITH NON-SHRINK GROUT.
2. FOR ASPHALTIC CONCRETE OVERLAYS ONLY, THE MAXIMUM THROAT DEPTH IS 24 INCHES.

SACRAMENTO AREA SEWER DISTRICT

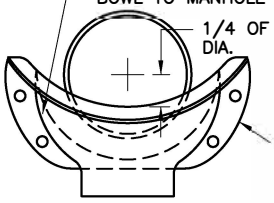
STANDARD PRECAST 48", 60", OR 72" MANHOLE FLAT SLAB TOP DETAIL

DRAWN BY: RAS
SCALE: NONE
DATE: 11/21

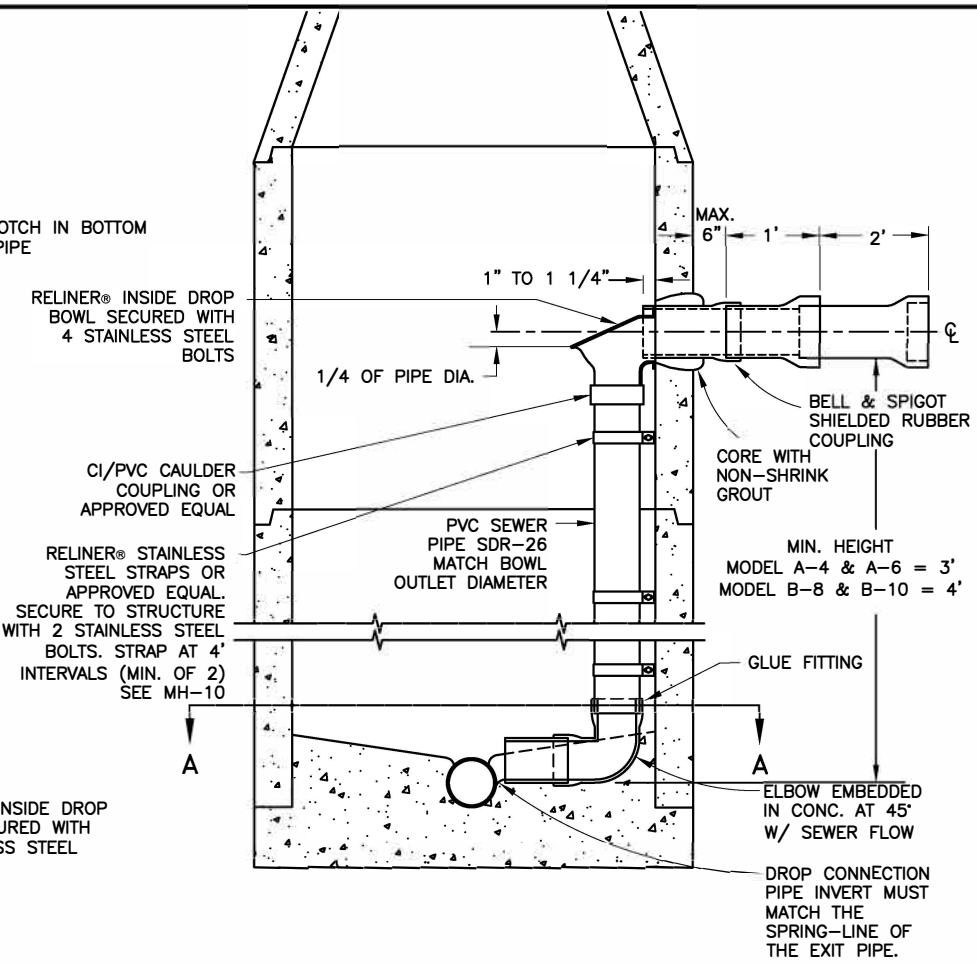
MH-06

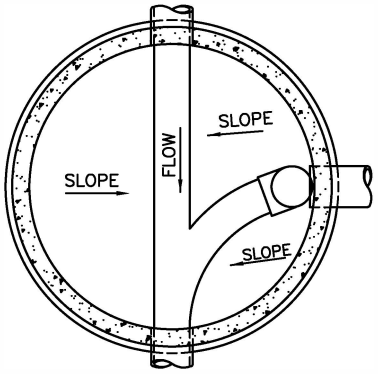


DROP BOWL MOUNTING POSITION TOP VIEW



DROP BOWL MOUNTING POSITION FRONT VIEW





SECTION A-A PLAN

NOTES:

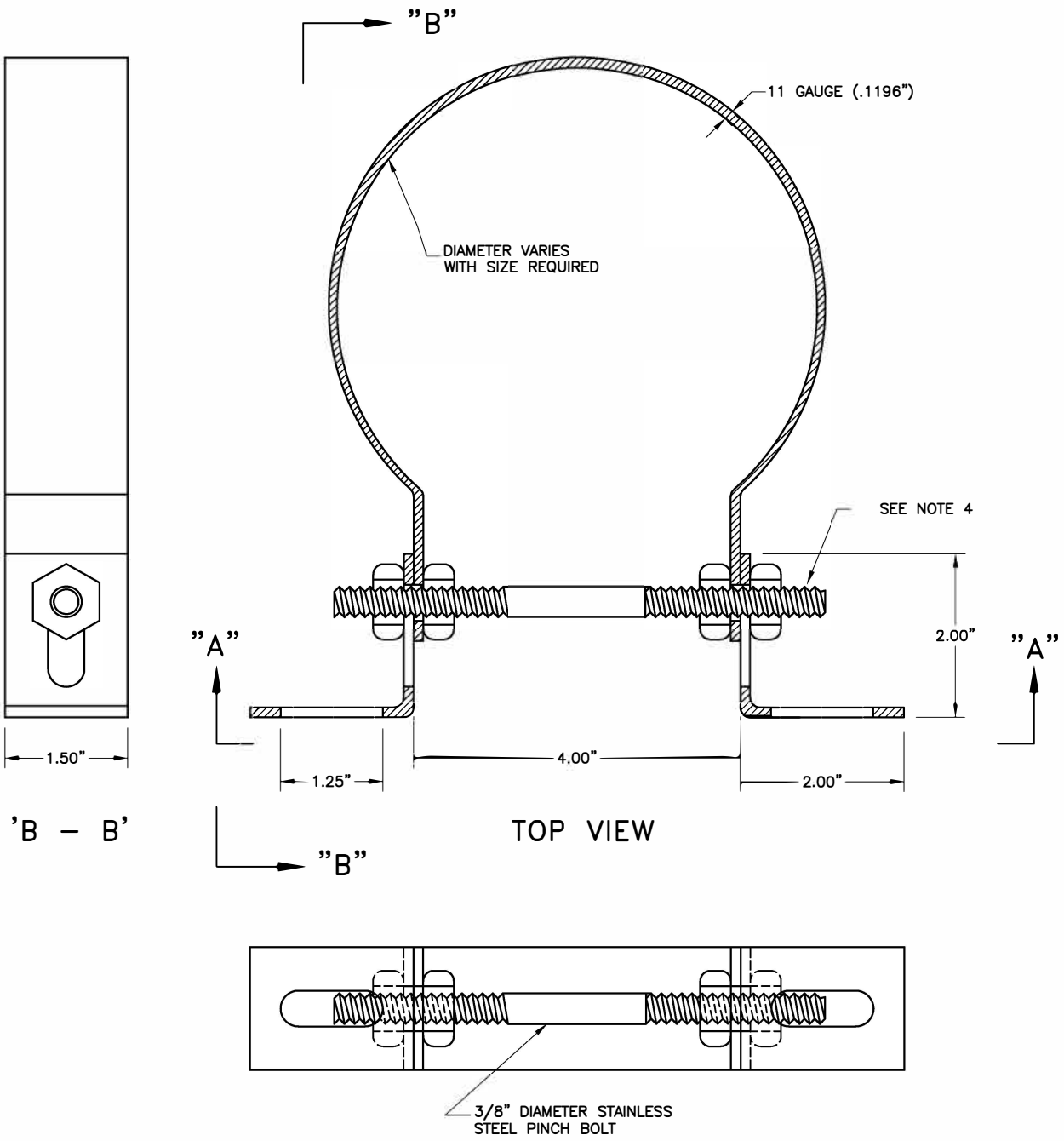
1. CREATING A HOLE IN THE MANHOLE WALL MUST BE BY CORE BORE. SEAL ANNULAR SPACE WITH BONDING AGENT AND NON-SHRINK GROUT.
2. ALL INSIDE DROP CONNECTIONS MUST USE THE DROP BOWL OR APPROVED EQUAL.
3. FOR RESIDENTIAL SERVICE, 4" PIPE AND 4" BOWL MUST BE USED.
4. DROP BOWL MODEL "A-4" MUST BE USED FOR ALL LINES UP THROUGH FULL 6" INLETS. DROP BOWL MODEL "A-6" MUST BE USED FOR ALL 8" INLETS. DROP BOWLS MODEL "B-8" MUST BE USED FOR ALL 10" INLETS. MODEL "B-10" MUST BE USED FOR ALL 12" INLETS.
5. SECURE DROP PIPE TO MANHOLE WALL WITH RELINER-DURAN, INC STAINLESS STEEL ADJUSTABLE CLAMPING BRACKETS OR APPROVED EQUAL (SEE MH-10).
6. ATTACH THE DROP BOWL & EACH CLAMPING BRACKET TO THE MANHOLE WALL WITH STAINLESS STEEL 3/8" X 3 3/4" RAMSET/RED HEAD BOLTS. PRE-ROTO DRILL AND SET BOLTS IN PLACE WITH EPOXY PASTE. EPOXY MUST BE SIKADUR 31 HI-MOD GEL BY SIKA CORPORATION OR APPROVED EQUAL.
7. MAXIMUM 2 DROP CONNECTIONS PER MANHOLE.

SACRAMENTO AREA **SEWER** DISTRICT

INSIDE DROP CONNECTIONS

DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

MH-07



STAINLESS STEEL ADJUSTABLE CLAMPING BRACKET AS MANUFACTURED BY:
RELINER–DURAN, INC.

SPECIFICATIONS:

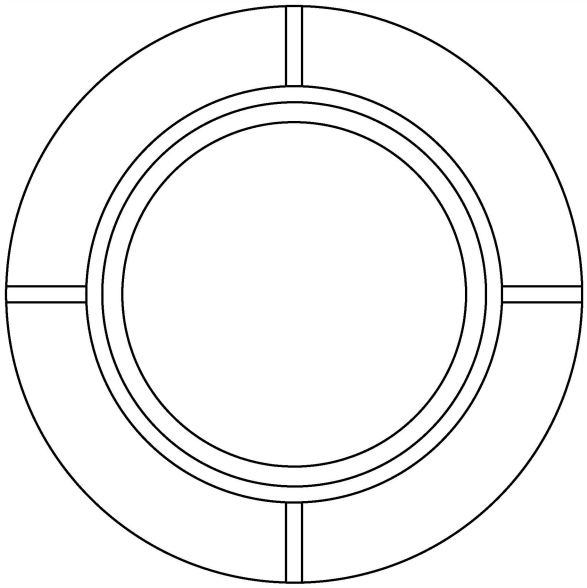
1. CLAMP AND BRACKETS IS TYPE 304 STAINLESS STEEL, 11 GAUGE (.1196").
2. 3/8" ø PINCH BOLT AND NUTS IS TYPE 18–8 STAINLESS STEEL.
3. STANDARD SIZES TO FIT 6" AND 8" PVC SEWER PIPE SDR–26.
4. LIBERALLY COAT ALL THREADS WITH ANTI–SEIZE.

SACRAMENTO AREA **SEWER** DISTRICT

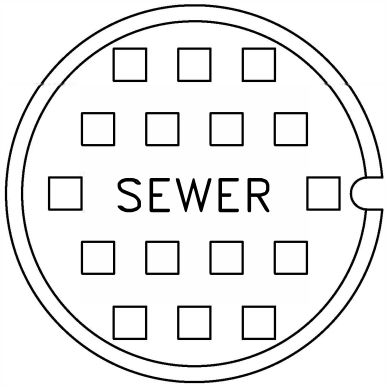
DROP CONNECTION ADJUSTABLE PIPE BRACKET

DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

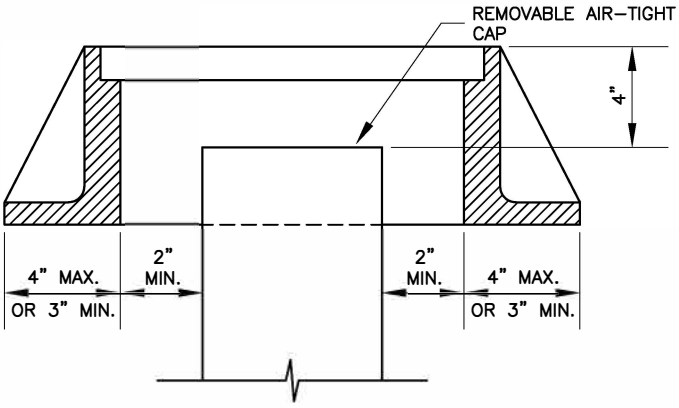
MH-08



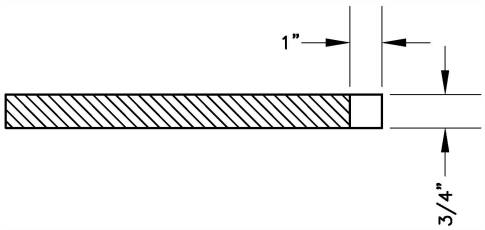
FRAME



COVER



FRAME PROFILE



COVER PROFILE

NOTES:

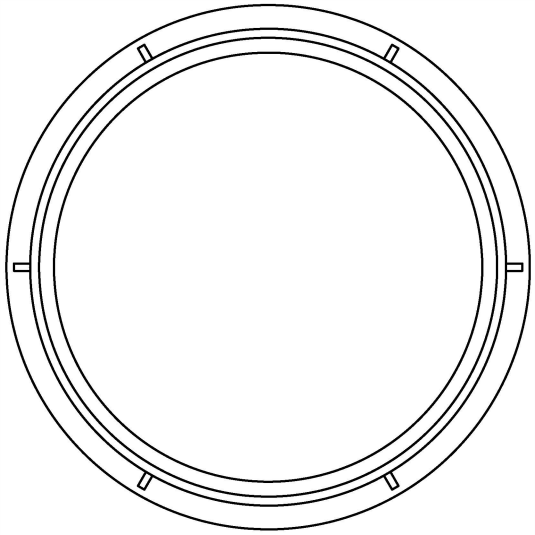
1. ALL MATERIALS USED IN MANUFACTURING MUST CONFORM TO ASTM A48, CLASS 35B.
2. CASTINGS MUST BE DIPPED IN BLACK, BITUMINOUS PAINT.
3. FRAME AND COVER MEETS H–20 WHEEL LOADING.
4. PIPE SIZES PER MH–02A & MH–02B.

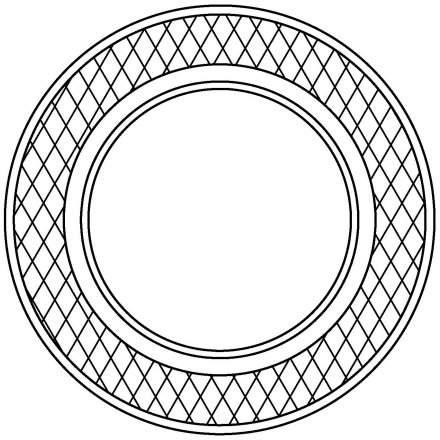
SACRAMENTO AREA **SEWER** DISTRICT

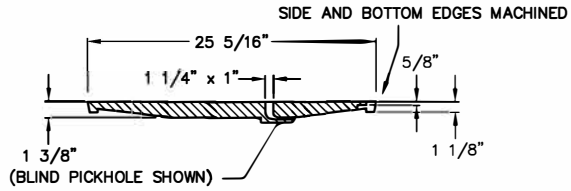
STANDARD FLUSHER BRANCH FRAME AND COVER

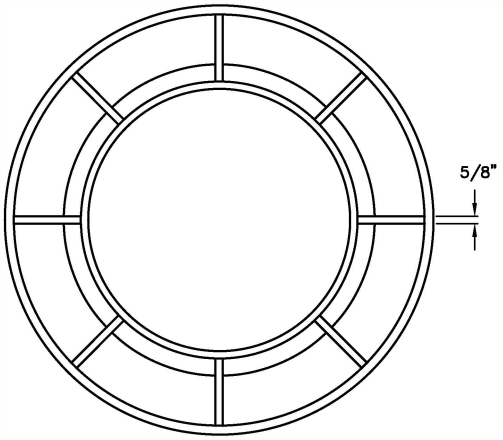
DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

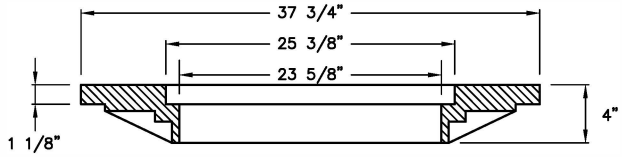
MH-09

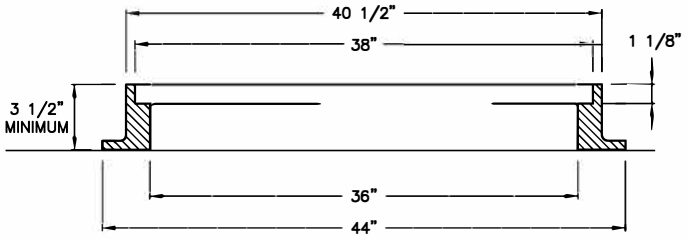


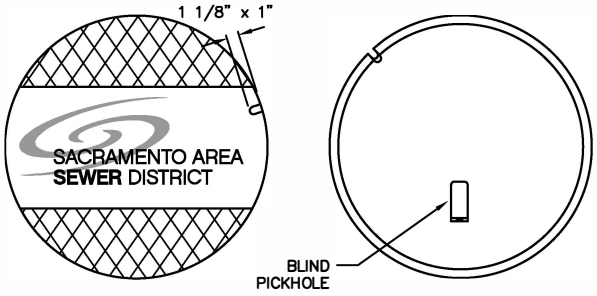












NOTES:

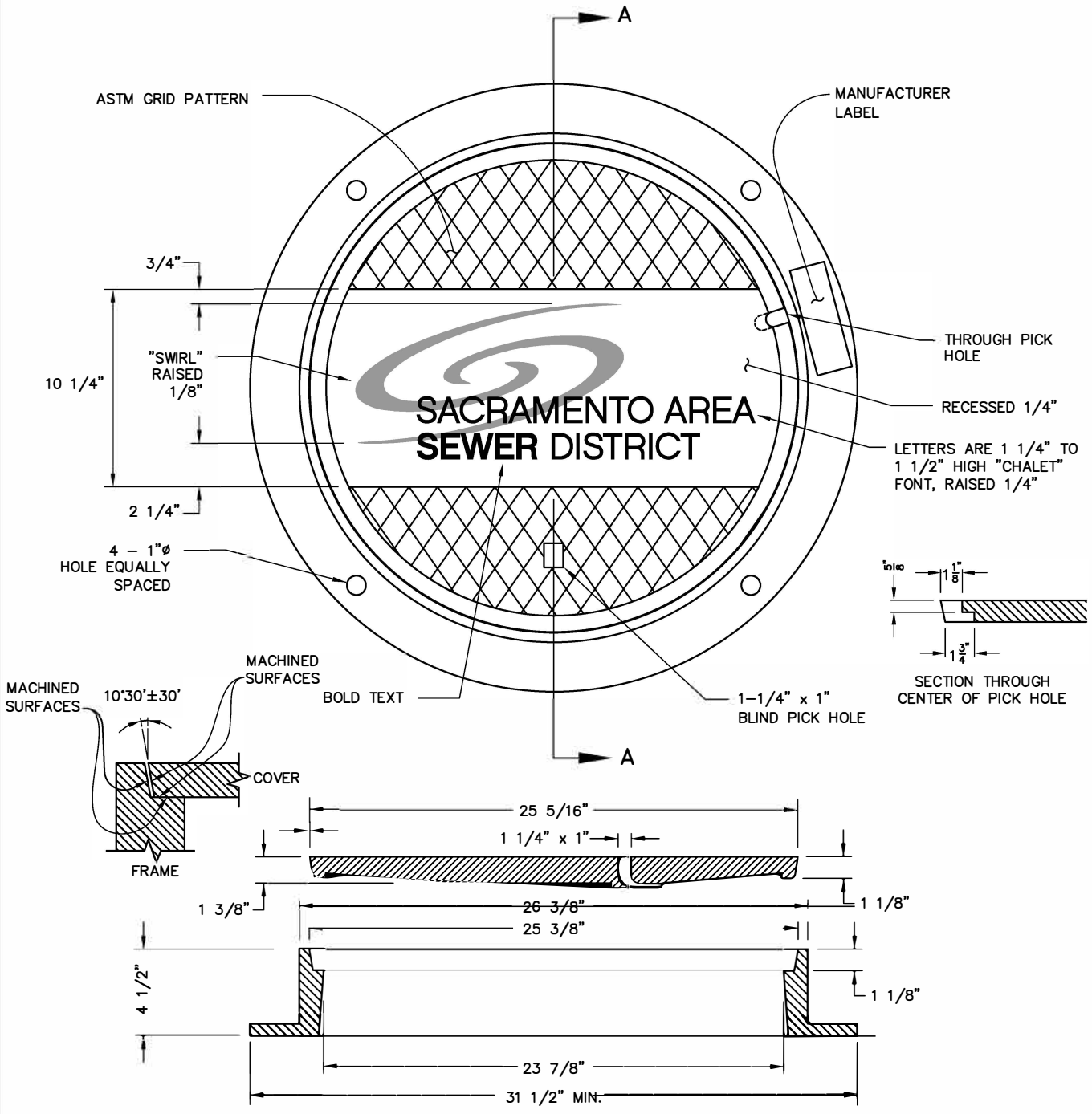
1. ALL CASTINGS TO CONFORM TO ASTM A48, CLASS 35B.
2. FRAME AND COVER TO MEET H–20 LOAD SPECIFICATIONS.
3. ALL MACHINED SURFACES MUST MAINTAIN SPECIFIED TOLERANCES PER AASHTO SPECIFICATIONS.
4. FRAME AND COVER MUST HAVE A COATING OF BITUMINOUS MATERIAL.

