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SECTION C – MEASUREMENT AND BASIS OF PAYMENT

1.00 GENERAL

IT IS THE INTENT OF THIS CONTRACT TO COVER ALL THE WORK TO BE PERFORMED SUBSIDIARY TO ALL THE ITEMS INCLUDED IN THE BID AND SUCH PRICES SHALL BE BALANCED INDIVIDUALLY AND SHALL INCLUDE FURNISHING ALL MATERIALS, SUPERINTENDENCY, SUPERVISION, CONSTRUCTION SURVEYING AND LAYOUT, LABOR, INSURANCE, BONDS, BENEFITS, MACHINERY, FUEL, VEHICLES, SAFETY EQUIPMENT, ADMINISTRATIVE COSTS, QUALITY CONTROL, GUARANTEES AND WARRANTIES, OVERHEAD, MOBILIZATION AND ALL INCIDENTALS FOR COMPLETING THE ASSIGNED WORK IN ACCORDANCE WITH THE PLANS AND SPECIFICATIONS COMPLETE IN PLACE. ***IN CASE THE FOLLOWING MEASUREMENT AND BASIS OF PAYMENT DESCRIPTIONS CONFLICT WITH THE CORRESPONDING DESCRIPTIONS CONTAINED WITHIN THE TECHNICAL SPECIFICATIONS FOR THIS PROJECT, THE FOLLOWING DESCRIPTIONS SHALL GOVERN.***

THE FOLLOWING ITEMS SHALL BE CONSIDERED AS PAY ITEMS. ALL OTHER WORK NOT SPECIFICALLY LISTED OR INDICATED BELOW SHALL BE SUBSIDIARY TO THE OVERALL COST OF THE PROJECT. ALL EXCAVATION IS UNCLASSIFIED.

WORK INCLUDED

1. **"PACKAGE-TYPE" SANITARY SEWER LIFT STATION:** When called for in the bid proposal, shall be paid for LUMP SUM complete in place and operational, and shall include the following:
   a. Site Preparation includes clearing, dewatering, fill material, security fence, gate with lock, reinforced concrete access entrance drive, wet-well excavation, trench safety and shoring, all as per the plans and specifications.
   b. Sanitary Sewer Duplex Sanitary Sewer Lift Station, Submersible, "Package-Type", complete in place including fiberglass wet well of the diameter specified on the plans, two(2) submersible pumps, dewatering, anti-flotation system, trench safety, suction and header piping, 8-inch sanitary sewer line and connections to receiving manhole, valves, quick-connect, control system, electrical connections to power source, pump control panel with stainless steel enclosure, construction staking and layout, reinforced concrete service vehicle apron and reinforced concrete lift station pad, all complete in place and in accordance with the plans and specifications.
   c. Operation and Maintenance Manual and operation training.
   d. Barricades and Traffic Control as required.
   e. Final Site Grading and Clean-Up.

2. **SANITARY SEWER FORCE MAIN:** When called for in the Proposal shall be paid for per lineal foot laid, measured with a flat surveyor's chain for the length constructed, and paid for at the Unit Price Bid, for all depths, including trenching, dewatering, trench safety system, backfilling, pavement and driveway repair (if required), required fittings, connections to receiving and discharge manholes, all complete in place as per the plans and specifications.

END OF SECTION C

SECTION D - SPECIAL PROVISIONS

IN ALL CASES WHERE THESE SPECIAL PROJECT PROVISIONS CONFLICT WITH THE TECHNICAL SPECIFICATION SECTIONS, MEASUREMENT AND BASIS OF PAYMENT, PLANS, GENERAL CONDITIONS OF THE AGREEMENT, SPECIAL CONDITIONS OF THE AGREEMENTS, CONTRACT CONDITIONS, ADVERTISEMENT AND INSTRUCTION TO BIDDERS OR ANY OTHER DOCUMENT CONTAINED OR ATTACHED OR MADE A PART HEREIN, THESE SPECIAL PROJECT PROVISIONS SHALL GOVERN.

All excavation in this project is UNCLASSIFIED.

1. The project's objective is to provide a Sanitary Duplex Submersible Lift Station for the proposed Texas A&M Facility, install a "Package-Type Sanitary Sewer Lift Station", including pumps and controls as specified in the "Package", all control boxes shall be stainless steel and shall include the installation of 2" sanitary sewer force main, and all necessary piping connections, plugs, etc. to the existing sewer facilities. By-Passing of the existing sanitary sewer receiving line shall be the responsibility of the Port Utility Department, and the Contractor shall be responsible for coordinating the by-passing and re-connection schedule to the new wet well.

2. The Lift Station shall be constructed within an existing easement as shown on the plans. The contractor will be responsible for clearing any debris on the site, and the pump pad foundation shall be stabilized to meet elevations as called for in the plans. The site shall be stripped as necessary to stabilize the finish grade elevation. Any organic material and debris shall be hauled off-site and disposed of at the contractor's expense. All fill material shall be placed in 8" lifts and compacted to 95% standard proctor density and such fill shall have a maximum P.I. (Plasticity index) of 17. Material unsuitable for fill shall be rejected and shall become the property of the contractor and disposed of at the expense of the Contractor.

   The Contractor shall be prepared with excavation equipment and means to stabilize the open excavation and provide safe and secured ground cuts to meet OSHA 29 CFR 1926, Subpart P Regulation Standards. The Contractor shall be prepared with groundwater dewatering equipment. Dewatering shall be performed with the objective of controlling the groundwater level in open excavations to achieve safe, stable, and firm ground surface at the prescribed plan elevation. The Contractor shall be responsible for the means and methods employed to control groundwater, and which may consist, but shall not be limited to well points. Dewatering equipment's discharge shall be directed away from the open excavated area in a manner to prevent sheet flow over the road surface or onto private property. Costs associated with groundwater dewatering shall be made subsidiary to the total construction cost.

3. Above-ground ductile flanged pipe shall conform to ANSI/AWWA C151/A21.51 for fabricated plain-end pipe with threaded ends. The pipe barrel and flanges shall have a taper thread (NTP) in accordance with ANSI B1.20.1. Flange bolt holes shall align in conformance with ANSI/AWWA C115/A21.15 Standard requirements. Ductile iron flanged pipe shall be coated on the inside with 40 mil Protecto 401™ Ceramic Epoxy and 40mil of Bitumastic® 300M Coal-Tar epoxy polyamide on the outside surface.

4. Above-ground ductile flanged fittings shall conform to ANSI/AWWA C110/A21.10 Standard requirements. Ductile iron flanged fittings shall be coated on the inside with 40 mil Protecto 401™ Ceramic Epoxy and 40mil of Bitumastic® 300M Coal-Tar epoxy polyamide on the outside surface.

5. Electrical work: The Contractor shall coordinate with the Port of Brownsville Engineering Department for the scheduling of the Service Power Drop and/or Brownsville PUB. The Port will be responsible for the service application and associated costs. All electrical connections to the Lift Station shall be underground. The contractor shall retain electrical engineering services from a registered professional engineer in the state of Texas for preparation of electrical plans. Electrical design is required to provide power to the pump station and area lighting. Area lighting fixtures shall be LED Wall Pack Model N

Series (EWNB) EvolveTM as manufactured by GE or equal. Area lighting fixtures shall be inclusive of pole. 110 Volt power is required to feed a flowmeter. Other power requirements consist of providing four 110-volt outdoor outlets, and two 220-volt outdoor outlets. Owner to provide outlet location. Light poles shall be made of Aluminum anchored to a reinforced concrete footing design to meet local wind speed. Electrical work shall be performed by a registered master electrician. The contractor shall provide proof of license number.

6. PVC pipe for force main shall be manufactured to meet AWWA C 900 Standard Requirements for DR 25 Class 165 psi pipe and shall be colored moss green. The pipe shall be properly bedded and hunched to meet plan requirements. The contractor shall be prepared with excavation equipment and means to stabilize the open excavation to provide safe and secured ground cuts to meet OSHA 29 CFR 1926, Subpart P Regulation Standards.

7. Any underground ductile iron fittings shall conform to ANSI/AWWA C153/A21.53 Standard requirements for mechanical joint ductile iron compact fittings. Mechanical joint restraint devices shall be Romagrip ™ as manufactured by Romac Industries, Inc. or approved equal. Ductile iron mechanical joint fittings shall be coated on the inside with 40 mil Protecto 401™ Ceramic Epoxy and 40mil of Bitumastic® 300M Coal-Tar epoxy polyamide on the outside surface. The fittings shall be wrapped in 8 mil plastic. Concrete trust blocks are required to reduce pipe movement.

8. **GEOTECHNICAL INFORMATION:** A copy of the Soils Investigation Report is available upon request from the Port of Brownsville Engineering Department. This Report is for information only and does not relieve the Contractor/Bidder of the obligation to conduct their own investigation of the subsurface conditions. Please note the Report's date and its relevance to groundwater profiles. Groundwater depths may vary with seasons, rainfall amounts, and frequency.

9. **EXCAVATION, FILLING, DEWATERING, AND DISPOSAL:** The CONTRACTOR shall do all necessary excavation, filling, trenching, drilling, boring, demolition, grading, backfilling, hauling away of material, etc., to complete the project. Dewatering shall be performed with the objective of controlling the groundwater level in open excavations to achieve safe, stable, and firm ground surface at the prescribed plan elevation. The contractor shall be responsible for the means and methods employed to control the groundwater, and which may consist, but shall not be limited to, well points. The dewatering equipment discharge shall be directed away from the open excavated area in a manner to prevent sheet flow over the road surface or onto private property. The contractor will be responsible to obtain approval from the road authority to direct the pump discharge into the storm drainage or road bar ditch.

   Any material used for fill (other than trench backfill), whether hauled in or from the site, must be DRY, free of trash, large boulders, organic or other material or debris, all in accordance with Specifications. All fill material shall be placed, spread, shaped, and compacted to the specified density and shall have a maximum P.I. (Plasticity Index) of 17. Any material unsuitable for fill shall be rejected and shall become the property of the CONTRACTOR and disposed of at the expense of the CONTRACTOR.

10. **PROTECTION OF ADJACENT PROPERTY:** All fences, plants, grass, trees, and shrubs shall be protected at all times. The areas in and adjacent to the construction site shall be restored to their original conditions after necessary fine grading is completed. Adjacent residents along the project route must have access to their homes or businesses at all times.

11. **TESTING:** All testing shall be done by and paid by the OWNER on all necessary testing selected by ENGINEER, but retesting shall be charged to the CONTRACTOR and deducted from his final payment,

and no additional compensation will be made or allowed for reworking the necessary defective work not meeting the specified work of the plans and specifications.

The CONTRACTOR will always, furnish the necessary materials, equipment and assistance to secure the necessary samples to be tested by others.

The strength, thickness, density and other requirements have been indicated on the plans and/or Specifications.

12. **CONTACT PERSONS:** The CONTRACTOR shall furnish the OWNER the names, addresses, and telephone numbers of all personnel responsible for the work in case of Emergencies.

13. **DAMAGES TO EXISTING OBJECTS – OVERHEAD AND UNDERGROUND:** Damages done to existing utilities, water lines, sewer lines, power poles, fences, signs, mailboxes, driveways, culverts, pavement, irrigation and drainage systems, etc., shall be repaired by the CONTRACTOR at no cost to the OWNER, and such costs shall be subsidiary to the project cost.

14. **FIRE/POLICE AND SHERIFF NOTIFICATION:** The CONTRACTOR shall notify the Fire, Police and/or Sheriff Department of streets or roadways to be closed or detoured for work at least 48 hours in advance of such closures or detours.

16. **WORK LIMITS:** The CONTRACTOR shall be limited only to existing rights-of-way and designated easements. Any damages done to property outside these work areas will be corrected to its original or better conditions by the CONTRACTOR at no extra cost to the OWNER. It is important that the CONTRACTOR be aware of the work limits so that no damage can result to those areas outside these limits.