SACRAMENTO AREA
SEWER DISTRICT

GREY IRON DOUBLE COVER 36" MANHOLE FRAME AND COVER

DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

MH-10



SECTION A–A

NOTES:

1. ALL CASTINGS TO CONFORM TO ASTM A48, CLASS 35B.
2. FRAME AND COVER TO MEET H–20 LOAD SPECIFICATIONS. WEIGHT AND LOAD SPECIFICATIONS TO BE SUBMITTED BY MANUFACTURER.
3. ALL MACHINED SURFACES MUST MAINTAIN SPECIFIED TOLERANCES PER AASHTO SPECIFICATIONS.
4. FRAME AND COVER MUST HAVE A COATING OF BITUMINOUS MATERIAL.
5. LOCKING COVER TYPE FRAME AND COVERS MUST BE USED IN EASEMENT AREAS UNLESS OTHERWISE APPROVED.

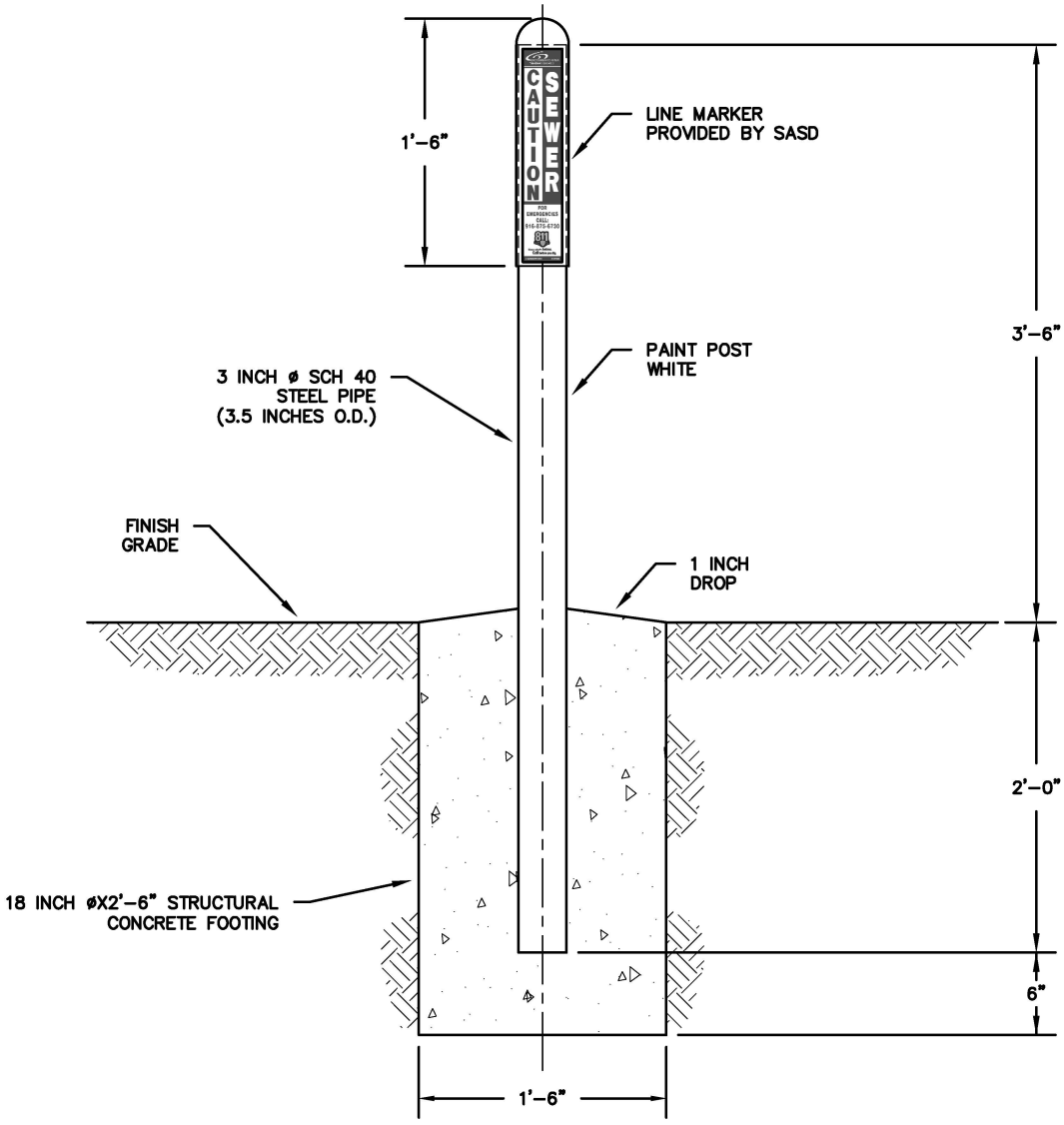
ITEM	APPROX. WT. (LBS)
COVER	130 ± 5%

SACRAMENTO AREA
SEWER DISTRICT

GREY IRON STANDARD 24" MANHOLE FRAME AND COVER

DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

MH-11



MARKER BOLLARD DETAIL

NOTES:

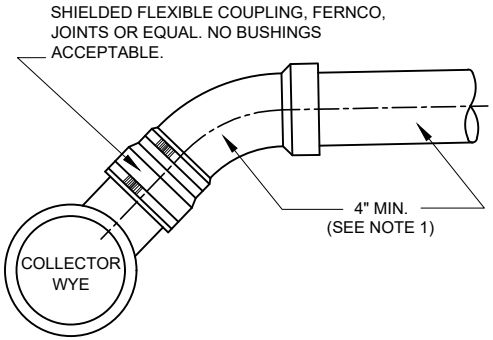
1. PLACE MARKER BOLLARD IN UNDEVELOPED PROPERTY 2 FT FROM CLEANOUT / FLUSHER BRANCH OR 5 FT FROM MANHOLE AS MEASURED FROM THE CENTERLINE.
2. PLACE MARKER BOLLARD BEHIND CLEANOUT / FLUSHER BRANCH OR MANHOLE AT END OF MAIN LINE RUN OR OFFSET 90 DEGREES TO THE RIGHT LOOKING UPSTREAM THROUGH MAIN LINES.
3. CLEAN POST WITH MINERAL SPIRITS AND APPLY A RUST–INHIBITIVE PRIMER FOLLOWED BY TWO COATS OF WHITE PAINT.

SACRAMENTO AREA
SEWER DISTRICT

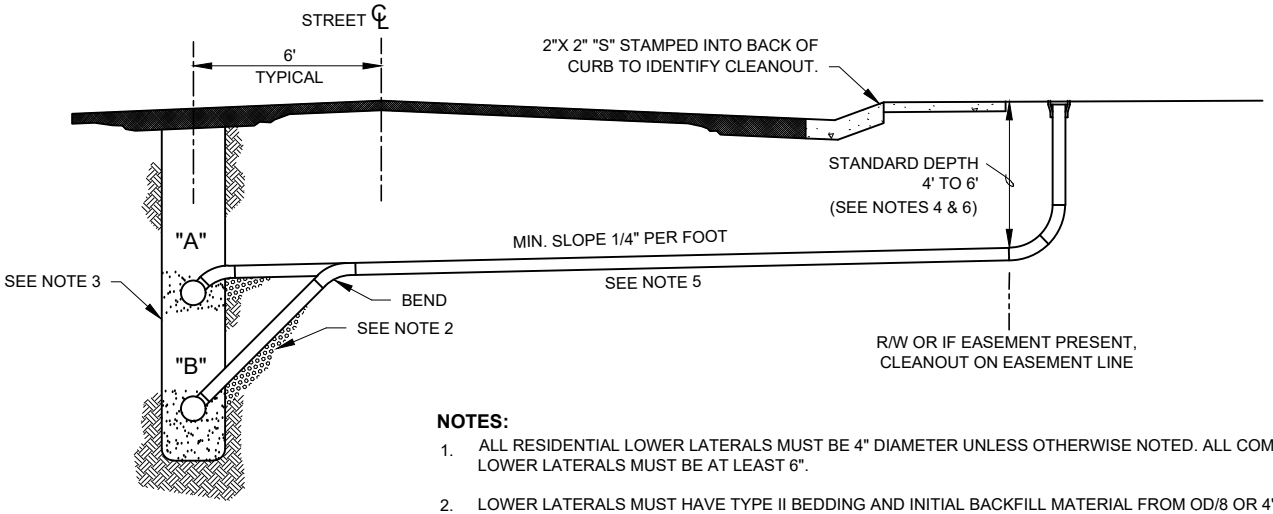
MARKER BOLLARD DETAIL

DRAWN BY: RAS
SCALE: NONE
DATE: 9/21

MH-12



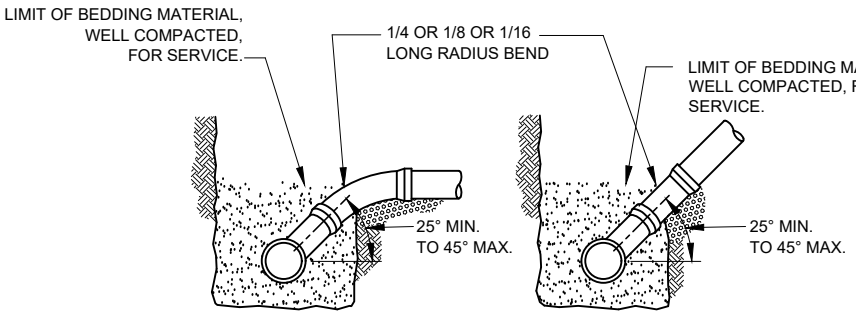
STANDARD LOWER LATERAL CONNECTION



ELEVATIONS

NOTES:

1. ALL RESIDENTIAL LOWER LATERALS MUST BE 4" DIAMETER UNLESS OTHERWISE NOTED. ALL COMMERCIAL LOWER LATERALS MUST BE AT LEAST 6".
2. LOWER LATERALS MUST HAVE TYPE II BEDDING AND INITIAL BACKFILL MATERIAL FROM OD/8 OR 4" MIN BELOW TO 12" MIN ABOVE THE PIPE BELL PER STANDARD DRAWING P-01.
3. CONTRACTOR MUST USE THE MOST APPROPRIATE TYPE CONNECTION (A OR B) FOR THE PARTICULAR SITUATION.
4. THE STANDARD LOWER LATERAL HAS 4' TO 6' OF COVER AT THE EDGE OF RIGHT-OF-WAY OR EASEMENT. THE STANDARD COVER MAY NEED TO BE DEEPER SHOULD OTHER UTILITIES BE LOCATED IN ADJACENT AREAS.
5. WHEN THE COLLECTOR SEWER DEPTH IS SUCH THAT MINIMUM COVER AT PROPERTY LINE CANNOT BE MET, THE MINIMUM SLOPE OF 1/4" PER FOOT MUST GOVERN THE COVER.
6. MINIMUM SPECIFIED COVER AT THE EDGE OF RIGHT-OF-WAY OR EASEMENT MUST BE MEASURED FROM EXISTING GROUND SURFACE OR EDGE OF ADJACENT ROADWAY, WHICHEVER IS LOWER.
7. A SPECIFIC ELEVATION AT THE EDGE OF RIGHT-OF-WAY OR EASEMENT, WHEN SHOWN ON THE PLANS OR DESIGNATED BY THE ENGINEER, MUST GOVERN.
8. A MINIMUM VERTICAL SEPARATION OF 1 FOOT BETWEEN WATER LINES AND SEWER LINES MUST BE MAINTAINED.
9. FACTORY TYPE WYE CONNECTIONS TO THE COLLECTOR MUST BE USED.
10. THE PIPE MATERIAL USED FOR THE CLEANOUT RISER MUST BE SDR-26 OR C900 WHEN THE DEPTH TO THE BOTTOM OF THE CLEANOUT IS MORE THAN 10 FEET.



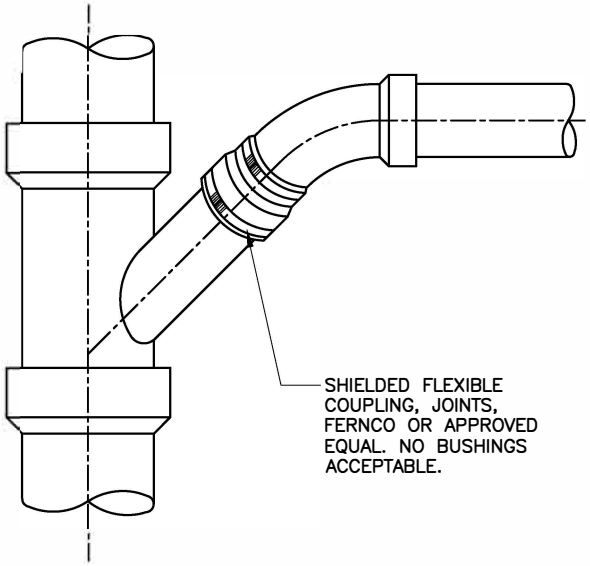
CONNECTION DETAILS

SACRAMENTO AREA SEWER DISTRICT

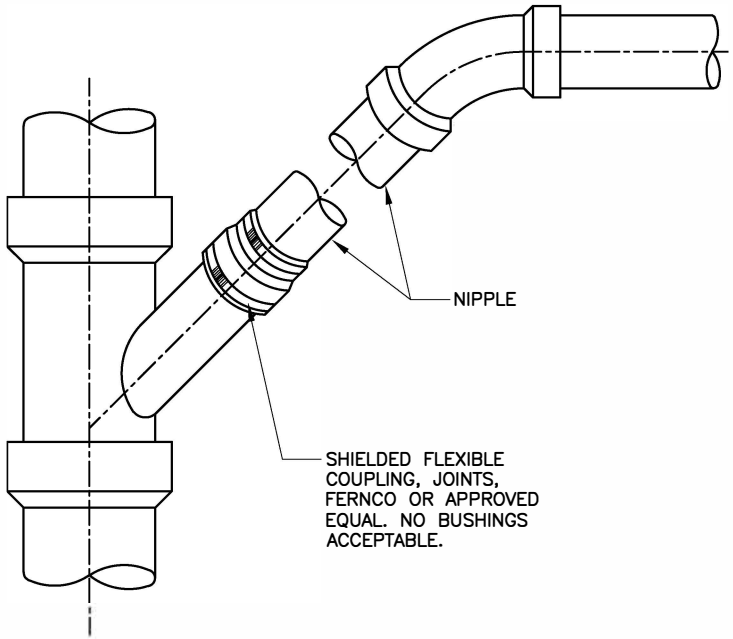
LOWER LATERAL

DRAWN BY: RAS
SCALE: NONE
DATE: 2/23

LL-01A



TYPE "A" SERVICE



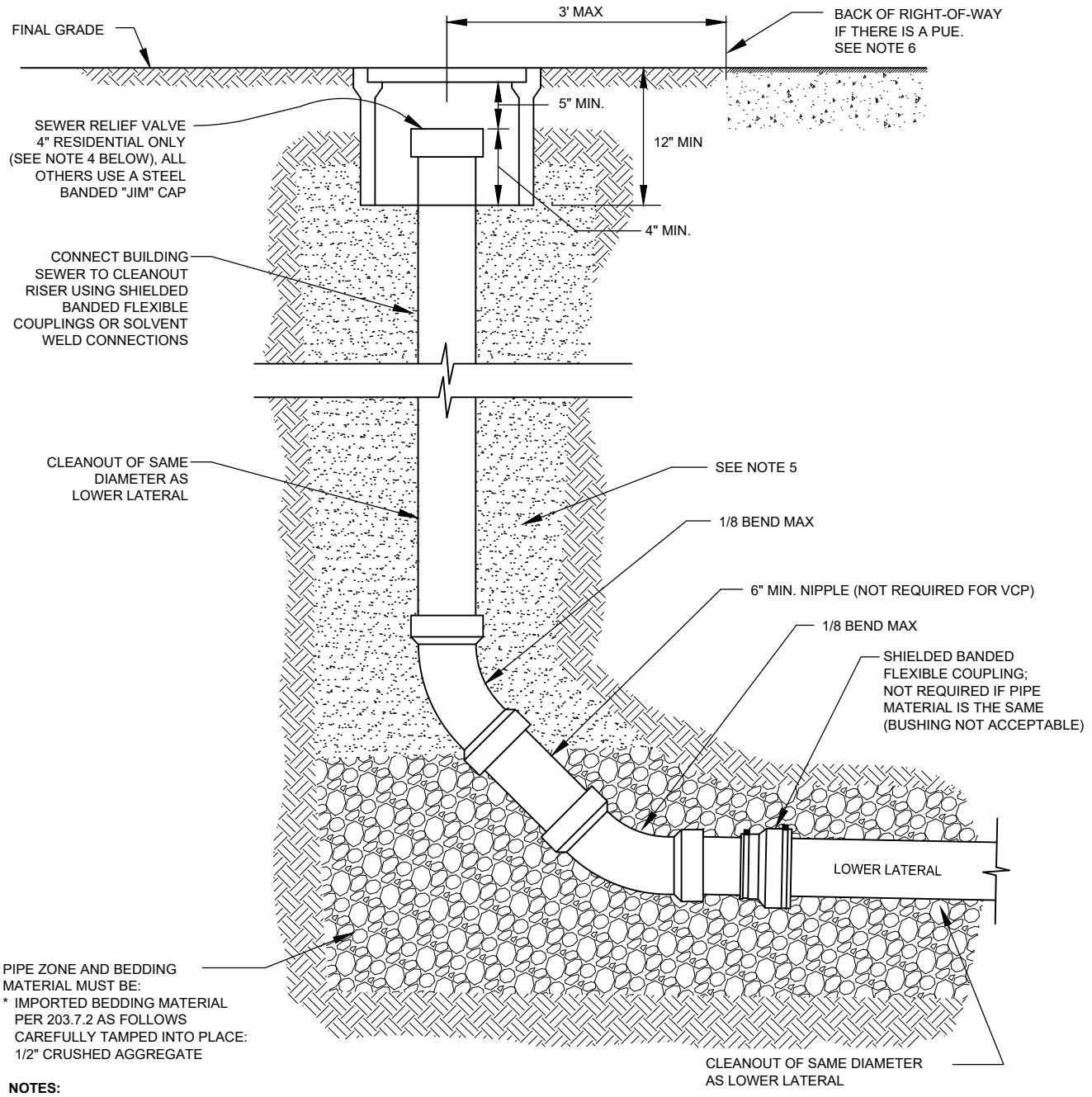
TYPE "B" SERVICE

SACRAMENTO AREA
SEWER DISTRICT

LOWER LATERAL CONNECTION PLAN VIEW

DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

LL-01B



NOTES:

1. CLEANOUT TO BE CONSTRUCTED USING SOLVENT WELD JOINTS WHENEVER POSSIBLE. VCP MUST BE BELL & SPIGOT WITH POLYURETHANE JOINT.

2. FOR 4" SERVICES IN NON-TRAVEL WAYS, INSTALL ROUND NON-TRAFFIC TYPE CONCRETE OR PVC VALVE BOX MANUFACTURED BY CARSON INDUSTRIES OR APPROVED EQUAL. COVER TO BE MARKED "SEWER". BOX INSIDE DIAMETER TO BE A MINIMUM OF 7" AND A MAXIMUM OF 10".

3. FOR SERVICES 4" AND 6" IN DRIVEWAYS OR OTHER TRAVEL WAYS, INSTALL ROUND CONCRETE TRAFFIC TYPE VALVE BOX WITH CAST IRON COVER SUCH AS CHRISTY #G-5 OR APPROVED EQUAL. COVER TO BE MARKED "SEWER".