17. **UTILITY LINE LOCATIONS:** The plans show approximate locations of utility lines. Some utility locations were obtained from surface locations furnished by “Dig-Tess” and from existing utility records. The CONTRACTOR shall notify the appropriate public (water and sanitary sewer) or private utility company (electric, gas sprinklers, irrigation lines) to locate and confirm locations and depths of all utility lines before construction operations begin. The CONTRACTOR shall exercise extreme care in working in the vicinity of these lines especially gas and fiber optic lines. The existing utilities such as water, sanitary sewer, gas, telephone and power must remain in service at all times. If service interruption is necessary due to tie-ins or changeovers, then the Contractor will first advise the Owner and if approved, the affected residents at least 48 hours before such interruption. Temporary bypasses to water or sanitary sewer lines may be necessary to accomplish the Project. All shutdowns required for the execution of the project shall be limited so as to not interrupt service to residents. All shutdowns shall be scheduled and coordinated with the Owner. The Contractor shall be aware that major shutdowns must be done during the low-peak (night) hours.

    Any plan specified water and sewer utility adjustments shall be made in coordination with the Port of Brownsville Engineering/Utility Department. The Contractor is responsible for notifying the Port within one week prior to any needed service interruptions.

18. **MATERIALS ON HAND:** No allowance for materials on hand will be paid unless approved by the Port of Brownsville and such materials are stored in a well protected fenced and secure area. The proper documentation shall be required if allowances are requested.

20. **MONTHLY ESTIMATES:** The CONTRACTOR shall use the special forms provided to him for monthly estimate submittal. These forms will be issued to the Contractor by the Engineer in electronic format. Any requests or invoices submitted in any other form will not be accepted and shall be returned. Monthly Estimates shall be submitted to the Engineer by the end of each month. The Engineer will

review the estimates for general compliance and submit them to the Owner's Inspection Department for further evaluation and approval.

21. **TRAFFIC CONTROL PLAN:** The CONTRACTOR shall submit the Traffic Control Plan to the Port of Brownsville at least 5 working days before closure and construction operations within those areas. The CONTRACTOR shall make necessary efforts to minimize inconvenience to traffic. If traffic is to be shut down, arrangements must be made with the Port of Brownsville at least 5 working days in advance of such interruptions. The Contractor shall be required to submit a Traffic Control Plan consistent with his project sequencing, which shall be prepared by a Registered Professional Engineer licensed in the State of Texas. Such plan shall be reviewed by the Port of Brownsville and the Project Engineer for approval and implementation. The Contractor shall not be compensated directly for the Traffic Control Plan, but such cost shall be subsidiary to the total project cost.

    All Traffic Control Devices used for this project shall conform to the "Texas Manual on Uniform Control Devices".

22. **RESIDENT ACCESS:** The CONTRACTOR shall minimize inconvenience to adjacent property owners' driveway entrances by not leaving open trenches open overnight and allowing safe passage.

23. **GENERAL SAFETY AND TRENCH SAFETY:** The CONTRACTOR is expected to execute his Project in the safest way possible. The CONTRACTOR shall submit to the Port of Brownsville and the Project Engineer three (3) copies of the TRENCH SAFETY SYSTEM as prepared by a qualified Registered Professional Engineer licensed in the State of Texas. No construction will be allowed on trenches or pits greater than five feet until the Port of Brownsville approves such Plan.

24. **CONSTRUCTION STAKING AND LAYOUT:** The Contractor has been given horizontal and vertical control for the construction of this Project. Since a portion of the construction is taking place in a Utility Easement and public Right-of-Way, the Contractor shall use a Registered Professional Land Surveyor, licensed in the State of Texas, for the project layout.

25. **WORKMANSHIP:** The Contractor is expected to perform his work with the highest quality craftsmanship. The Owner expects only the best supervision and workmanship for the entire project to ensure that ALL the requirements outlined in the PLANS AND TECHNICAL SPECIFICATIONS are met in terms of quality, application, and installation. Any defects due to product performance or workmanship shall be replaced at the direction of the Engineer or the Owner.

26. All work shall be performed in strict accordance with the plans and specifications.
    The contract documents may be amended by Change Order only to add, delete, or revise the work, or to modify the terms and conditions thereof.

27. All work shall be programmed for regular weekday work hours, Monday to Friday, from 7:00 AM to 6:00 PM. Work that requires programming outside the regular weekday work hours or during holidays shall be coordinated with the owner and engineer before taking place.

28. The contractor is responsible for identifying the location of spotted underground utilities.

29. The contractor shall furnish the owner and engineer the contact information, including emergency telephone number(s) of the project superintendent, project manager, project representative or foreman in charge of the project.

30. The contractor shall be responsible for construction staking. Horizontal and vertical control will be provided by the owner before construction begins. Contractor is responsible for protecting the control points and benchmark provided by the owner. Re-staking of control points or additional requested control from the owner will be paid for by the contractor. Construction staking shall be performed by a licensed professional land surveyor registered to practice in the State of Texas. Professional fees in connection to construction staking shall be made subsidiary to the various bid items of the proposal form.

31. The contractor is expected to conduct his work in such a manner as to minimize any soil erosion or sediment runoff from the construction site. Earthen cuts and fills shall have smooth, flat side slopes, as generally indicated on the plans, to preclude erosion of the soil. Such operations should be timed consistent with the actual need for doing the work and only to leave raw, unprotected surfaced for a minimum of time.

32. Regular scheduled monthly construction progress meetings shall be held at a location and time to be determined. The contractor is expected to provide monthly progress schedules. Once substantial completion is achieved the contractor shall provide engineer a complete set of marked record drawings (plans) indicating field adjustments and modifications made to the original set of plans. Final Payment will not be made to the Contractor until the record drawings are submitted.

33. The contractor shall always have at the project site a copy of the complete set of plans and specifications. All Sub-Contractors shall have a complete copy of the plans and specifications while working on the site.

34. **SHOP DRAWINGS:** The Contractor shall submit shop drawings, material specifications, or equipment specifications proposed for use in the project to the Engineer via electronic mail in PDF Format. Contractor shall allow 5 working days for the engineer's comments or approval. It is important that the contractor furnish the engineer copies of all applicable warranties related to the different items or fixtures used for this project.

35. **PERMITS:** The contractor shall have full responsibility for obtaining and paying for all necessary permits as required for construction of this project. The contractor shall always have a copy of any and all permit(s) at the job site. All permit's special conditions must be followed, whether they are issued by the state or any other authority.

36. **TRAFFIC CONTROL PLAN**: Disruption of public traffic shall be maintained at minimum. The contractor will be responsible to obtain professional engineering services for preparation of the traffic control plan(s) required for all construction stages and for coordinating with the corresponding road authority for approval of the proposed traffic control plan(s) prior to any work takes place in the field. The traffic control plan(s) shall be signed and sealed by a Texas licensed professional engineer. The traffic control plan shall be consistent with the contractor's work sequence. Should the traffic control plan involve the need to close a public street, roadway, or thoroughfare, the CONTRACTOR is responsible for contacting the corresponding road authority, Police, Fire Department, EMS services, and public-school system.

    The contractor will be responsible for the installation and maintenance of all temporary traffic control signs and markings. All traffic control devices, including but not limited to temporary sign, pavement marks, raised markers, and accessories, shall be in accordance with the Texas Manual on Uniform Traffic Control Devices (TMUTCD), latest edition, and compliant with the TXDOT Standards for this matter.

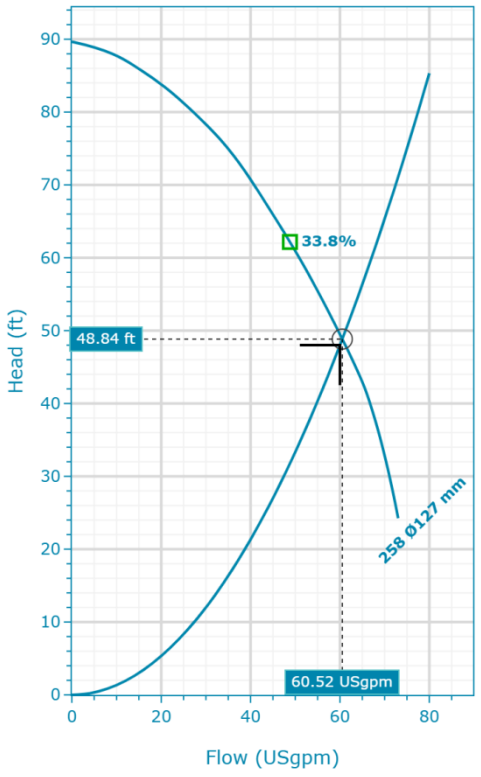
END OF SECTION D

xylem
Let's Solve Water

MP 3069 HT 3~ 258

Created On: 11/24/25

MP 3069 HT 3~ 258 | Configuration Summary



Curve: ISO 9906

Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances. Please consult your local Flygt representative for additional performance guarantees.

GENERAL

Explosion Proof
No

Impeller Diameter
127 mm

Max. Pumped Media Temp.
104 °F

MATERIAL AND COATING

Impeller Material
Grey Cast Iron

Volute Material
Grey Cast Iron

MOTOR

Rated Voltage
460 V

Motor Efficiency Class
Standard

Coupling
Y

Rated Power
2.7 Hp

INSTALLATION

Installation Type
P - Semi-Permanent, Wet

MP 3069 HT 3~ 258 | Product Details

Description

M 3069

Hard Working, Heavy-Duty Grinder Pump

The Flygt M 3069 grinder pump is a high-performing submersible, centrifugal pump. Excellent for pumping wastewater in residential, commercial and agricultural applications. The grinder pump reduces waste content to fine slurry, pumped through small-diameter pipes. The main application for Flygt M 3069 is pressurized sewage systems that are generally used when flat land, uphill topography, surface rock and high water tables pose tough challenges for conventional gravity systems.
Whether you need a single grinder pump, a complete pump station or an entire wastewater system, Xylem offers a smart and economical delivery of wastewater to the nearest pump station or sewer main.

Reliable Operation

The M 3069 is engineered to meet all challenges of a wastewater system. It comes equipped with a unique impeller for optimum hydraulic efficiency and a heavy-duty cutting device, which grinds solids into 5 × 15 mm particles to enable easily transporting fluids through small-diameter pipes.
All components are specially designed and manufactured to optimize operation and prolong pump service life.

- Double mechanical seal system. Two sets of mechanical shaft seals work independently to provide double security. They are available in Tungsten carbide (WCCR) or Silicone carbide (SiC) depending on pumped media.
- Made of robust and durable cast iron
- Spin-out outer seal protection design that protect seals from abrasive particles
- Motor cable SUBCAB® specially developed for submersible use

Product Features

- Use for heavy-duty shredding applications
- Non-clogging design
- Reliable operation
- Heavy-duty cutting device