4. SEWER RELIEF VALVE MUST BE ONE OF THE FOLLOWING OR APPROVED EQUAL:
   MISSION RUBBER PART NO. 0704013 OR 0705025

5. PLACE A MINIMUM OF 12" OF BACKFILL ALL AROUND THE OUTSIDE DIAMETER OF THE RISER AND MECHANICALLY COMPACT TO 90% RELATIVE DENSITY. BACKFILL MATERIAL MUST BE USED TO 12" FROM GRADE OR TO TOP OF SUBGRADE IF UNDER CONCRETE.

6. THE CLEANOUT MUST BE PLACED AT THE EDGE OF THE RIGHT-OF-WAY IF NO PUE EXISTS. THE CLEANOUT MUST BE PLACED WITHIN THE PUE A MAXIMUM OF 3' FROM BACK OF SIDEWALK WHEN THE RIGHT-OF-WAY IS AT BACK OF CURB. THE CLEANOUT MUST BE PLACED WITHIN THE PUE A MAXIMUM OF 3' FROM BACK OF CURB WHEN LANDSCAPING SEPARATES THE CURB AND SIDEWALK AND THE RIGHT-OF-WAY IS AT THE BACK OF CURB.

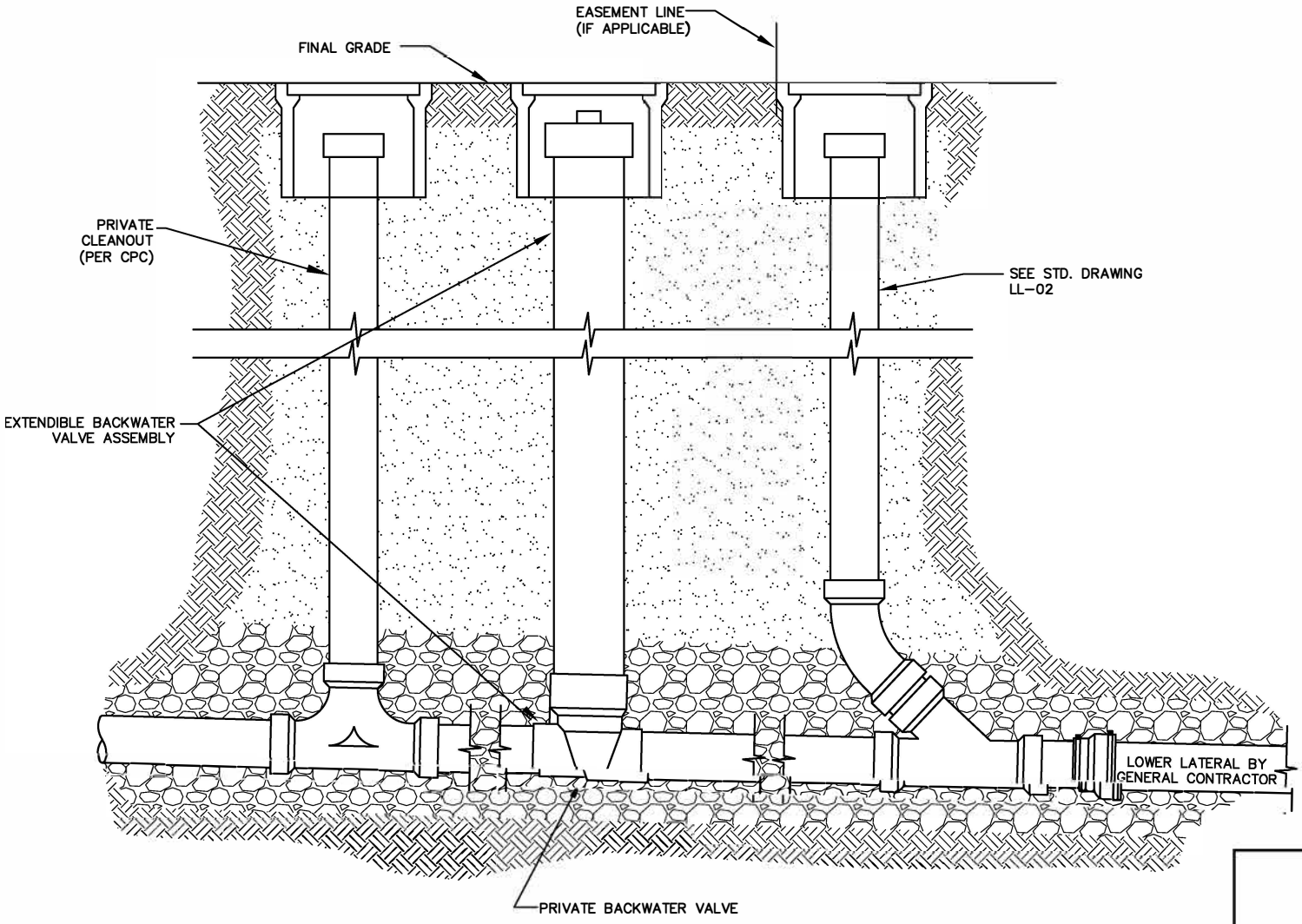
7. THE PIPE MATERIAL USED FOR THE CLEANOUT RISER MUST BE SDR-26 OR C900 WHEN THE DEPTH TO THE BOTTOM OF THE CLEANOUT IS MORE THAN 10 FEET.

SACRAMENTO AREA
SEWER DISTRICT

STANDARD CLEANOUT TO GRADE

DRAWN BY: RAS
SCALE: NONE
DATE: 2/23

LL-02



NOTES:

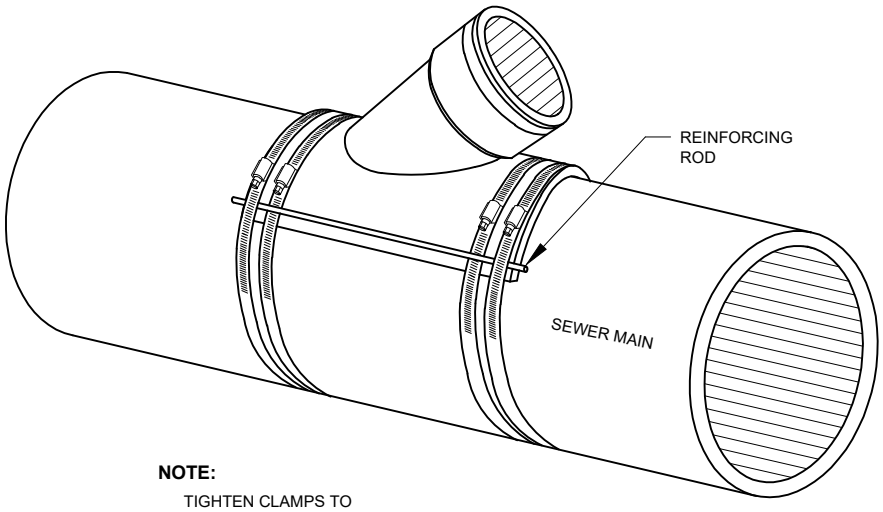
1. MAINTENANCE OF THE BACKWATER VALVE TO BE PERFORMED BY THE PROPERTY OWNER OR OCCUPANT PER THE MANUFACTURERS RECOMMENDATIONS. NEVER ROD THROUGH THE BACKWATER VALVE SEAT AREA. REMOVE THE VALVE ASSEMBLY BEFORE MAINTENANCE ACTIVITIES.
2. ANY MODIFICATION OR RELOCATION OF THE BACKWATER VALVE TO BE DONE PER THE MANUFACTURER'S RECOMMENDATIONS. A PLUMBING PERMIT AND INSPECTION IS REQUIRED BY BUILDING INSPECTION DIVISION.
3. IF MULTI-STORY STRUCTURE, CONNECT BACKWATER VALVE AS REQUIRED BY CALIFORNIA PLUMBING CODE (CPC).

SACRAMENTO AREA
SEWER DISTRICT

PRIVATE BACKWATER VALVE TO GRADE

DRAWN BY: RAS
SCALE: NONE
DATE: 8/20

LL-03



NOTE:

TIGHTEN CLAMPS TO MANUFACTURER'S RECOMMENDATIONS.

NOTES:

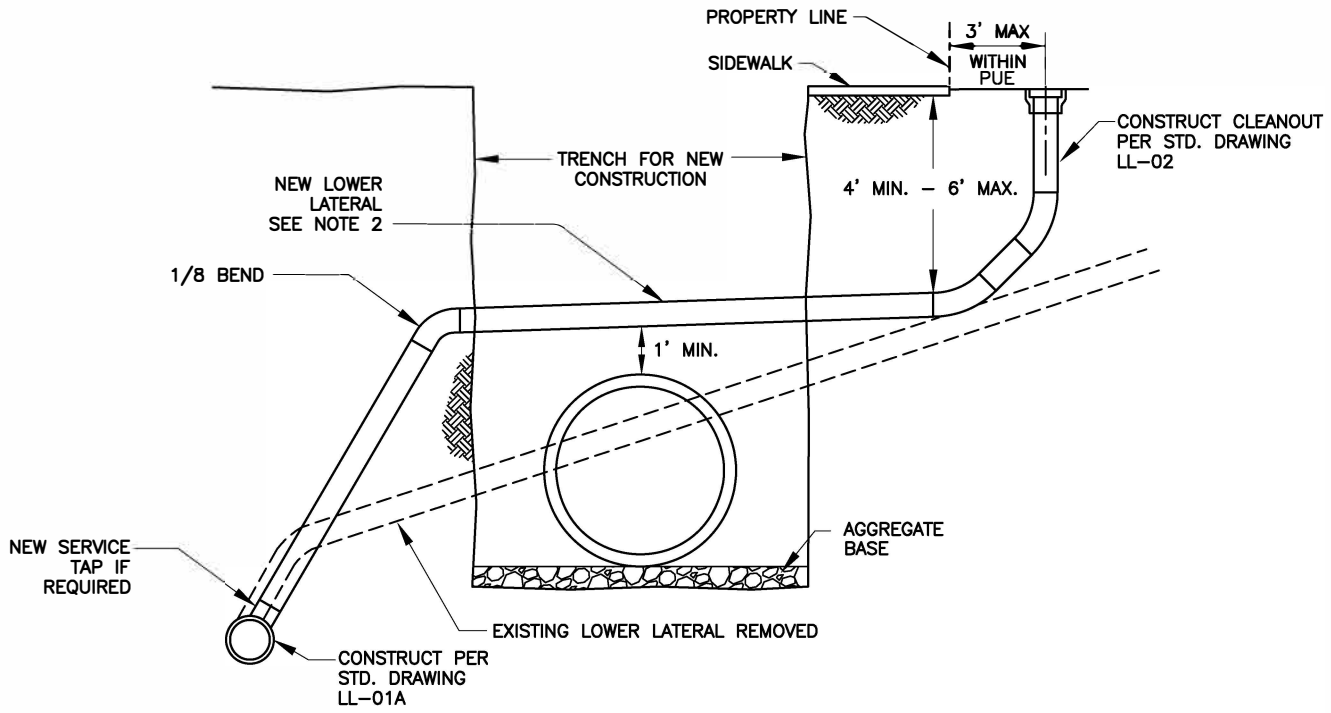
1. FLEXIBLE TAP SADDLE WITH PRESSURE KIT MANUFACTURED BY FERNCO OR APPROVED EQUAL.
2. THIS METHOD REQUIRES APPROVAL OF SACSEWER PRIOR TO CONSTRUCTION.
3. WRAP SADDLE IN 8 MILS LOW DENSITY POLYETHYLENE.
4. TAP MUST BE CORE DRILLED, NO CHIPPING OF THE SEWER MAIN ALLOWED.

SACRAMENTO AREA SEWER DISTRICT

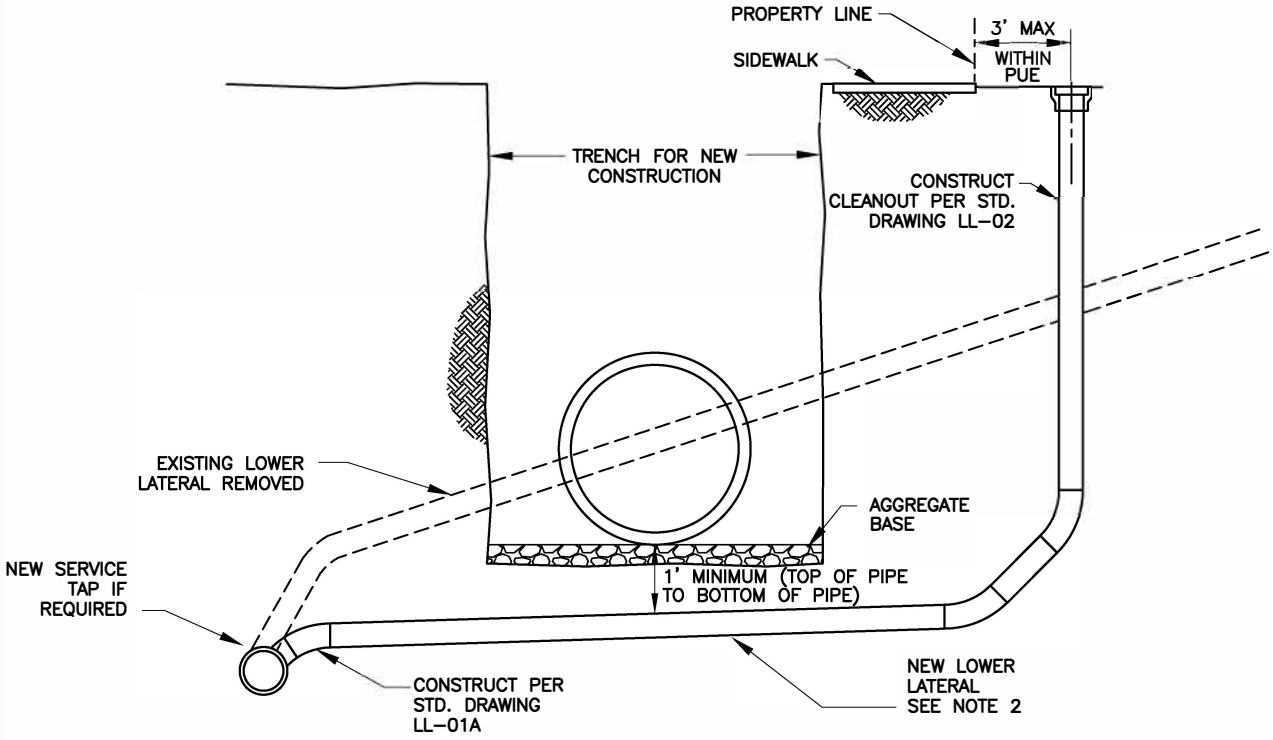
LOWER LATERAL ALTERNATIVE CONNECTION TO EXISTING MAIN LINE

DRAWN BY: RAS
SCALE: NONE
DATE: 2/23

LL-04



EXISTING LOWER LATERAL RELOCATION OPTION OVER NEW CONSTRUCTION



EXISTING LOWER LATERAL RELOCATION OPTION UNDER NEW CONSTRUCTION

NOTES:

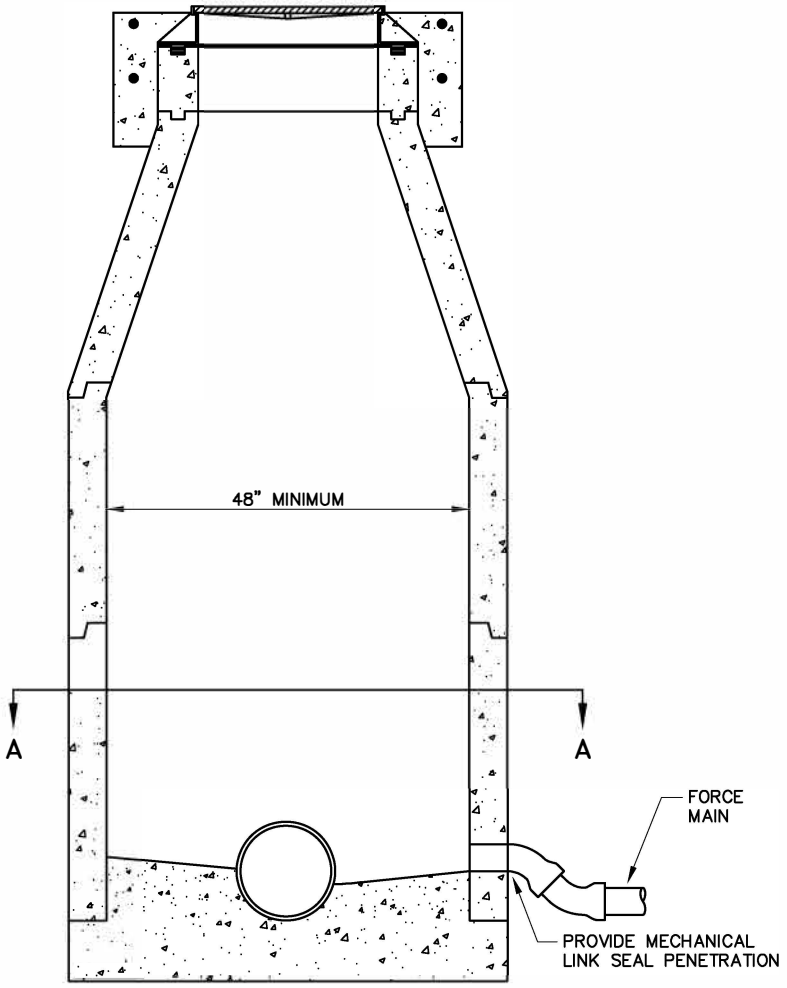
1. IF NEITHER OF THESE OPTIONS IS AVAILABLE, THE ELEVATION OF THE NEW FACILITY WILL NEED TO BE ADJUSTED TO ACCOMMODATE ONE OF THESE OPTIONS.
2. NEW LATERAL (MIN. SLOPE = 1/4" PER FT.) MUST HAVE TYPE II ALTERNATE BEDDING AND INITIAL BACKFILL MATERIAL FROM OD/8, 4" MIN. BELOW TO 12" MIN. ABOVE THE PIPE BELL PER STANDARD DRAWING P-01.

SACRAMENTO AREA **SEWER** DISTRICT

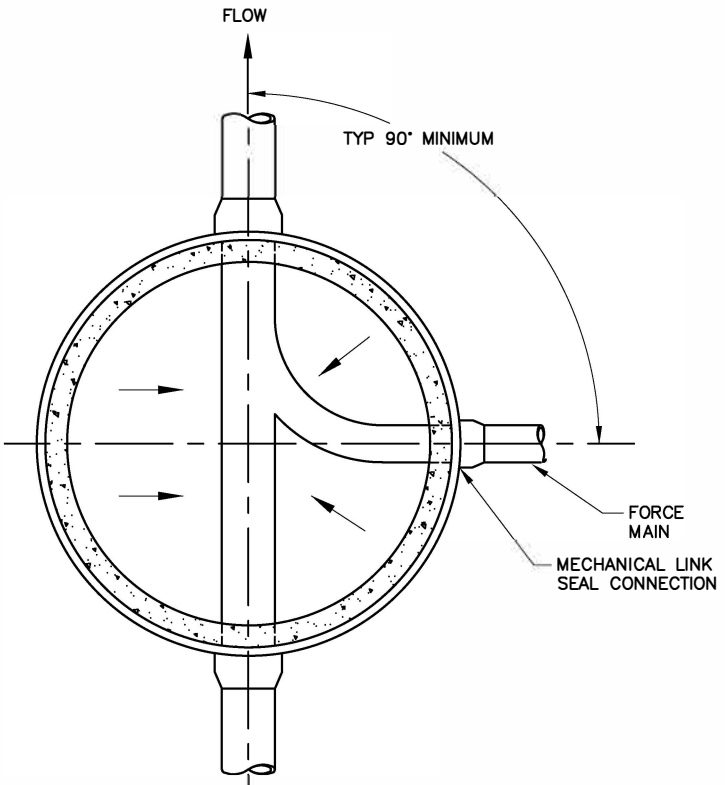
LOWER LATERAL REPLACEMENT

DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

LL-05



SECTION A–A



PLAN VIEW OF INVERT

NOTES:

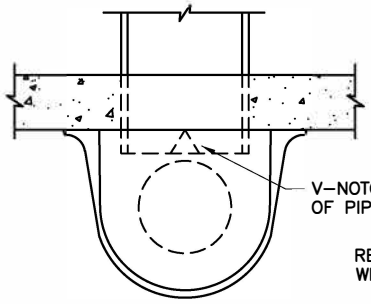
1. CREATING A HOLE IN THE MANHOLE WALL MUST BE BY CORE BORE. METHOD MUST INSURE MANHOLE INTEGRITY. SEAL BOTH INSIDE AND OUTSIDE WITH NON–SHRINK GROUT.
2. LINE RECEIVING MANHOLE AND NEXT DOWNSTREAM MANHOLE WITH ARMOR ROCK OR APPROVED EQUAL.
3. INVERT ELEVATION OF FORCE MAIN MUST MATCH THE SPRING LINE ELEVATION OF OUTGOING GRAVITY PIPE.