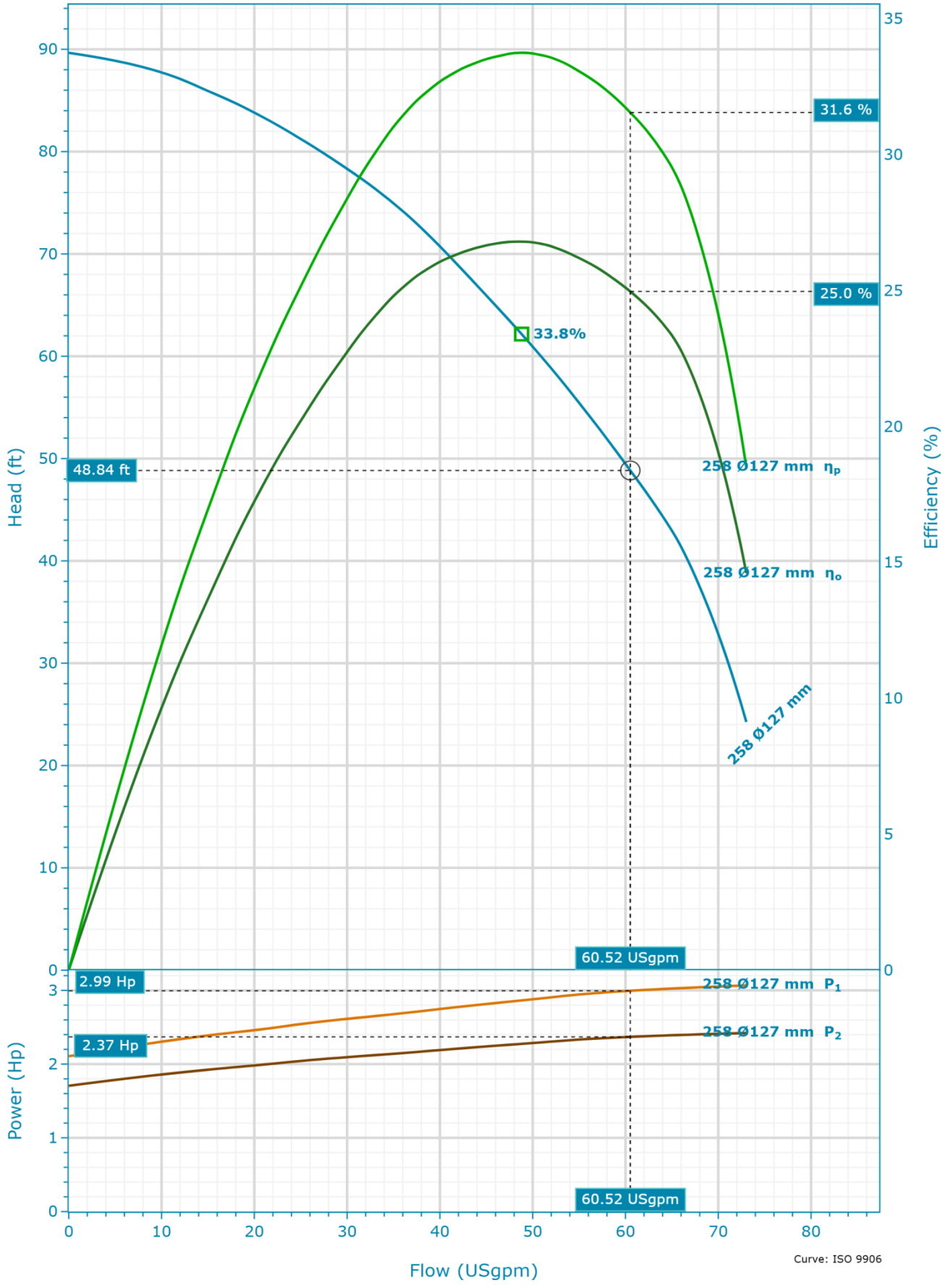
Construction Materials

Impeller Material	Volute Material	Stator Cover Material
Grey Cast Iron	Grey Cast Iron	-

Motor

Rated Power	Number Of Phases	Start Current Ratio	Motor Issue
2.7 Hp	3	5.1	10
Motor Denomination	**Rated Motor Speed**	**Insulation Class**	**Locked Rotor Code**
13-08-2BB	3,290 RPM	F	G
Motor Efficiency Class	**Rated Voltage**	**Approval**	**Max starts per hour**
Standard	460 V	STD	15
Version Code	**Rated Current**	**Total moment of inertia**	**Power Factor 100%**
170	3.7 A	0.06 ft^2lbf	0.89
Frequency	**Start Current**	**Type of duty**	**Power Factor 75%**
60 Hz	19 A	S1	0.85
Max P2 (1x)	**Starting Current, Direct Starting**	**Stator Variant**	**Power Factor 50%**
2.42 Hp	19 A	1	0.76
Number Of Poles	**Starting Current, Star Delta**	**Motor Module**	**Efficiency 100%**
2	6.33 A	101	77.5 %
			Efficiency 75%
			80.4 %
			Efficiency 50%
			81.1 %

MP 3069 HT 3~ 258 | Hydraulic Data & Performance Curve



Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances. Please consult your local Flygt representative for additional performance guarantees.

Project:	Created By:	Created On:	Last Update:
MP 3069 HT 3~ 258	Patrick Palacios	11/24/25	-

Selection

Series M 3000	Curve Code 258
Name MP 3069 HT 3~ 258	Impeller Diameter 127 mm
Frequency 60 Hz	Inlet Diameter 40 mm
Total Flow 60 USgpm	Outlet Diameter 2 in
Total Head 48 ft	Number Of Vanes 5
Pump Flow 60 USgpm	
Pump Head 48 ft	
System Type Single Pump	
Operating Pumps 1	
Standby Pumps No Standby Pump	

Fluid and Operating Conditions

Fluid Type Water	Density 62.43 lb/ft³
Fluid Temperature 39.2 °F	Dynamic Viscosity 1.57 cP
Specific Gravity 1	Fluid Vapor Pressure 0.12 psi
	Atmospheric Pressure 14.7 psi
	Elevation 0 ft
	Ambient Temperature 68 °F
	NPSH Available 33.68 ft
	Submergence 0 ft

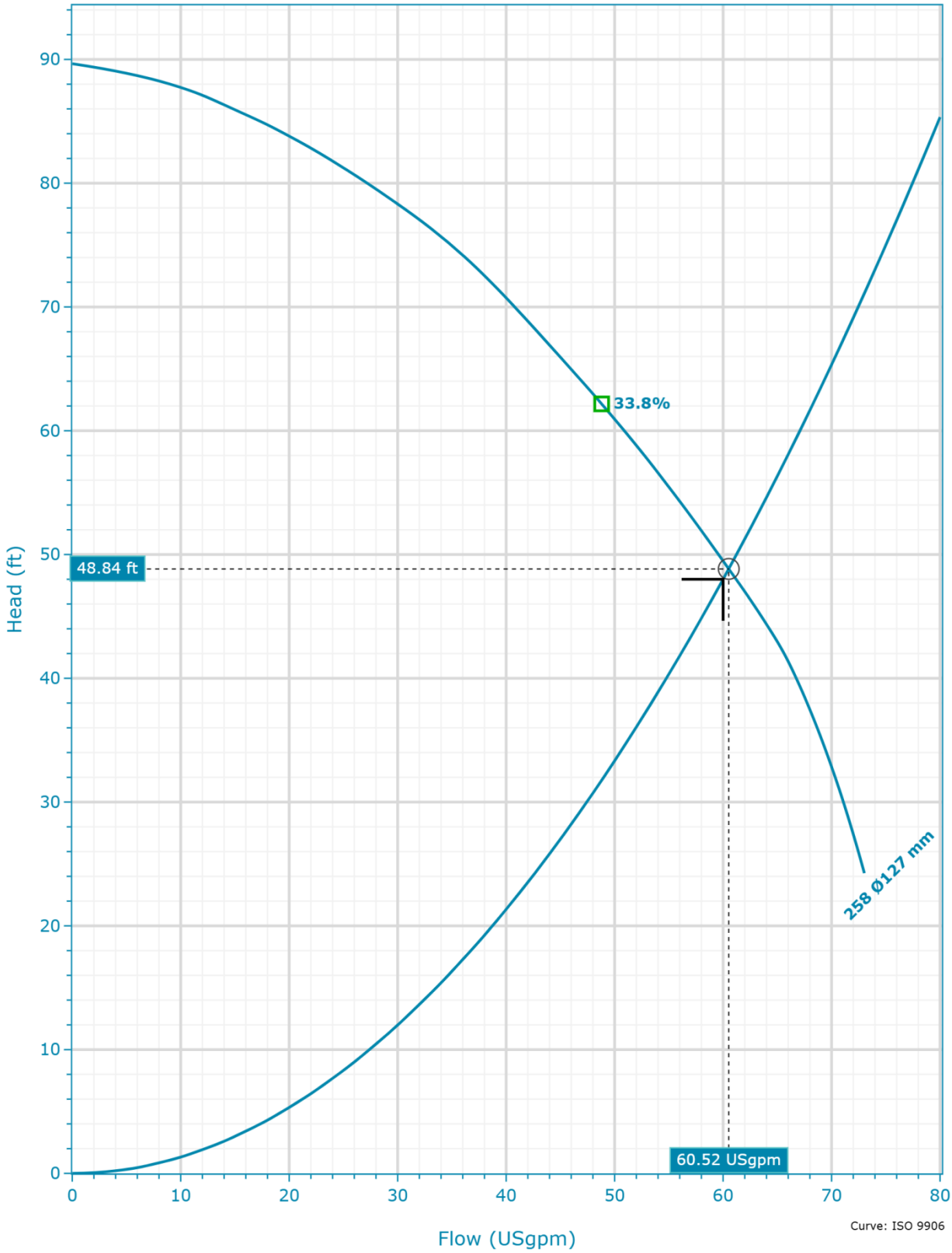
Design Point

Flow 60.52 USgpm	Shaft power (P2) 2.37 Hp
Head 48.84 ft	Flow To BEP Ratio 124 %
Overall Efficiency (ηo) 24.97 %	
Pump Efficiency (ηp) 31.56 %	
Input Power (P1) 2.99 Hp	

Design Curve

Rated Speed 60 Hz	BEP Flow 48.81 USgpm
Max Flow 73.02 USgpm	BEP Head 62.17 ft
H@QMin 89.66 ft	Max P2 2.42 Hp
H@QMax 24.26 ft	Specific Energy 0.0006 kWh/USgal
BEP 33.75 %	

MP 3069 HT 3~ 258 | Duty Analysis

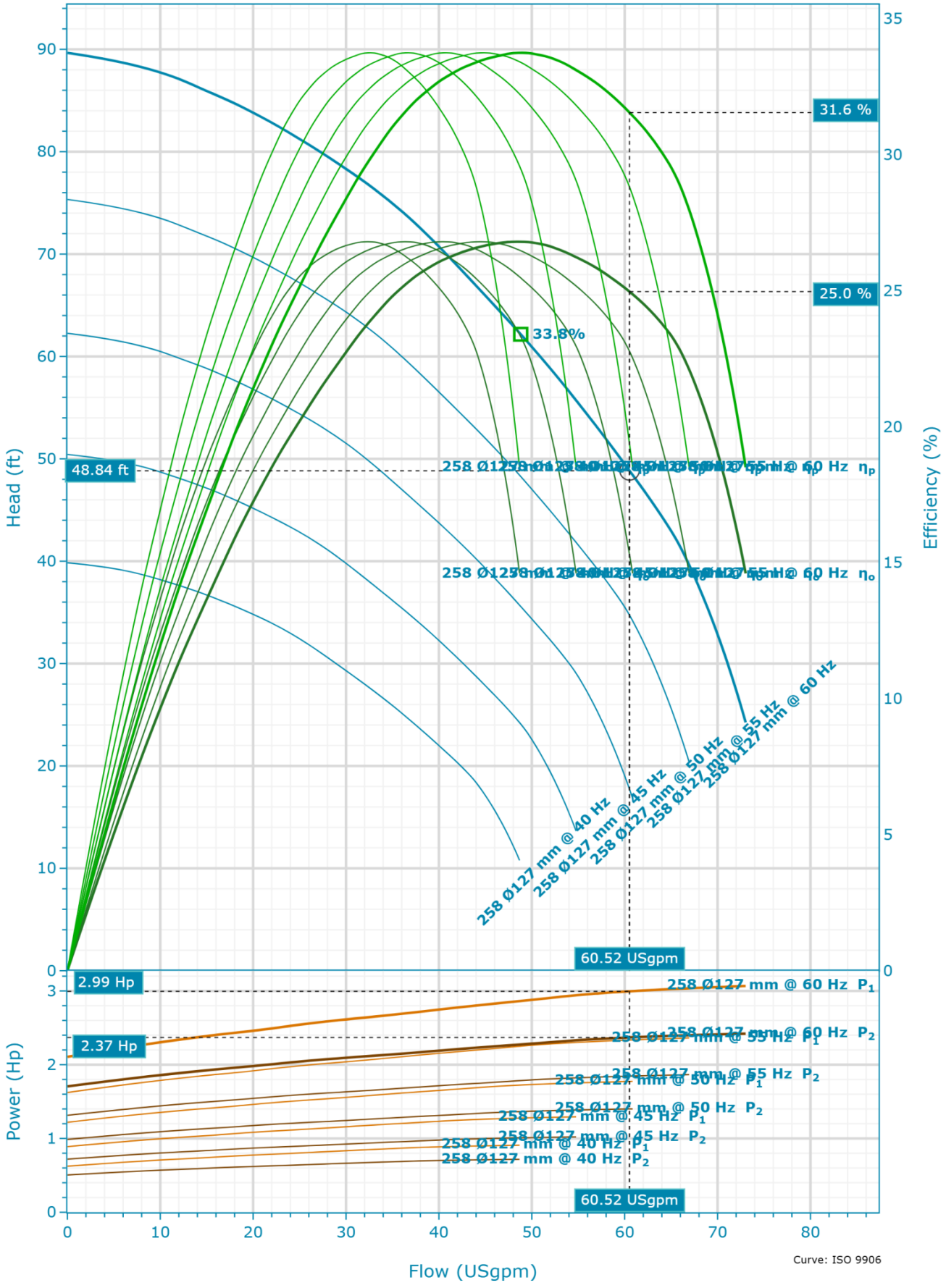


Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances. Please consult your local Flygt representative for additional performance guarantees.