SACRAMENTO AREA
SEWER DISTRICT

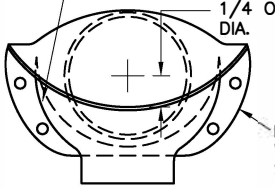
FORCE MAIN TIE-IN AT BASE MANHOLE

DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

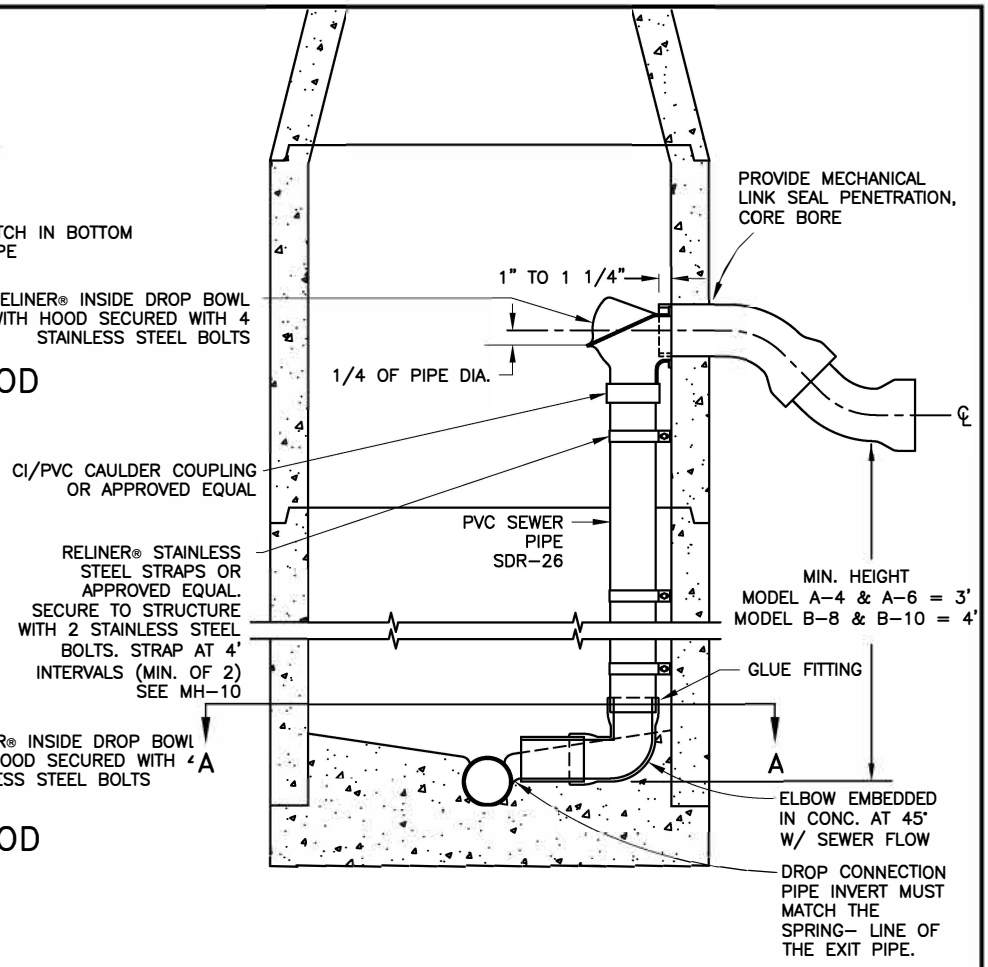
FM-01A



DROP BOWL WITH HOOD
MOUNTING POSITION
TOP VIEW

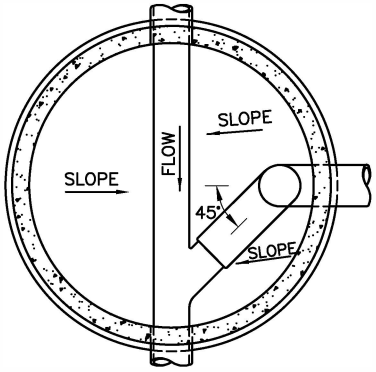


DROP BOWL WITH HOOD
MOUNTING POSITION
FRONT VIEW



NOTES:

1. CREATING A HOLE IN THE MANHOLE WALL SHALL BE BY CORE BORE. METHOD MUST INSURE MANHOLE INTEGRITY. SEAL BOTH INSIDE AND OUTSIDE WITH NON–SHRINK GROUT.
2. ALL INSIDE DROP CONNECTIONS MUST USE A DROP BOWL BY RELINER–DURAN, INC. OR APPROVED EQUAL.
3. DROP BOWL MODEL "A–4" MUST BE USED FOR ALL LINES UP THROUGH FULL 6" INLETS. DROP BOWL MODEL "A–6" MUST BE USED FOR ALL 8" INLETS. DROP BOWLS MODEL "B–8" MUST BE USED FOR ALL 10" INLETS. MODEL "B–10" MUST BE USED FOR ALL 12" INLETS.
4. SECURE DROP PIPE TO MANHOLE WALL WITH RELINER–DURAN, INC STAINLESS STEEL ADJUSTABLE CLAMPING BRACKETS OR APPROVED EQUAL (SEE STD. DWG. MH–10).
5. ATTACH THE DROP BOWL & EACH CLAMPING BRACKET TO THE MANHOLE WALL WITH STAINLESS STEEL 3/8" X 3 3/4" RAMSET/RED HEAD BOLTS. PRE–ROTO DRILL AND SET BOLTS IN PLACE WITH EPOXY PASTE TYPE SIKADUR 31 HI–MOD GEL BY SIKA CORPORATION OR APPROVED EQUAL.
6. MAXIMUM 2 DROP CONNECTIONS PER MANHOLE.
7. COAT INTERIOR OF RECEIVING AND NEXT DOWNSTREAM MANHOLES WITH SHERWIN WILLIAMS DURA–PLATE 6100 HIGH PERFORMANCE EPOXY AT 100–15 MILS OR APPROVED EQUAL.



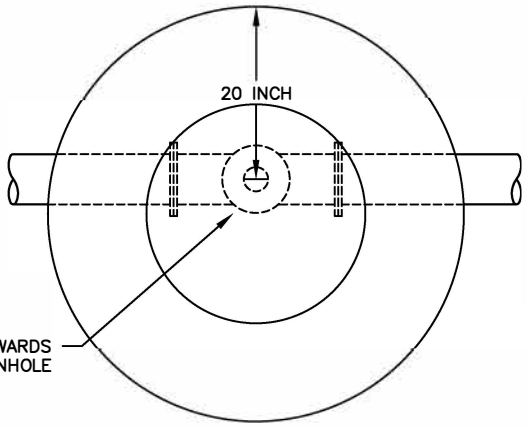
SECTION A–A
PLAN

SACRAMENTO AREA
SEWER DISTRICT

FORCE MAIN TIE-IN
DROP CONNECTION

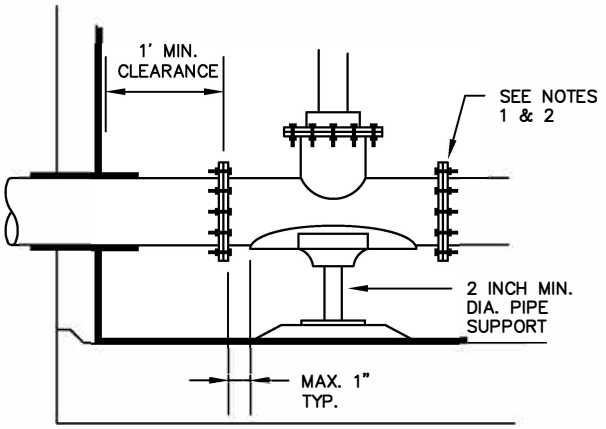
DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

FM-01B



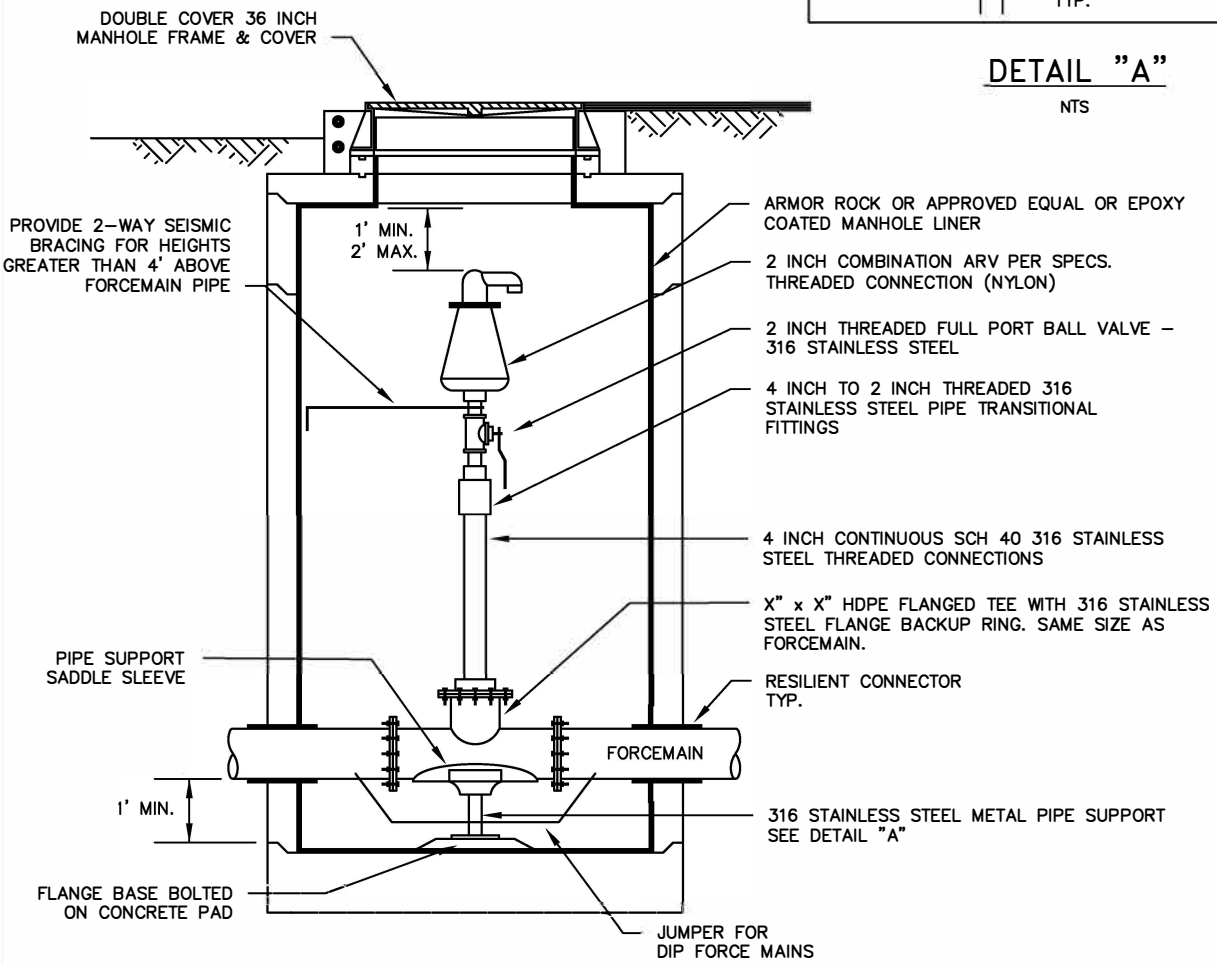
MANHOLE PLAN VIEW

SEE NOTE 4



DETAIL "A"

NTS



MANHOLE SECTION

NTS

NOTES:

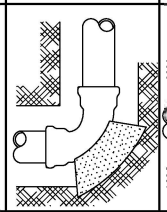
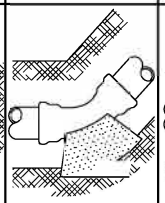
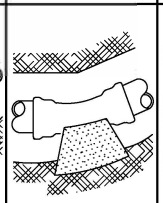
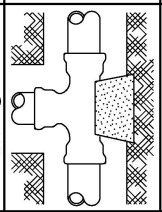
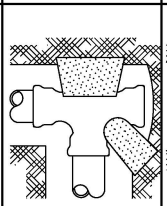
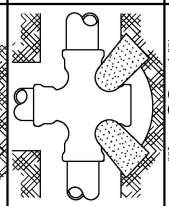
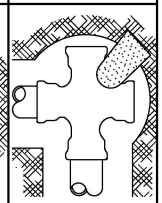
1. ALL HARDWARE AND FASTENERS MUST BE 316 STAINLESS STEEL.
2. FLANGE CONNECTIONS MUST USE NEOPRENE GASKETS BETWEEN FLANGES WITH STAINLESS STEEL WASHERS ON THE OUTSIDE.
3. PIPE PENETRATIONS THROUGH MANHOLE MUST INCLUDE RESILIENT CONNECTORS CONFORMING TO ASTM STANDARD C923 SUCH AS KOR-N-SEAL 306 SERIES OR APPROVED EQUAL.
4. FORCEMAIN OFFSET, NOT CENTERED, IN MANHOLE.

SACRAMENTO AREA **SEWER** DISTRICT

STANDARD 60" AIR RELEASE VALVE MANHOLE

DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

FM-02

REQUIRED BEARING AREA – TOTAL SQUARE FEET								
TYPE OF FITTING		90° BEND	45° BEND	11 1/4" OR 22 1/2" BEND	TEE OR DEAD END	TEE W/PLUG	CROSS W/PLUG	CROSS W/PLUGS
TYPICAL INSTALLATION								
SIZE OF PIPE	4"	2	1	1	2	2	2	2
	6"	4	2	1	3	4	4	4
	8"	7	4	2	5	7	7	7
	10"	12	6	3	8	12	12	12
	12"	16	10	5	12	16	16	16

NOTES:

1. THRUST BLOCKS TO BE CONSTRUCTED OF CLASS "B" CONCRETE.
2. AREAS GIVEN ARE FOR CLASS 150 PIPE AT TEST PRESSURE OF 150 P.S.I. IN SOIL WITH MINIMUM 2,000 P.S.F. BEARING CAPACITY. INSTALLATIONS USING DIFFERENT PIPE, TEST PRESSURES, AND/OR SOIL TYPES SHOULD ADJUST AREAS ACCORDINGLY.
3. BLOCKS TO BE POURED AGAINST UNDISTURBED SOIL.
4. JOINTS AND FACE OF PLUGS TO BE KEPT CLEAR OF CONCRETE.
5. THRUST BLOCKS ARE REQUIRED AT EVERY ANGLE, TEE, AND CROSS UNRESTRAINED.
6. BACKFILL OVER THRUST BLOCKS CANNOT PROCEED UNTIL CONCRETE HAS CURED.

THRUST BLOCK DETAILS

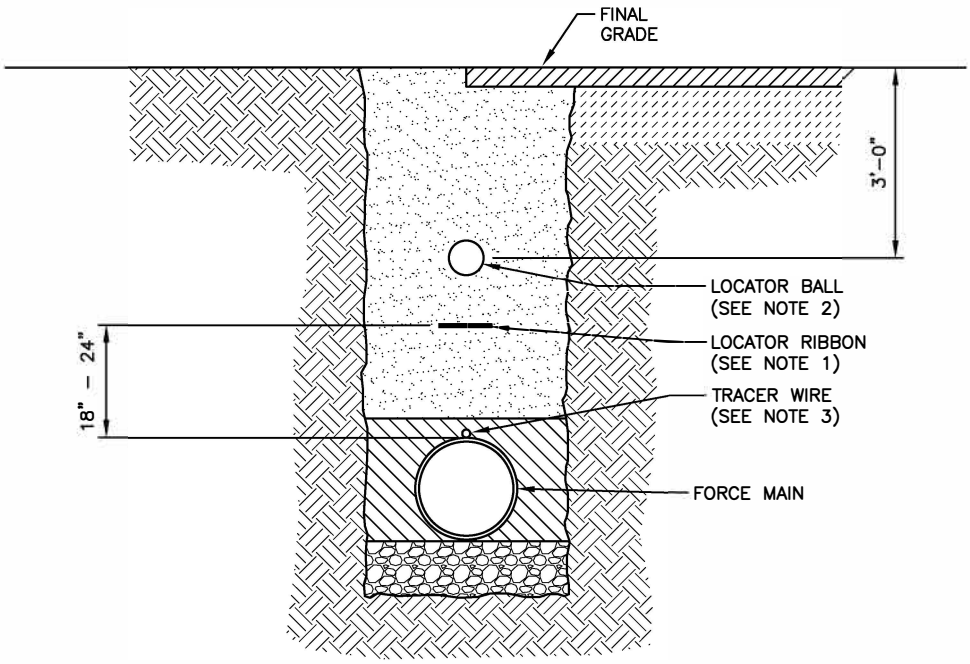
NOT TO SCALE

SACRAMENTO AREA **SEWER** DISTRICT

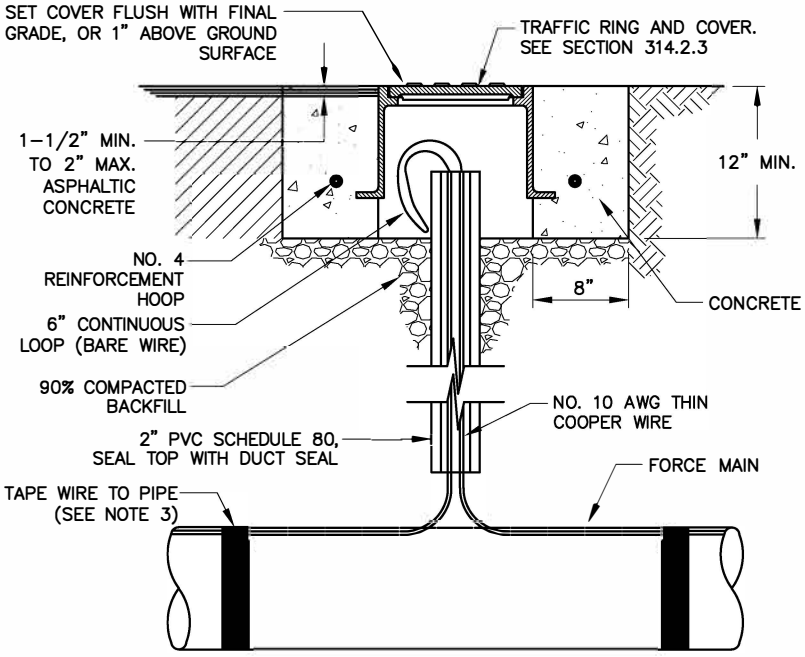
THRUST BLOCK DETAILS

DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

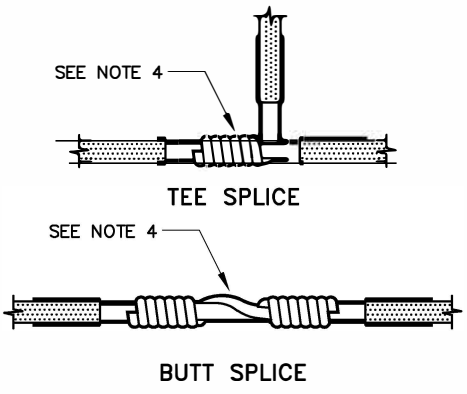
FM-03



TRENCH SECTION



LOCATING WIRE STATION



SPLICE DETAILS

NOTES:

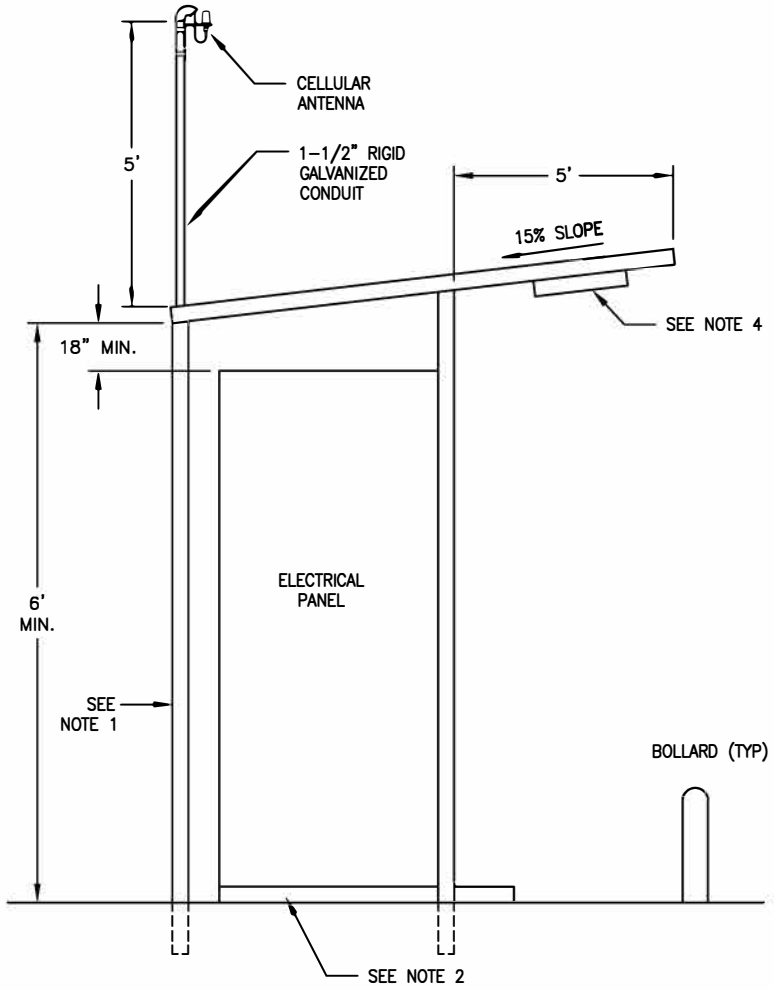
1. CENTER 6" WIDE PIPE LOCATOR RIBBON MARKED "SEWER FORCE MAIN" OVER ENTIRE LENGTH OF FORCE MAIN.
2. INSTALL LOCATOR BALLS AT THE START, MIDDLE, AND END OF ALL VERTICAL AND HORIZONTAL BENDS INCLUDING DEFLECTED SECTIONS AND AT UTILITY CROSSINGS. LOCATOR BALLS ARE TO BE PLACED AT LEAST EVERY 200 FEET ON STRAIGHT RUNS.
3. PLACE NO. 10 AWG COPPER TRACER WIRE ON TOP OF FORCE MAIN AND SECURE TO PIPE AT 10 FOOT INTERVALS WITH 10 MIL PVC TAPE OR EQUAL.
4. SOLDER AND COVER SPLICES OF TRACER WIRE WITH 2 WRAPS OF 10 MIL PVC TAPE.
5. USE TRAFFIC RATED BOX AND LID. LID MUST BE MARKED "SEWER".

SACRAMENTO AREA **SEWER** DISTRICT

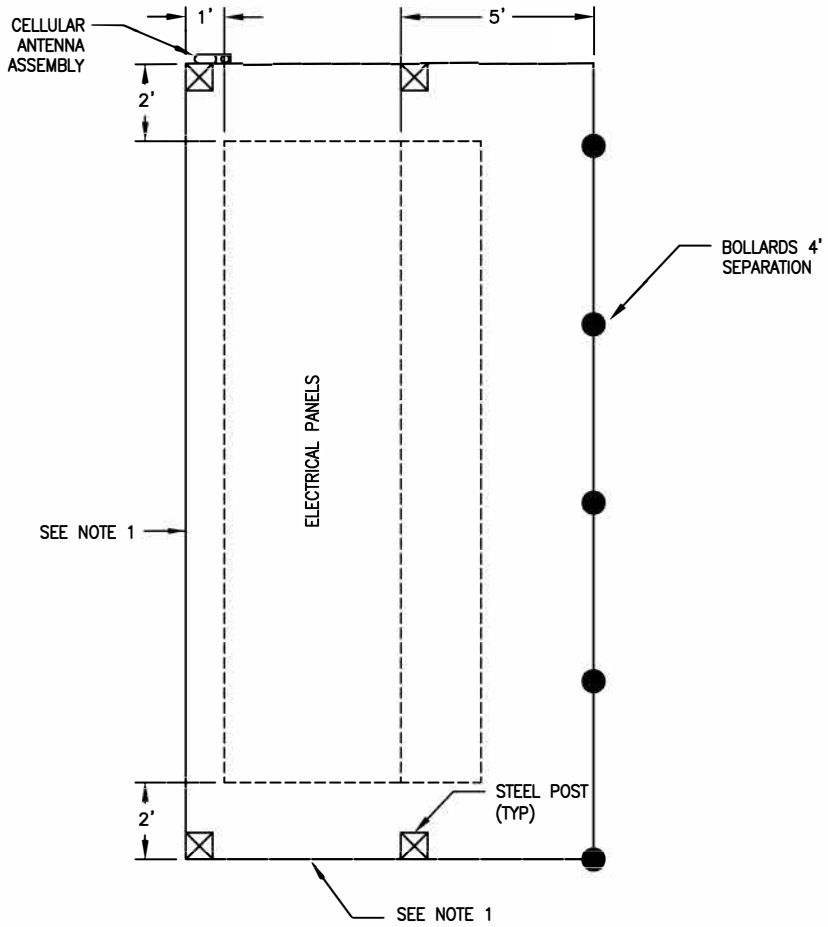
PIPE LOCATING WIRE, LOCATOR RIBBON, AND LOCATOR BALL INSTALLATION

DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

FM-04



SIDE VIEW
NTS



TOP VIEW
NTS

NOTES:

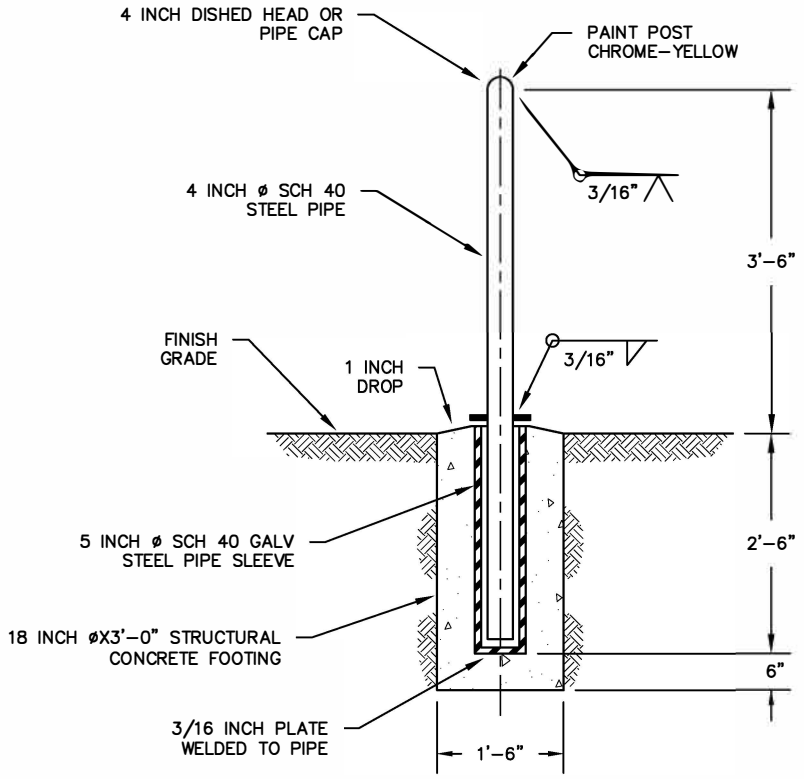
1. ATTACH SUNSHIELD TO CANOPY POSTS ON ALL SIDES EXCEPT FRONT ACCESS.
2. CONCRETE PAD EXTENDED 4 INCHES ABOVE SURROUNDING GRADE.
3. CANOPY AND CONCRETE PAD MUST BE DESIGNED BY REGISTERED ENGINEER.
4. PROVIDE SUFFICIENT LIGHTS UNDER CANOPY.

SACRAMENTO AREA **SEWER** DISTRICT

CANOPY SCHEMATIC

DRAWN BY: PL
SCALE: NONE
DATE: 3/20

PS-01



REMOVABLE BOLLARD DETAIL

NOTE:

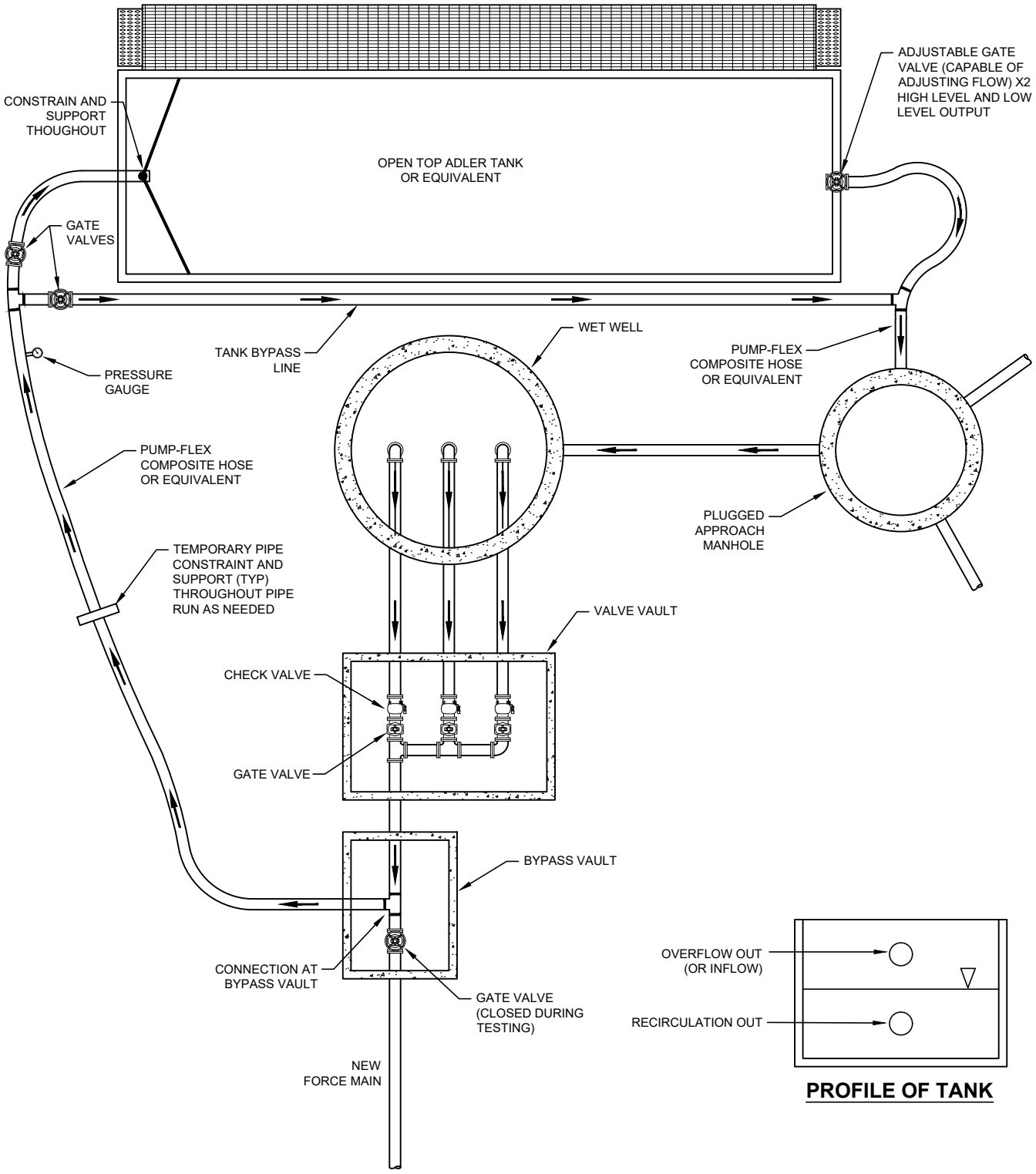
SEE SECTION 324.3 "BOLLARDS" FOR SPECIFICATIONS.

SACRAMENTO AREA **SEWER** DISTRICT

REMOVABLE BOLLARD DETAIL

DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

PS-02



PROFILE OF TANK

TYPICAL FRESH WATER TEST LAYOUT

NOTES:

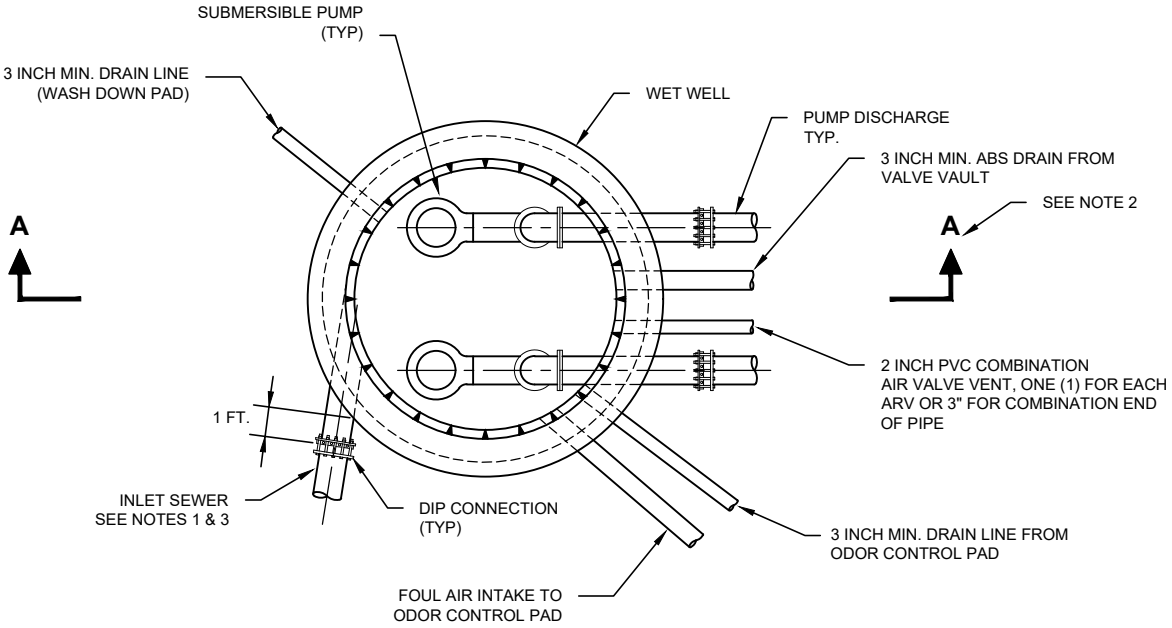
1. CONTRACTOR MUST FOLLOW GUIDELINES SET IN SACSEWER'S PUMP STATION START UP CHECKLIST AND 330.5

SACRAMENTO AREA SEWER DISTRICT

PUMP STATION 10-DAY FRESH WATER TEST

DRAWN BY: RAS
SCALE: NONE
DATE: 2/23

PS-03



℄ WET WELL

PLAN VIEW

NOTES:

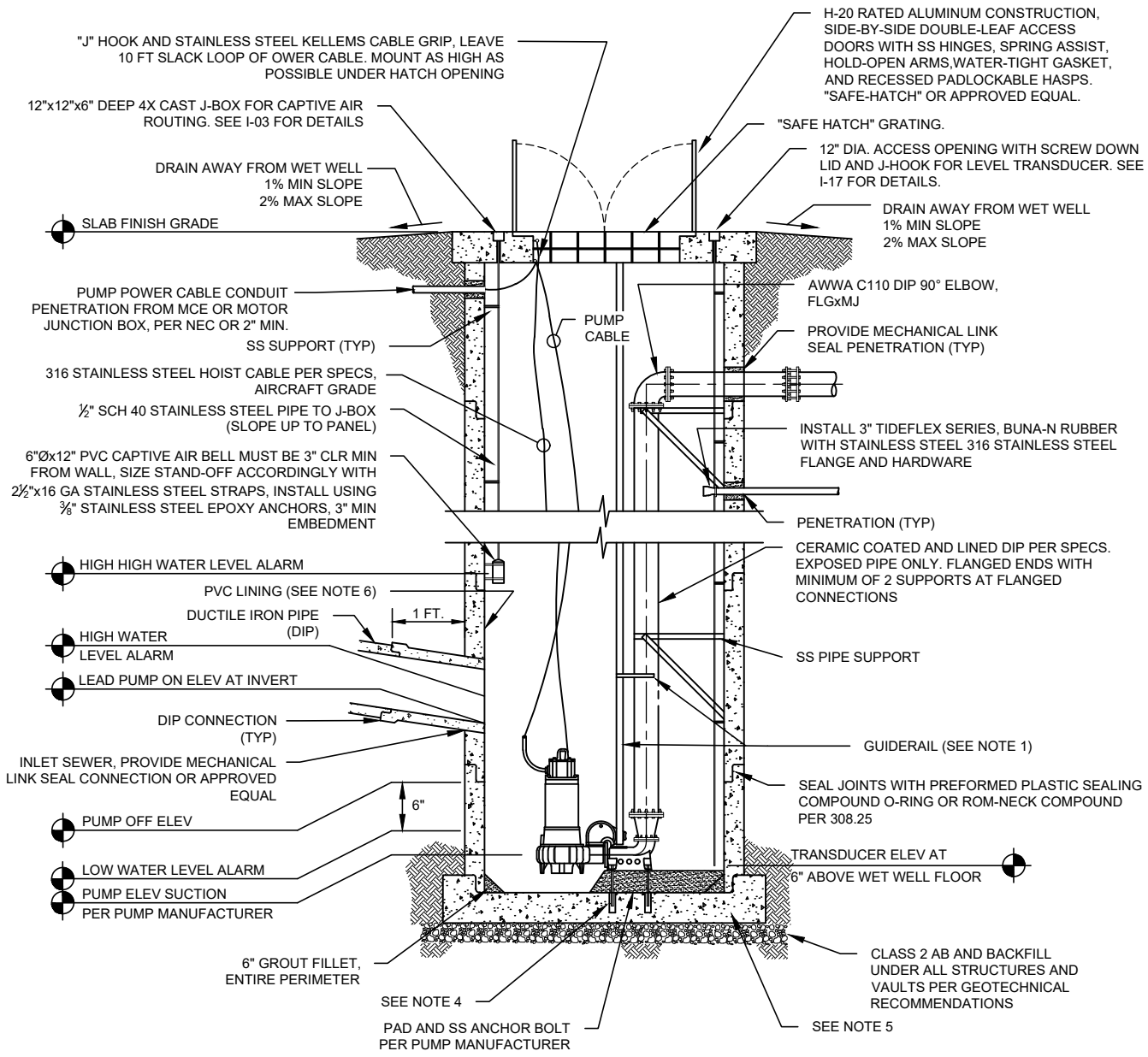
1. PLACE INLET SEWER PIPE SO THAT PIPE IS TANGENTIAL OR PERPENDICULAR TO WET WELL WALL AS DETERMINED BY SACSEWER.
2. REFER TO DRAWING M-05 FOR SECTION A-A.
3. INLET SEWER PIPE MUST BE DUCTILE IRON.

SACRAMENTO AREA SEWER DISTRICT

CIRCULAR WET WELL PLAN VIEW

DRAWN BY: RAS
SCALE: NONE
DATE: 2/23

M-01



SECTION A-A

NOTES:

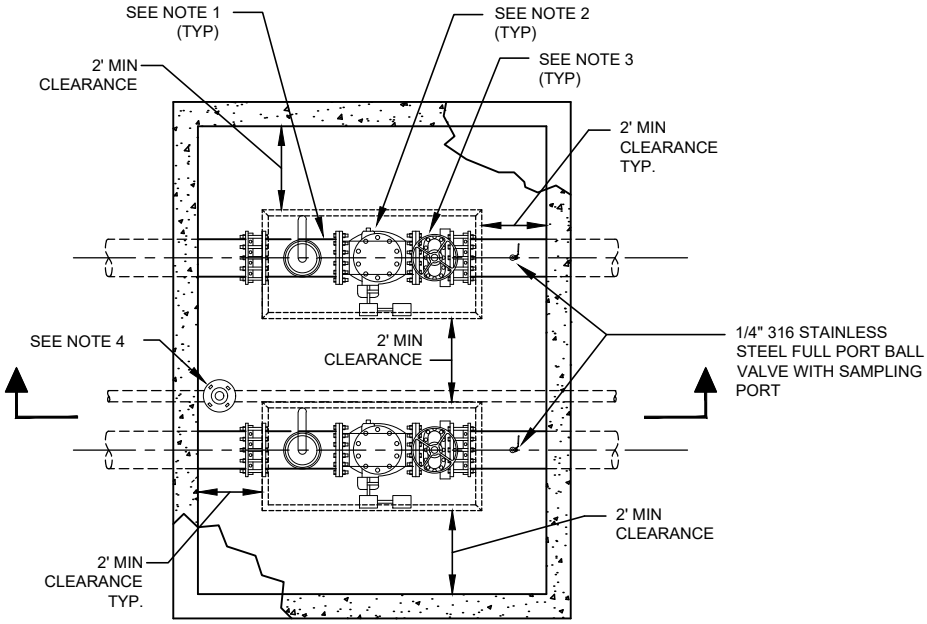
1. GUIDERAIL MUST BE MADE OF 316 STAINLESS STEEL AND MUST BE SIZED PER PUMP MANUFACTURER WITH INTERMEDIATE SUPPORT.
2. REFER TO STD. DRAWING M-01 FOR PLAN VIEW.
3. MIN OPENING HATCH MUST NOT INTERFERE WITH PUMP REMOVAL AND MAINTENANCE OPERATIONS.
4. PAD, STAINLESS STEEL ANCHOR BOLT ASSEMBLY, AND LOCATION MUST BE DESIGNED PER MANUFACTURER REQUIREMENTS.
5. THICKNESS OF WET WELL FLOOR MUST BE PER STRUCTURAL ENGINEER RECOMMENDATIONS.
6. PVC LINING (ARMOR LOCK OR APPROVED EQUAL) MUST BE SUPPLIED BY THE MANUFACTURER AND MUST NOT BE APPLIED IN THE FIELD.
7. ALL CONDUITS MUST HAVE A MATCHING MATERIAL END BUSHING.
8. REFER TO STD. DRAWING I-15 FOR WET WELL LEVEL TRANSDUCER DETAIL.