Name	Q (1x) [USgpm]	H (1x) [ft]	P2 (1x) [Hp]	Q [USgpm]	H [ft]	P2 [Hp]	ηp [%]	SE [kWh/USgal]	NPSHr [ft]
DP @ 1x	60.52	48.84	2.37	60.52	48.84	2.37	31.56	0.0006	0

Project:	Created By:	Created On:	Last Update:
MP 3069 HT 3~ 258	Patrick Palacios	11/24/25	-

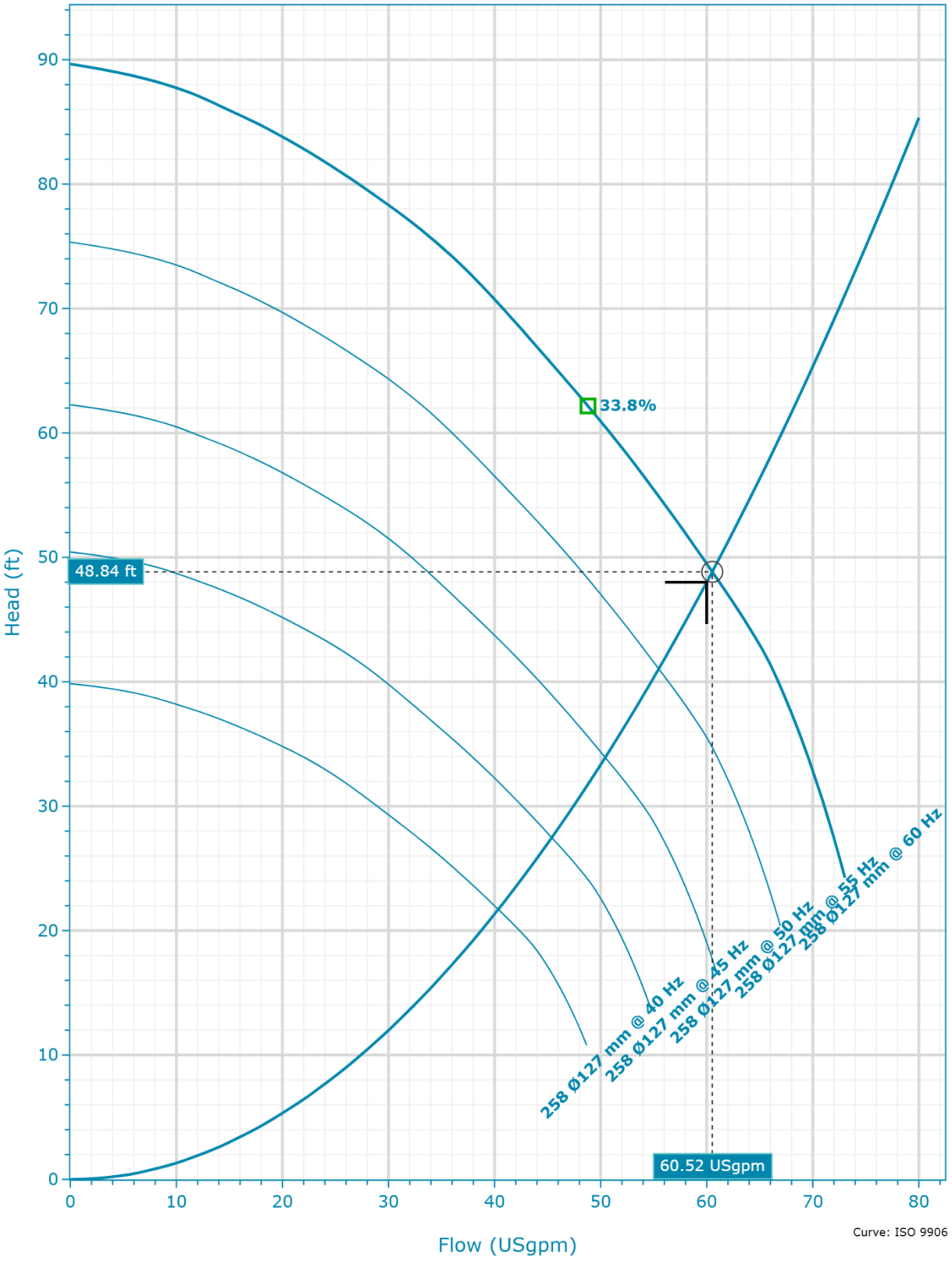
MP 3069 HT 3~ 258 | Variable Speed Curve



Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances. Please consult your local Flygt representative for additional performance guarantees.

Project:	Created By:	Created On:	Last Update:
MP 3069 HT 3~ 258	Patrick Palacios	11/24/25	-