SACRAMENTO AREA SEWER DISTRICT

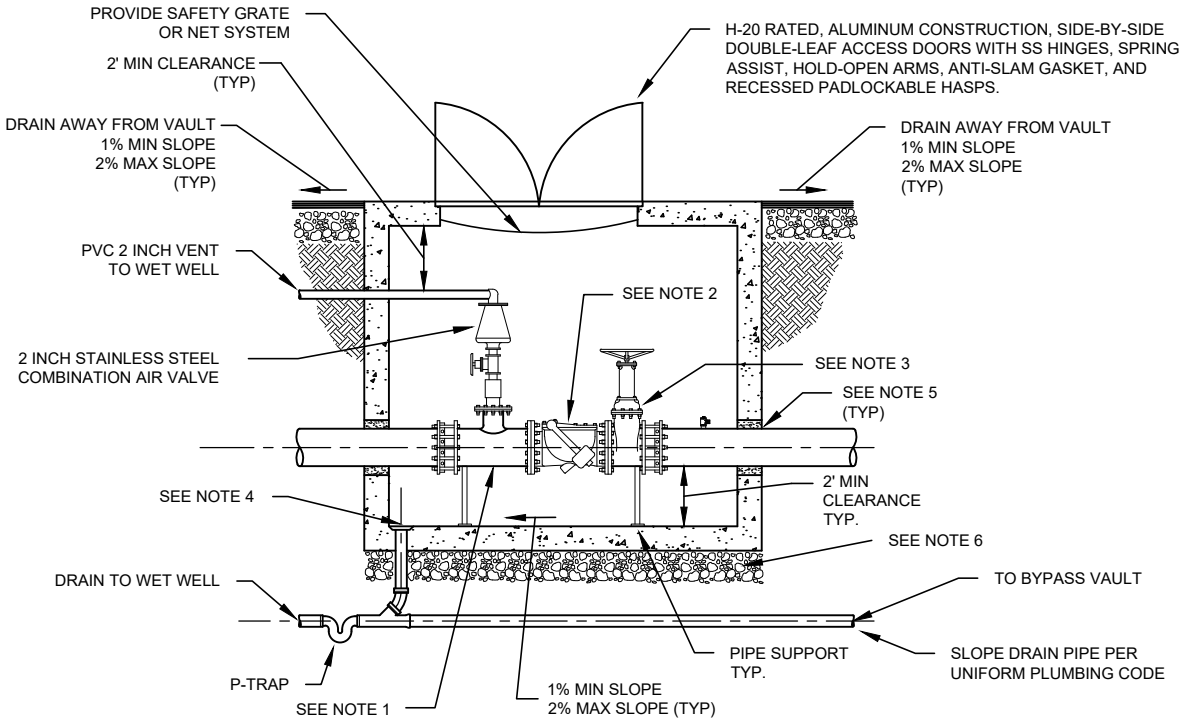
CIRCULAR WET WELL SECTION A-A

DRAWN BY: RAS
SCALE: NONE
DATE: 2/23

M-02



PLAN VIEW



SECTION

NOTES:

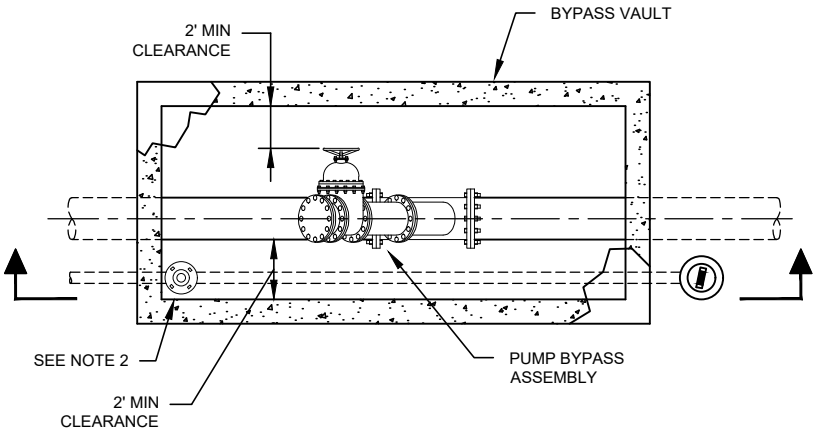
1. AWWA C110 REDUCING TEE, FLGxFLGxFLG
2. AWWA C508 FLGxFLG SWING CHECK VALVE WITH LEVER AND COUNTERWEIGHT
3. AWWA C500 FLGxFLG DOUBLE DISC GATE VALVE WITH NRS AND HANDWHEEL
4. 3 INCH Ø ABS DRAIN, LENGTH AS REQUIRED
5. PIPE PENETRATIONS MUST BE BORED OR BLOCKED OUT AND SEALED WITH LINK-SEAL OR APPROVED EQUAL. OPENINGS MUST BE ADDITIONALLY REINFORCED PER STRUCTURAL DRAWINGS.
6. AB THICKNESS MUST BE PER GEOTECHNICAL RECOMMENDATION.
7. CONCRETE WALLS MUST BE FINISHED WITH NON-SHRINK GROUT AT PIPE PENETRATIONS.

SACRAMENTO AREA
SEWER DISTRICT

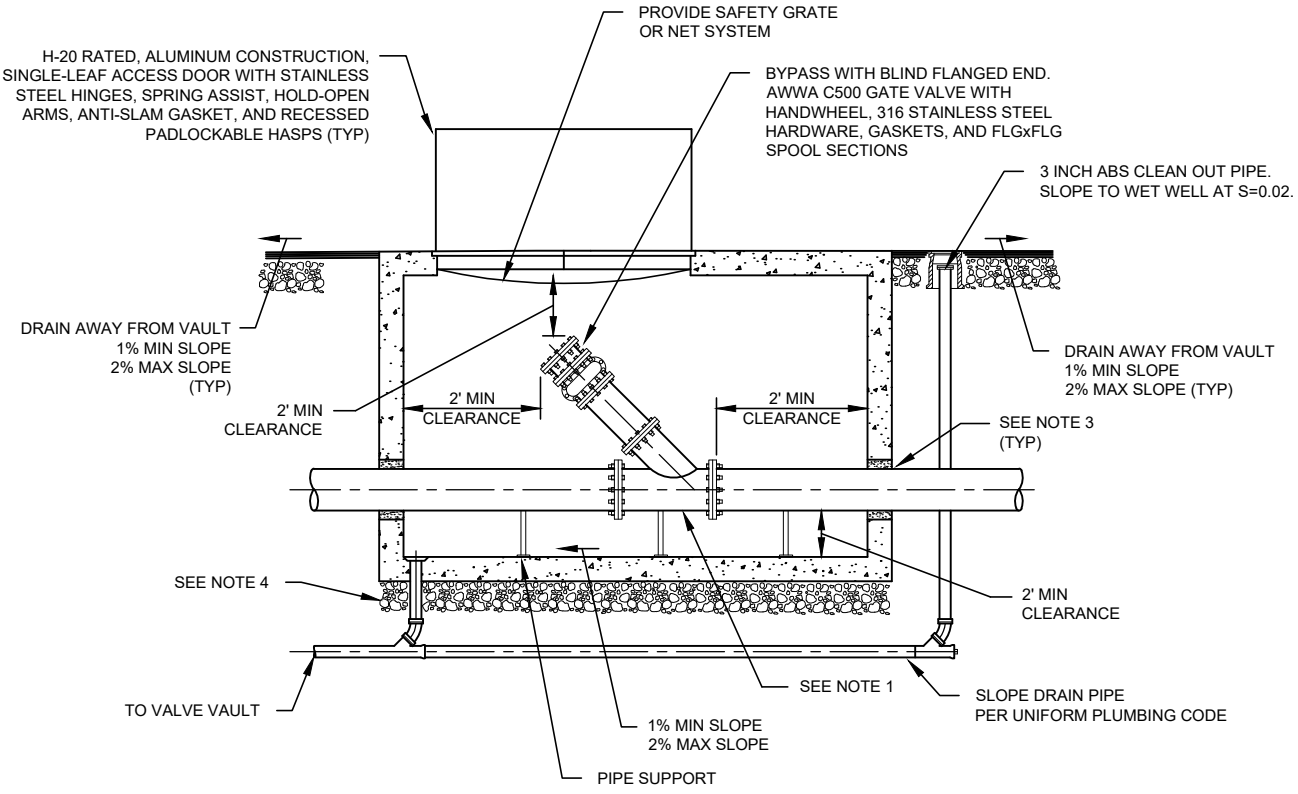
VALVE VAULT

DRAWN BY: PL
SCALE: NONE
DATE: 2/23

M-03



PLAN VIEW



SECTION

NOTES:

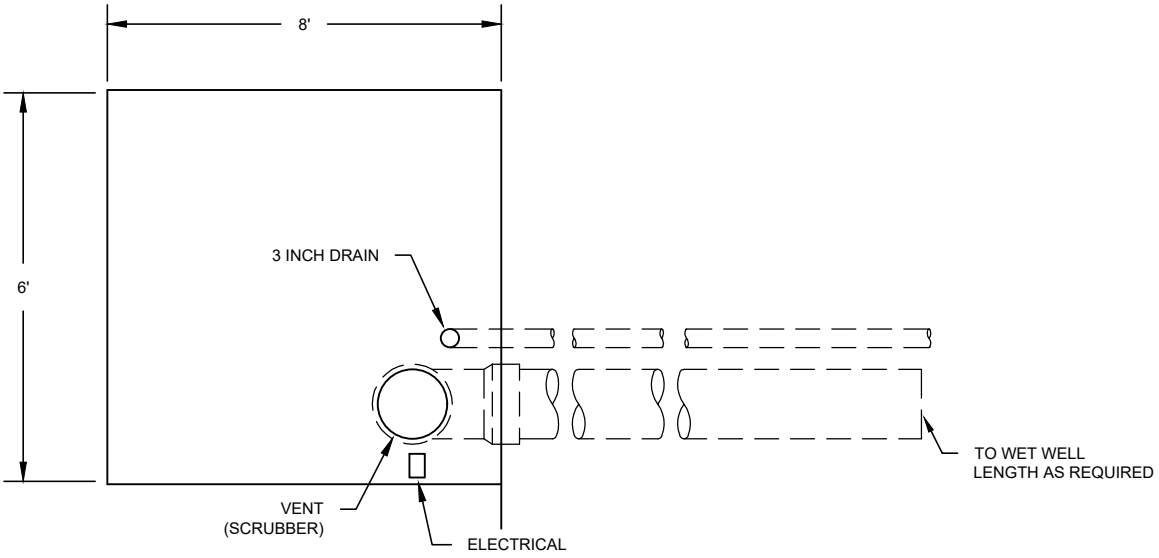
1. AWWA C110 REDUCING WYE, FLGxFLGxFLG
2. 3 INCH Ø ABS DRAIN, LENGTH AS REQUIRED
3. NOTED PIPE PENETRATIONS MUST BE BORED OR BLOCKED OUT AND SEALED WITH LINK SEAL OR APPROVED EQUAL. OPENINGS MUST BE ADDITIONALLY REINFORCED PER STRUCTURAL DRAWINGS
4. AB THICKNESS MUST BE PER GEOTECHNICAL RECOMMENDATION.
5. CONCRETE WALLS MUST BE FINISHED WITH NON-SHRINK GROUT AT PIPE PENETRATIONS.

SACRAMENTO AREA SEWER DISTRICT

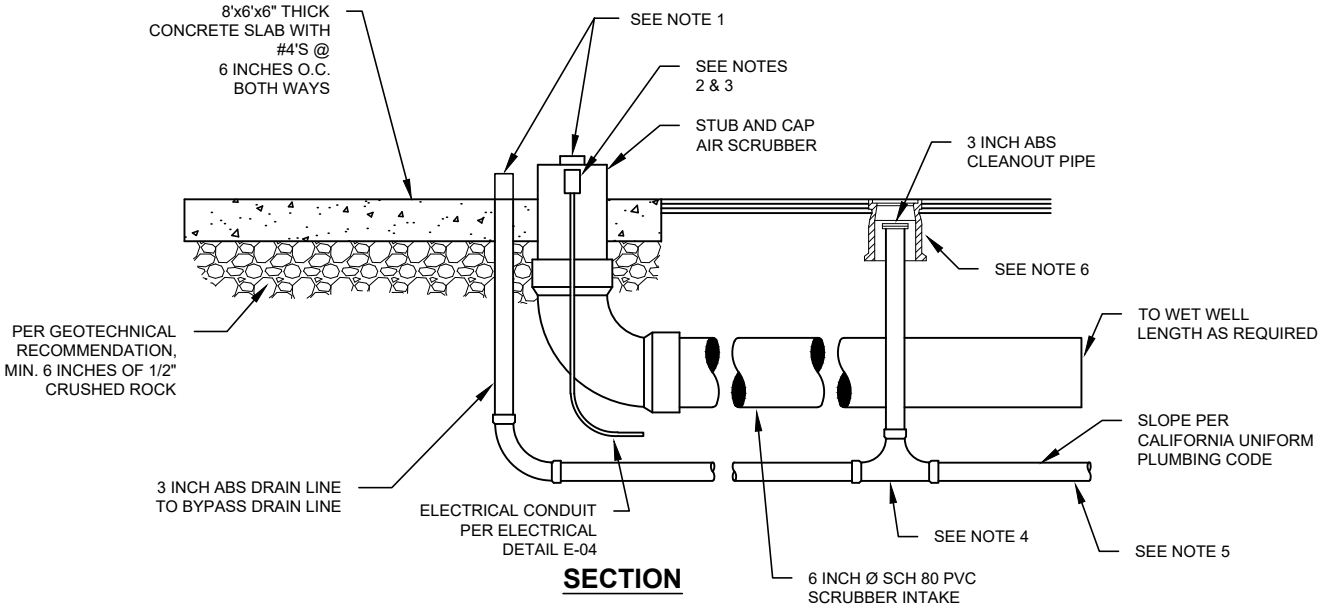
BYPASS VAULT

DRAWN BY: PL
SCALE: NONE
DATE: 2/23

M-04



PLAN VIEW



SECTION

NOTES:

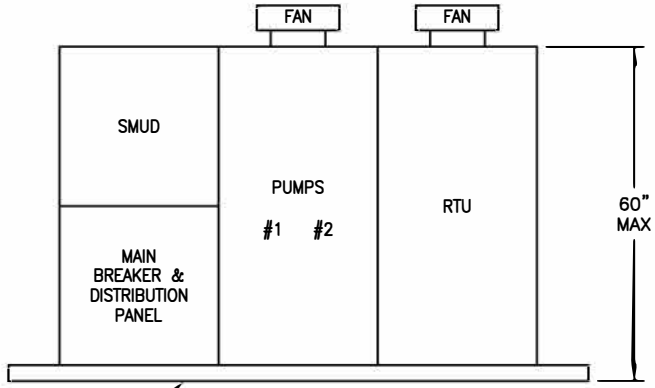
1. STUB 6 INCH ABOVE FINAL GRADE. ALL PIPING AND CONDUIT TO BE PAINTED FOR UV PROTECTION.
2. STUB ELECTRICAL CONDUIT 1' ABOVE PAD.
3. PROVIDE PULL ROPE IN CONDUIT.
4. CLEANOUT TEE, TWO WAY ABS HUB.
5. CONNECT TO BYPASS DRAIN LINE.
6. INSTALL ROUND CONCRETE TRAFFIC TYPE VALVE BOX WITH CAST IRON COVER. COVER TO BE MARKED "SEWER".

SACRAMENTO AREA
SEWER DISTRICT

ODOR CONTROL PAD

DRAWN BY: PL
SCALE: NONE
DATE: 2/23

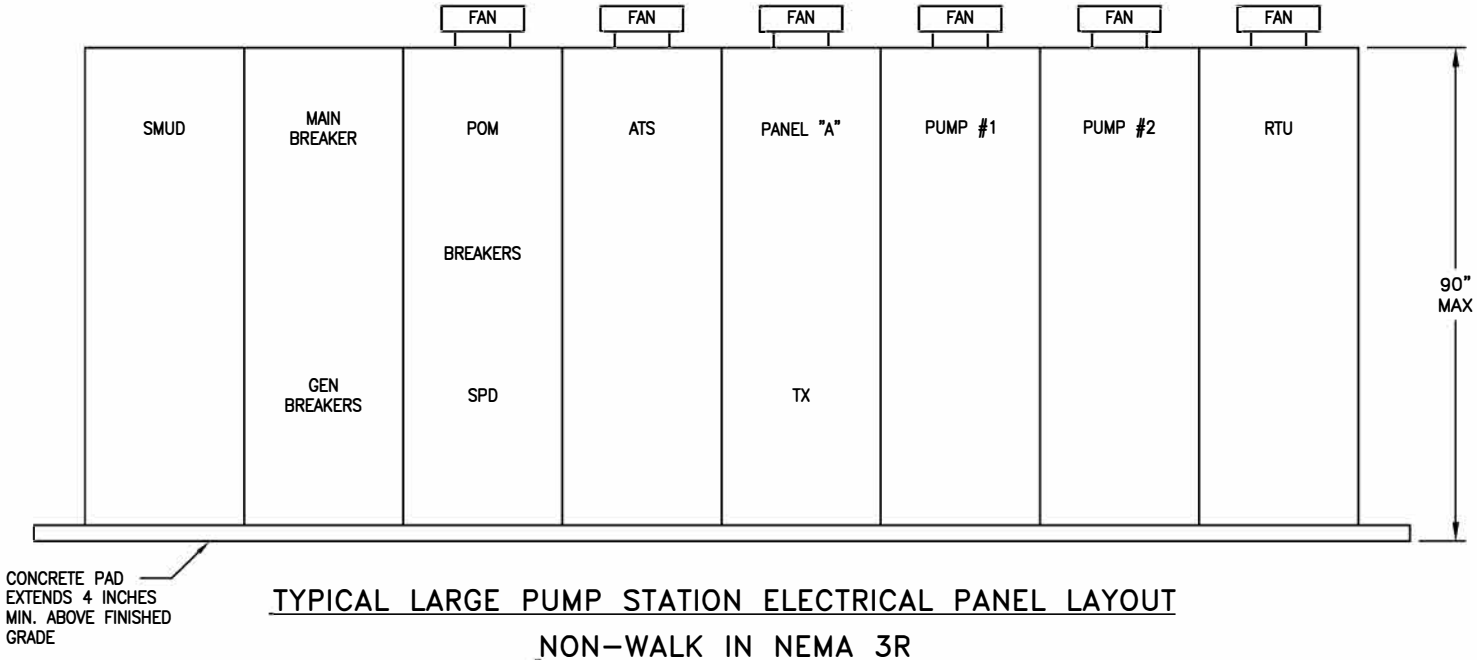
M-05



TYPICAL SMALL / MEDIUM PUMP STATION ELECTRICAL PANEL LAYOUT

NON-WALK IN NEMA 3R

NTS



TYPICAL LARGE PUMP STATION ELECTRICAL PANEL LAYOUT

NON-WALK IN NEMA 3R

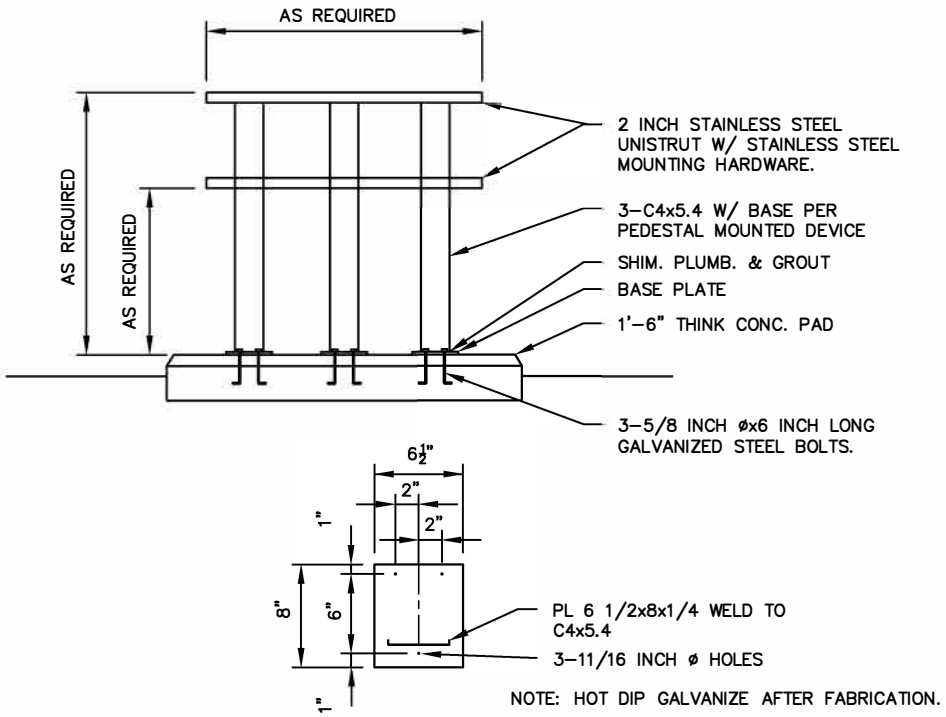
NTS

SACRAMENTO AREA
SEWER DISTRICT

TYPICAL OUTDOOR ELECTRICAL PANEL LAYOUT

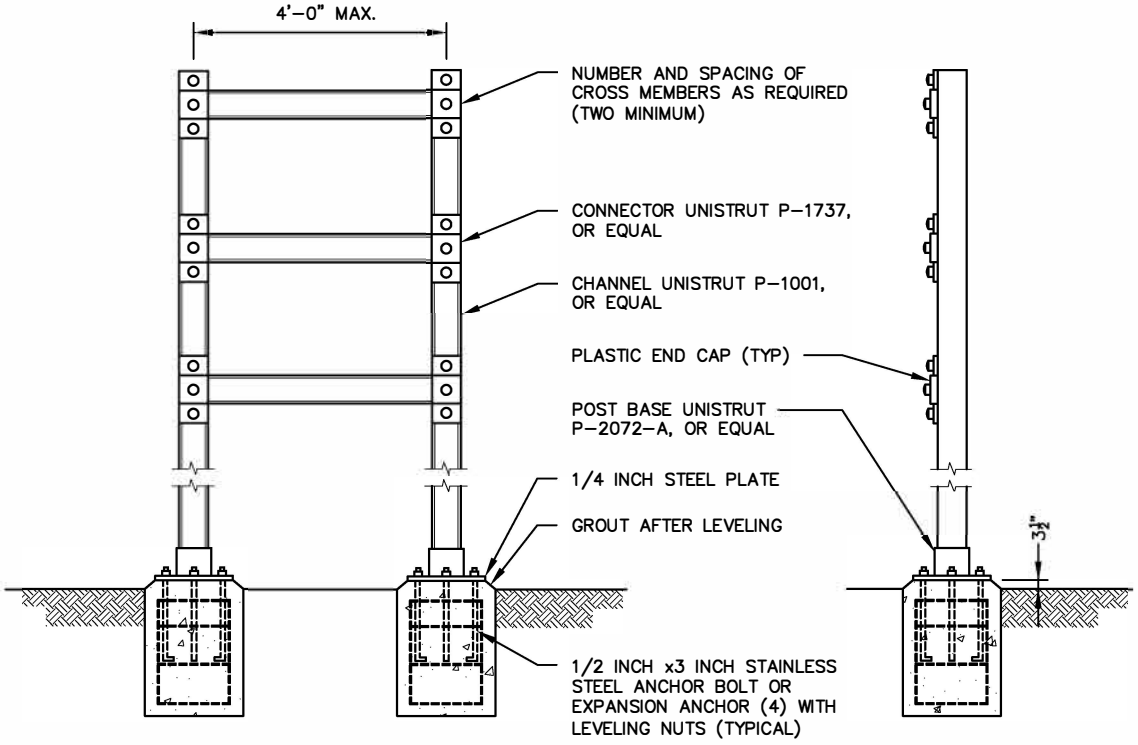
DRAWN BY: PL
SCALE: NONE
DATE: 3/20

E-01



A – LARGE PEDESTAL MOUNTING DETAIL

SCALE: NONE



NOTES:

1. INSTRUMENT RACK CHANNELS AND FITTINGS MUST BE 316 STAINLESS STEEL.
2. HEIGHT AS REQUIRED SO MOUNTED INSTRUMENTS OR EQUIPMENT MUST BE 60 INCHES TO TOP OF ENCLOSURE.

B – INSTRUMENT MOUNTING RACK

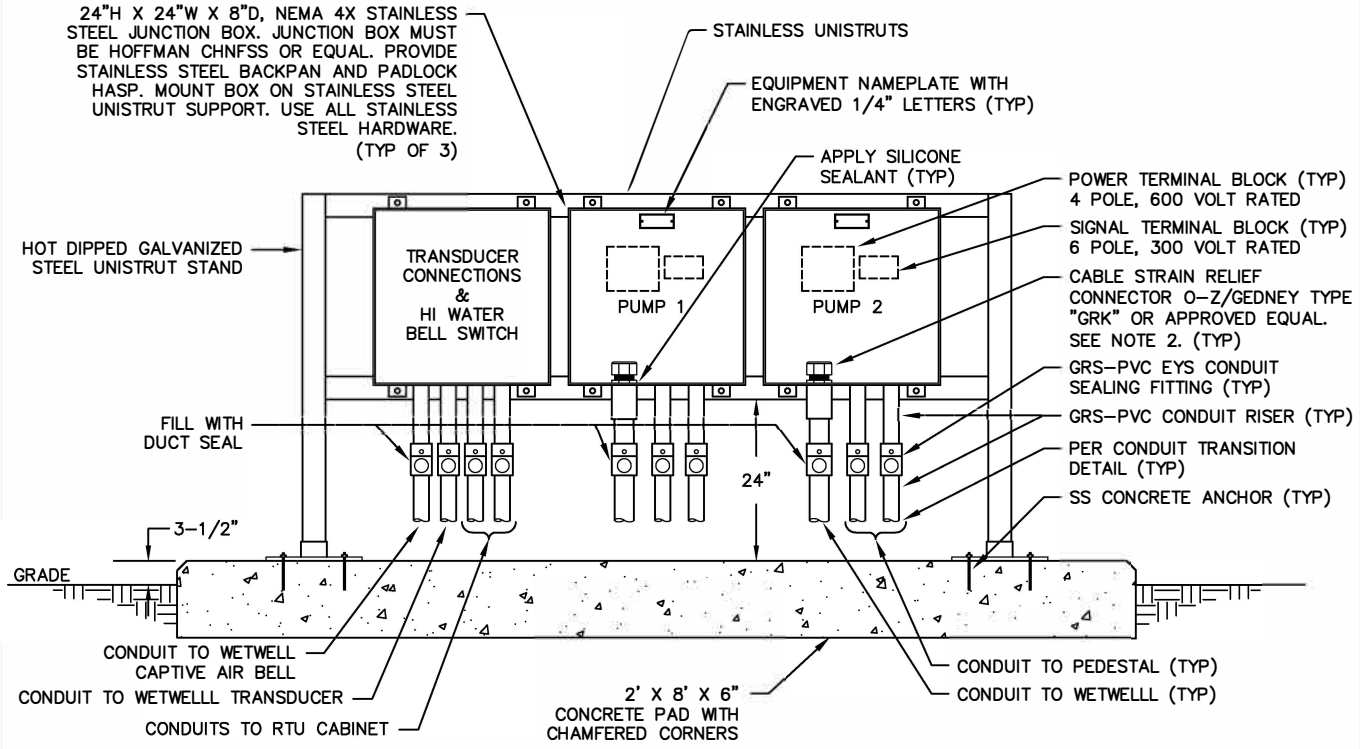
SCALE: NONE

SACRAMENTO AREA **SEWER** DISTRICT

INSTRUMENTATION MOUNTING RACK AND LARGE PEDESTAL MOUNTING DETAIL

DRAWN BY: PL
SCALE: NONE
DATE: 3/20

E-02



MOTOR AND TRANSDUCER JUNCTION BOX MOUNTING DETAIL

NO SCALE

NOTES:

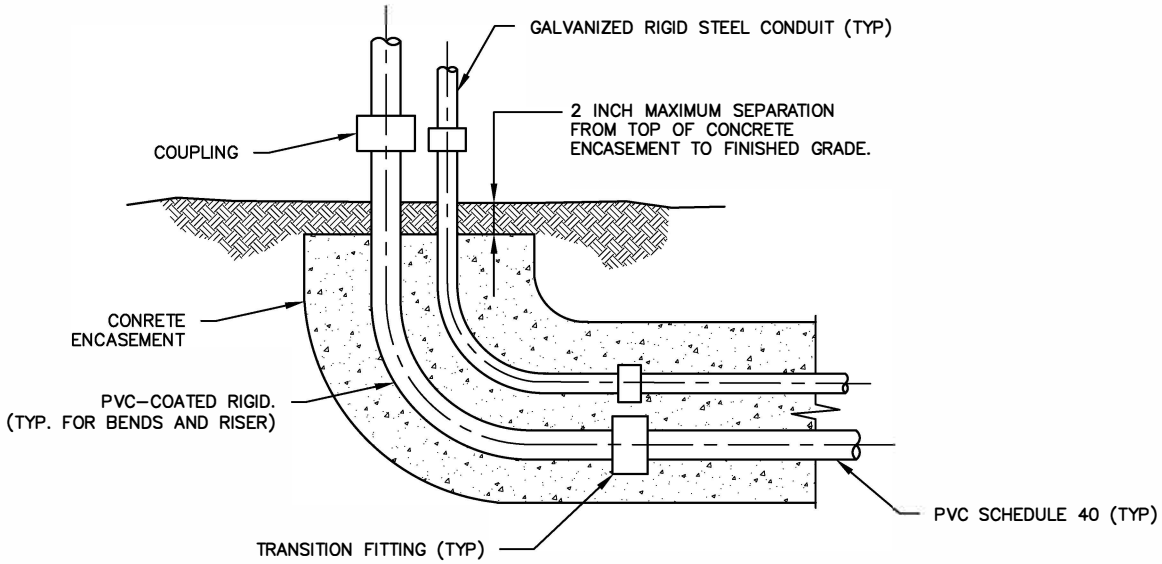
1. GROUND JUNCTION BOX DOORS AND BOXES TO BE GROUND GRID.
2. ALL CONDUIT SEALING FITTINGS OF CONDUIT FROM MCC TO MORTOR JUNCTION TO BE POURED WITH SEALING COMPOUND.

SACRAMENTO AREA **SEWER** DISTRICT

JUNCTION BOX MOUNTING DETAIL

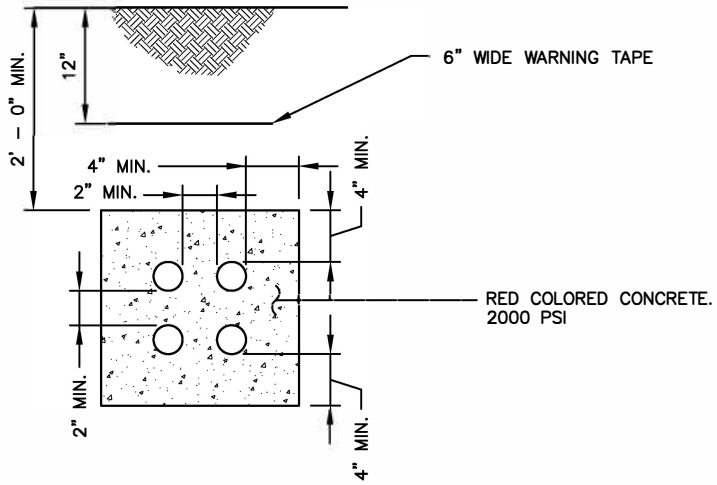
DRAWN BY: RAS
SCALE: NONE
DATE: 3/20

E-03



A – CONDUIT RISER FROM GROUND

SCALE: NONE



B – DUCT BANK SECTION

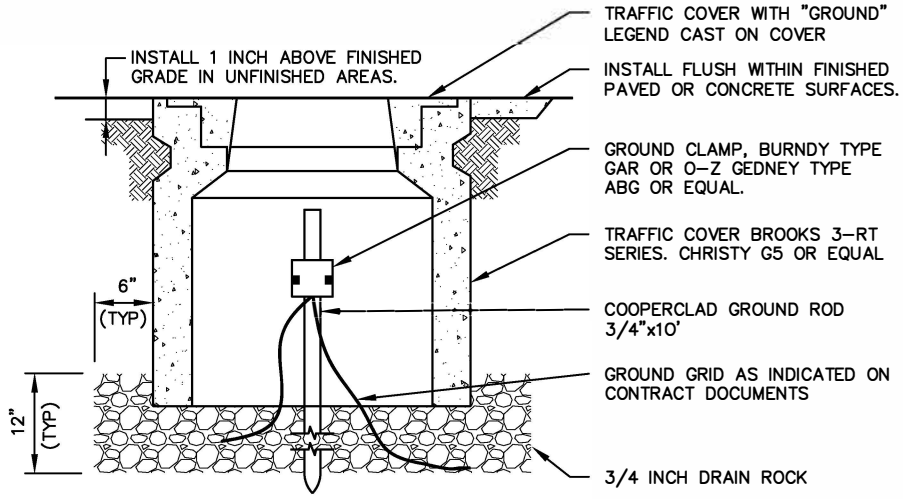
SCALE: NONE

SACRAMENTO AREA **SEWER** DISTRICT

CONDUIT RISER FROM GROUND AND DUCT BANK SECTION

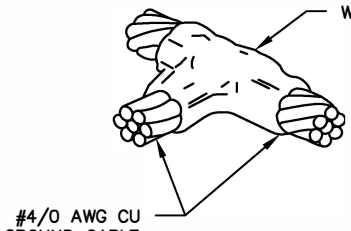
DRAWN BY: PL
SCALE: NONE
DATE: 3/20

E-04



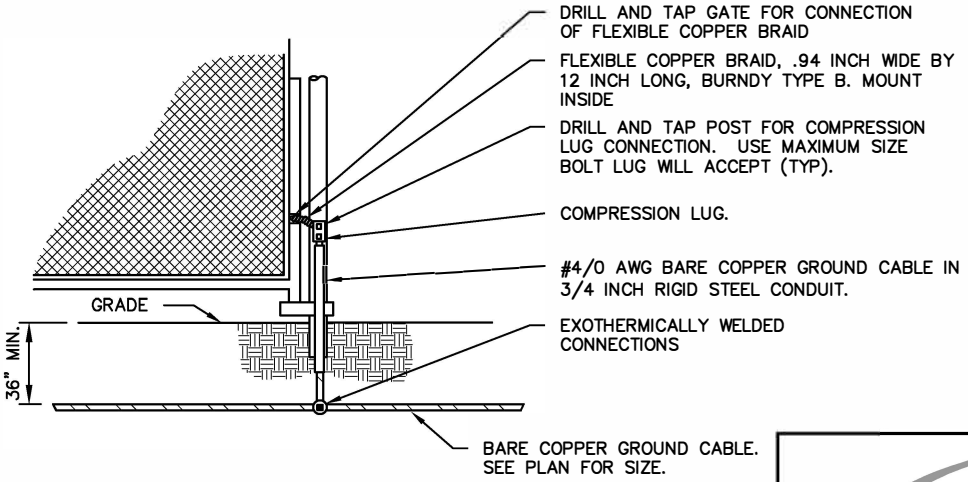
A – GROUND WELL

SCALE: NONE



B – GROUND GRID TEE CONNECTION DETAIL

SCALE: NONE



NOTE

GROUND EACH CORNER POST, GATE, GATE SUPPORT POST AND EVERY OTHER FENCE POST.

C – FENCE GROUNDING

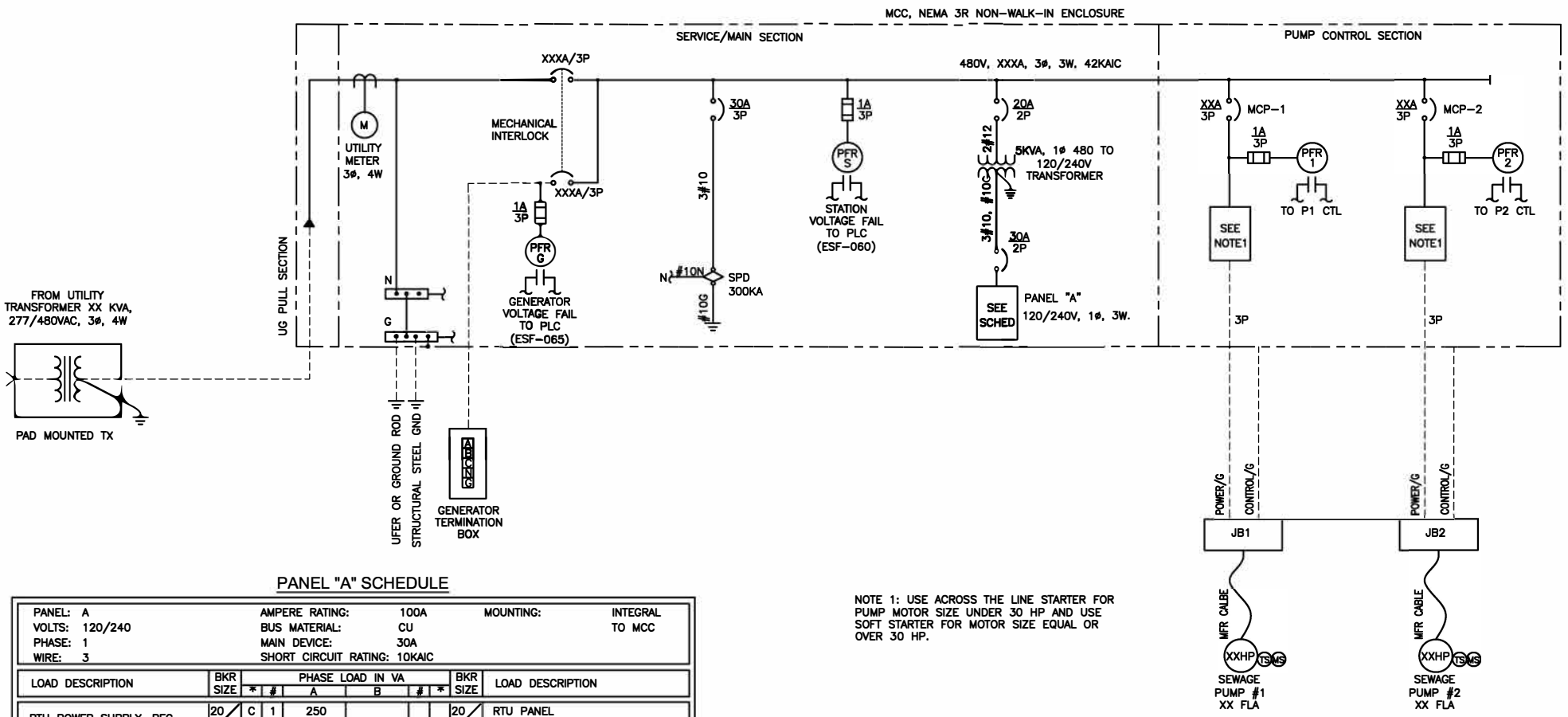
SCALE: NONE

SACRAMENTO AREA **SEWER** DISTRICT

GROUNDING DETAILS

DRAWN BY: PL
SCALE: NONE
DATE: 3/20

E-05



PANEL "A" SCHEDULE

PANEL: A	AMPERE RATING:	100A	MOUNTING:	INTEGRAL TO MCC	
VOLTS: 120/240	BUS MATERIAL:	CU			
PHASE: 1	MAIN DEVICE:	30A			
WIRE: 3	SHORT CIRCUIT RATING:	10KAIC			

LOAD DESCRIPTION	BKR SIZE	*	#	PHASE LOAD IN VA A	PHASE LOAD IN VA B	#	*	BKR SIZE	LOAD DESCRIPTION
RTU POWER SUPPLY, REC.	20/1	C	1	250				20/1	RTU PANEL (FAN, HTR & LIGHT)
					500	2	C		
GENERATOR BATTERY CHARGER	20/1	C	3	600				20/1	GENERATOR BLOCK HEATER
					300	4	C		
PUMP CONTROL PANEL (FAN, HTR, LIGHT & REC.)	20/1	C	5	500				20/1	SERVICE/MAIN PANEL (LIGHT & REC.)
					300	6	C		
ODOR CONTROL REC.	20/1	C	7	500				20/1	CANOPY & SITE LIGHTING/REC.
					800	8	C		
SPARE	20/1	–	9					20/1	SPARE
						10	–		
SPACE		–	11						SPACE
						12	–		

TOTAL CONNECTED LOAD	1850	1900	HIGH LEG LOAD
*C = CONTINUOUS X 125%	2313	2375	
N = NON-CONTINUOUS	0	0	$\frac{2375}{120}\ \frac{VA}{V} = 19.8$ AMPERES
M = LARGEST MOTOR X 125%	0	0	
TOTAL CALCULATED NEC LOAD	2313	2375	

NOTE 1: USE ACROSS THE LINE STARTER FOR PUMP MOTOR SIZE UNDER 30 HP AND USE SOFT STARTER FOR MOTOR SIZE EQUAL OR OVER 30 HP.

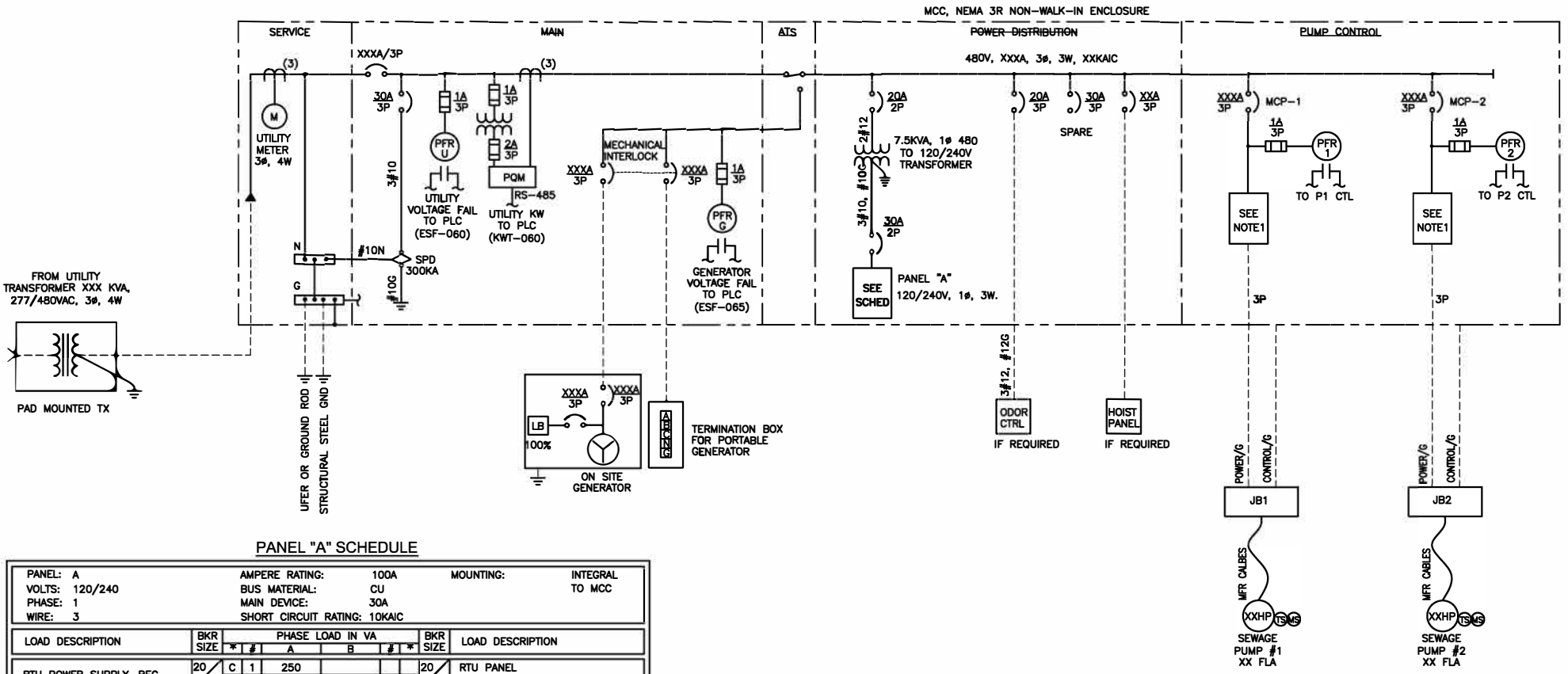
SINGLE LINE DIAGRAM
(TYPICAL FOR SMALL/MEDIUM PUMP STATION)

SACRAMENTO AREA **SEWER** DISTRICT

SINGLE LINE DIAGRAM TYPICAL FOR SMALL/MEDIUM PUMP STATION

DRAWN BY: WZ
SCALE: NONE
DATE: 3/20

E-06



PANEL "A" SCHEDULE

PANEL: A	AMPERE RATING: 100A	MOUNTING:	INTEGRAL TO MCC
VOLTS: 120/240	BUS MATERIAL: CU		
PHASE: 1	MAIN DEVICE: 30A		
WIRE: 3	SHORT CIRCUIT RATING: 10KAIC		

LOAD DESCRIPTION	BKR SIZE	*	#	PHASE LOAD IN VA A	PHASE LOAD IN VA B	#	*	BKR SIZE	LOAD DESCRIPTION
RTU POWER SUPPLY, REC.	20/1	C	1	250				20/1	RTU PANEL (FAN, HTR & LIGHT)
					500	2	C		
GENERATOR BATTERY CHARGER	20/1	C	3	1000+600				20/2	GENERATOR BLOCK HEATER
					600	4	C		
PUMP CONTROL PANEL (FAN, HTR, LIGHT & REC.)	20/1	C	5	500				20/1	SERVICE/MAIN PANEL (LIGHT & REC.)
					300	6	C		
POWER MONITOR	20/1	C	7	100				20/1	CANOPY & SITE LIGHTINGS/REC.
					1000	8	C		
SPARE	20/1	–	9			10	–	20/1	SPARE
SPACE		–	11			12	–		SPACE

	A	B
TOTAL CONNECTED LOAD	2450	2400
*C = CONTINUOUS X 125%	3063	3000
N = NON-CONTINUOUS	0	0
M = LARGEST MOTOR X 125%	0	0
TOTAL CALCULATED NEC LOAD	3063	3000

HIGH LEG LOAD:

$\frac{3063\ VA}{120\ V} = 25.5$ AMPERES

SINGLE LINE DIAGRAM (TYPICAL FOR LARGE PUMP STATION)

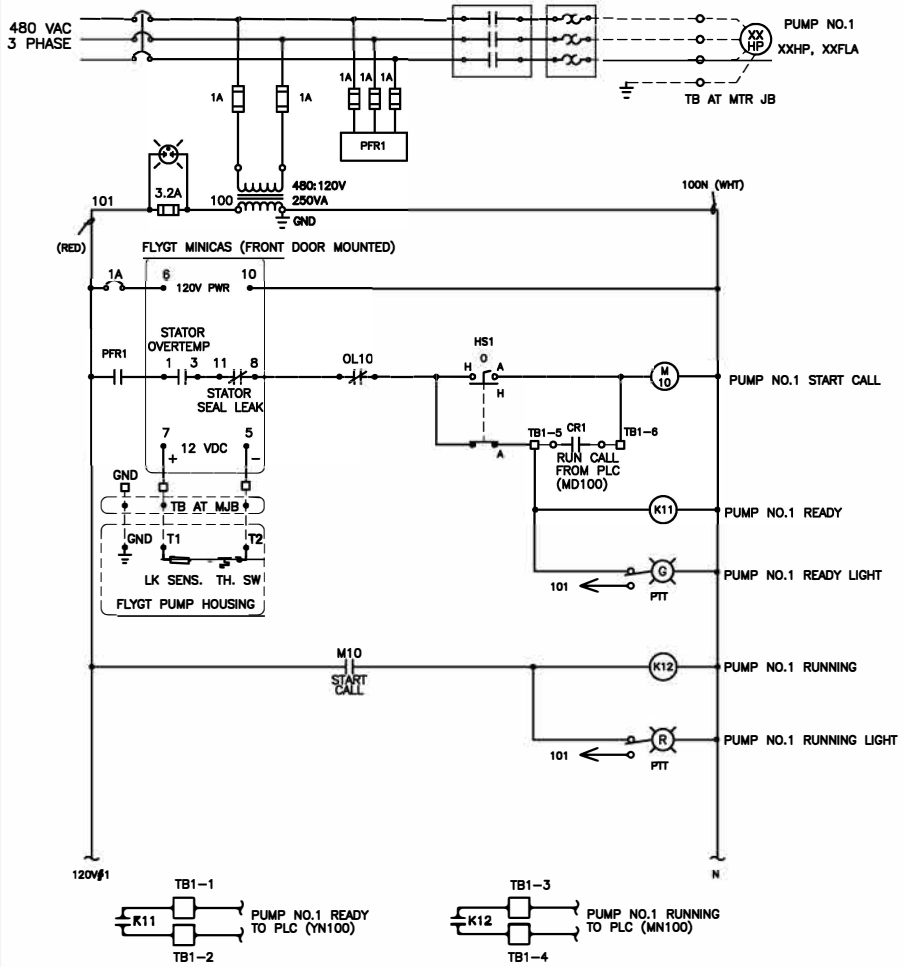
NOTE 1: EITHER SOFT STARTER OR VFD PER DESIGN REPORT.

SACRAMENTO AREA **SEWER** DISTRICT

SINGLE LINE DIAGRAM TYPICAL FOR LARGE PUMP STATION

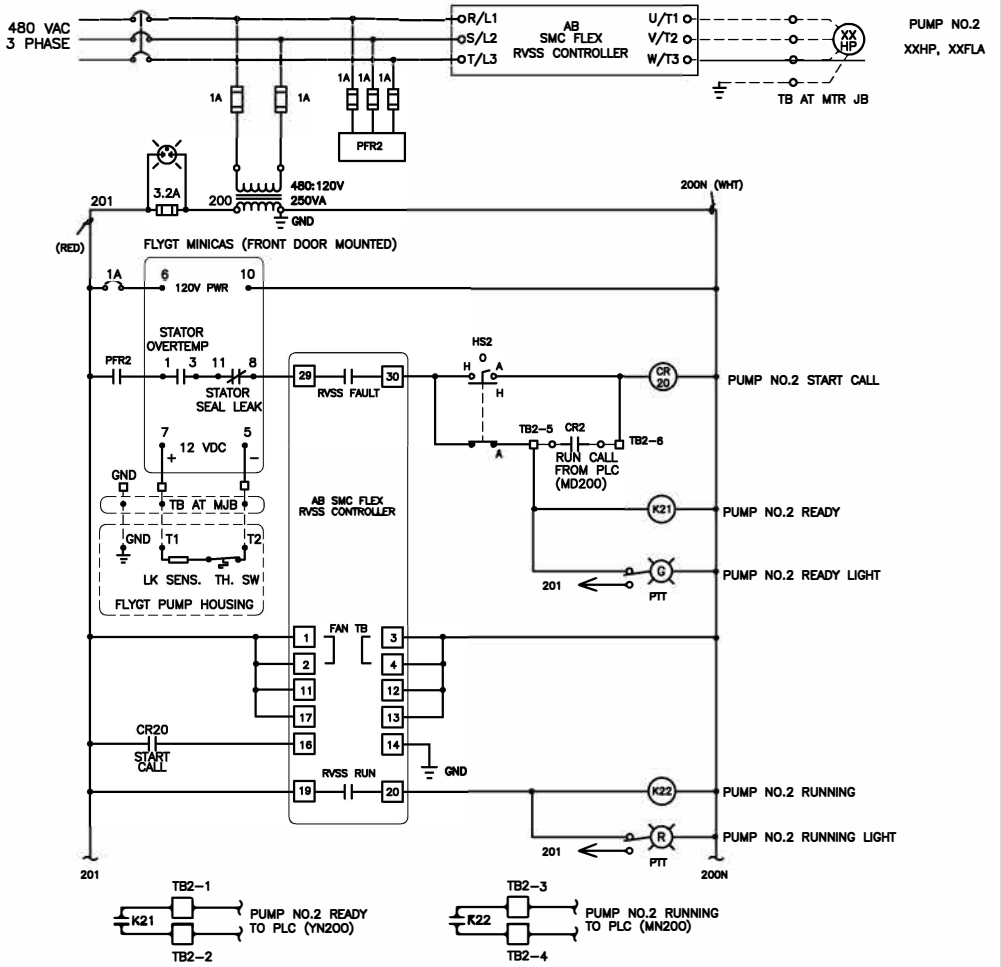
DRAWN BY: WZ
SCALE: NONE
DATE: 3/20

E-07



PUMP NO. 1 CONTROL DIAGRAM

(TYPICAL FOR SMALL CAPACITY PUMP < 30HP)



PUMP NO. 2 CONTROL DIAGRAM

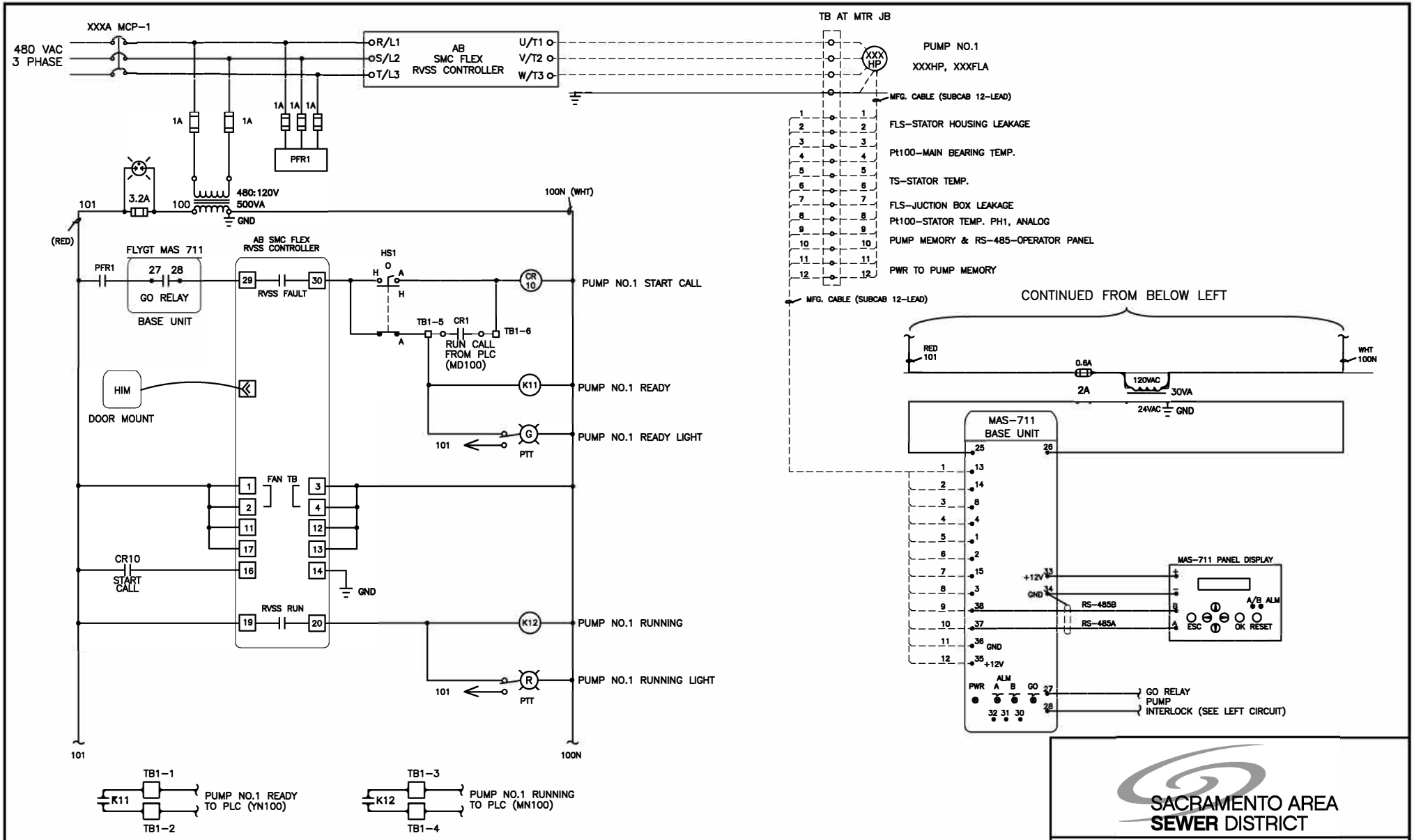
(TYPICAL FOR MEDIUM CAPACITY PUMP >= 30HP)

SACRAMENTO AREA **SEWER** DISTRICT

PUMP CONTROL DIAGRAMS TYPICAL FOR SMALL/MEDIUM CAPACITY PUMPS

DRAWN BY: WZ
SCALE: NONE
DATE: 3/20

E-08



PUMP NO. 1 CONTROL DIAGRAM

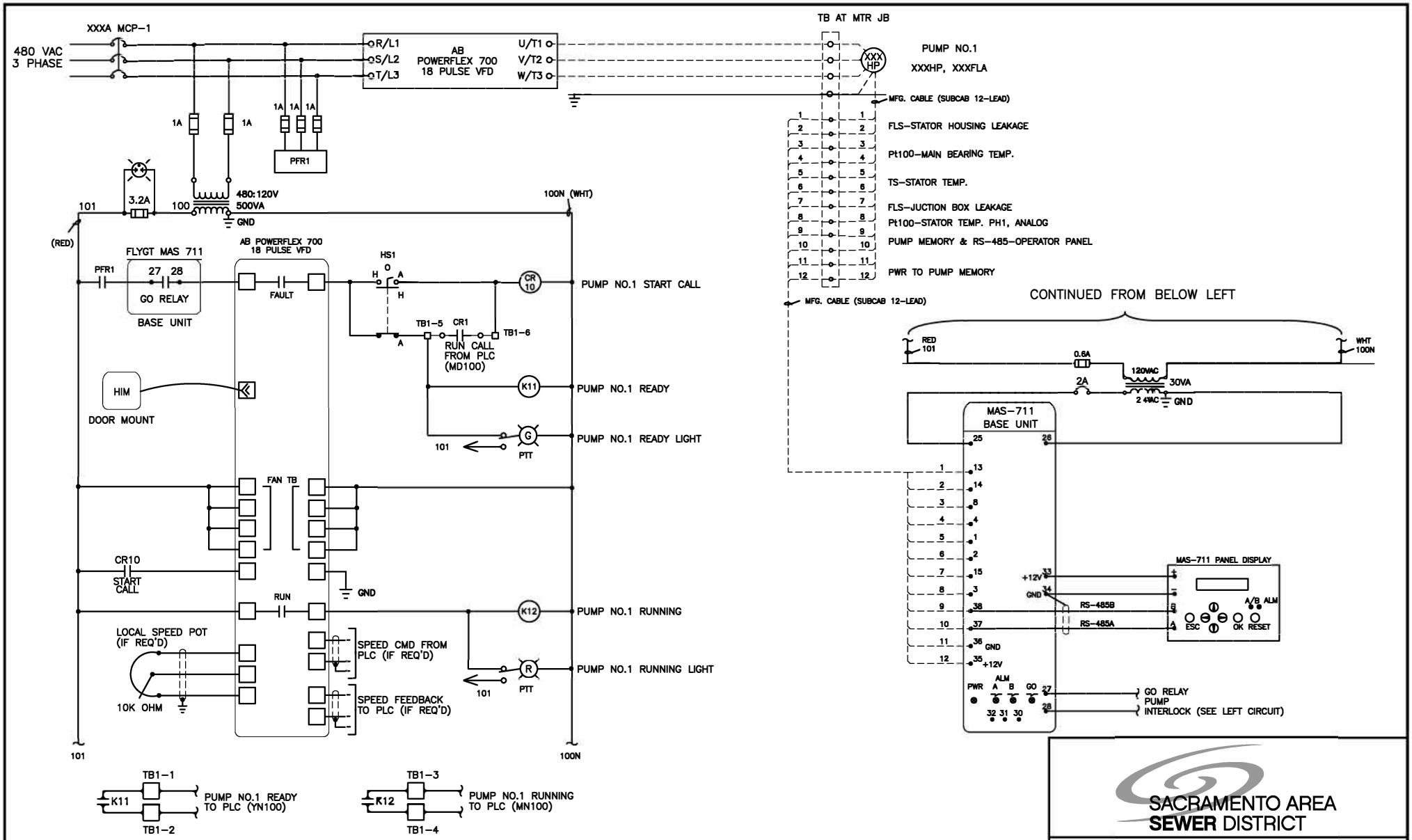
(TYPICAL FOR LARGE CAPACITY PUMP >= 100HP)

SACRAMENTO AREA
SEWER DISTRICT

PUMP CONTROL DIAGRAM TYP. FOR LARGE CAPACITY PUMP WITH SOFT STARTER

DRAWN BY: WZ
SCALE: NONE
DATE: 3/20

E-09



PUMP NO. 1 CONTROL DIAGRAM

(TYPICAL FOR LARGE CAPACITY PUMP >= 100HP)

SACRAMENTO AREA
SEWER DISTRICT

PUMP CONTROL DIAGRAM TYP. FOR LARGE CAPACITY PUMP WITH VFD

DRAWN BY: WZ
SCALE: NONE
DATE: 3/20

E-10