MP 3069 HT 3~ 258 | Variable Speed Analysis



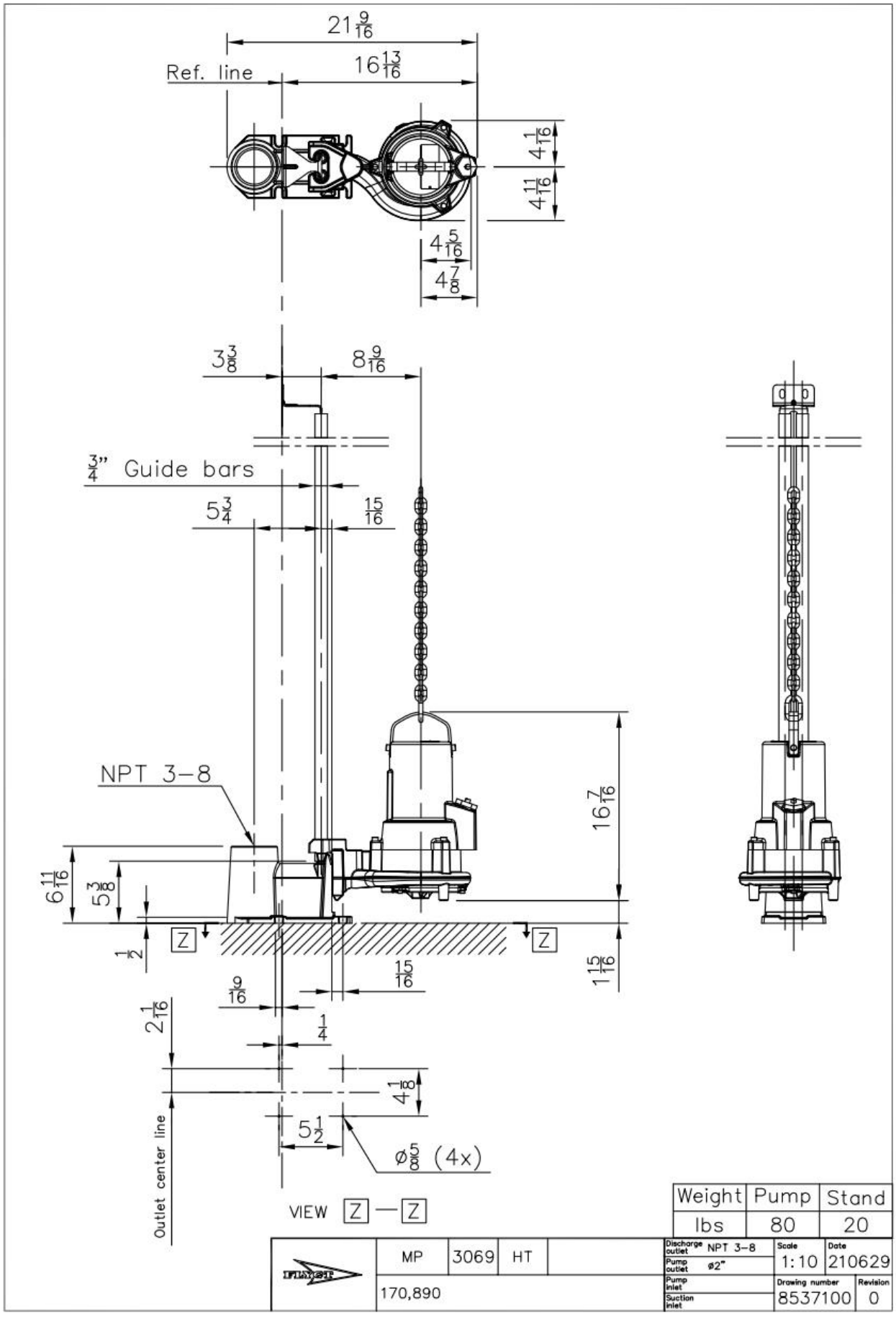
Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances. Please consult your local Flygt representative for additional performance guarantees.

Name	Speed	Q (1x) [USgpm]	H (1x) [ft]	P2 (1x) [Hp]	Q [USgpm]	H [ft]	P2 [Hp]	ηp [%]	SE [kWh/USgal]	NPSHr [ft]
DP @ 1x	40 Hz	40.35	21.71	0.7	40.35	21.71	0.7	31.56	0.0003	0
DP @ 1x	45 Hz	45.39	27.47	1	45.39	27.47	1	31.56	0.0003	0

Project:	Created By:	Created On:	Last Update:
MP 3069 HT 3~ 258	Patrick Palacios	11/24/25	-

DP @ 1x	50 Hz	50.43	33.91	1.37	50.43	33.91	1.37	31.56	0.0004	0
DP @ 1x	55 Hz	55.48	41.04	1.83	55.48	41.04	1.83	31.56	0.0005	0
DP @ 1x	60 Hz	60.52	48.84	2.37	60.52	48.84	2.37	31.56	0.0006	0

MP 3069 HT 3~ 258 | Dimensional Data & Drawing



Weight	Pump	Stand
lbs	80	20

FLYGT	MP	3069	HT	Discharge outlet NPT 3–8	Scale 1:10	Date 210629
	170,890			Pump outlet ø2"	Drawing number 8537100	Revision 0
				Pump inlet		
				Suction inlet		

Company	Xylem
Contact	Patrick Palacios
Phone No.	4697121011
Email	patrick.palacios@xylem.com

xylem
Let's Solve Water

SECTION 00006 BEDDING AND BACKFILL

6.1. WORK INCLUDED. Under this section is included the bedding and backfilling of excavated trenches for WATER and SEWER lines and spaces around the completed structures to the original grades, unless otherwise shown on the drawings or set forth in the proposal.

6.2. BEDDING PROCEDURES. The following bedding procedures will be used for Polyvinyl Chloride (PVC) Pipe and Vitrified Clay Pipe. All installations shall be as specified in the plans and in accordance with AWWA C900 or AWWA C905 for Water Pipe and ASTM D 2321 or ASTM C 12, Latest for Sewer Pipe.

6.2.1 DRY OR STABLE CONDITIONS. Before pipes have been tested and approved, partial backfilling shall be done with approved material free from large clods.

The bedding zone shall extend from a point at least 6 inches below bottom of pipe to a point at least 6 inches above top of pipe, as well as at least 6 inches on each side of pipe, or as specified in the Plans, and shall be compacted to at least 90% of maximum density as determined by ASTM Standard D 698, latest revision.

Contractor to furnish bedding of the kind and type specified in the plans from 6 inches below bottom of pipe to bottom of pipe shall be placed in one lift and shall be mechanically tamped. Bedding from bottom of pipe to spring line of pipe shall be placed by hand in 4 inch lifts and shall be hand tamped with proper tools. Bedding from spring line of pipe to 6 inches above top of pipe shall be placed in 6 inch lifts and shall be mechanically tamped.

6.2.2 UNSTABLE OR WET CONDITIONS. When the ENGINEER determines that the trench bottom or trench wall is unstable at the bedding zone, or when pipe is to be placed under groundwater (below water table), preparation by special bedding material and ground water drawdown procedures shall be required. Unstable bedding zone conditions shall be determined immediately after trench excavation by checking soil bearing strength capacities at the bedding zone using a Standard Pocket Penetrometer or other appropriate means. A minimum of three readings shall be obtained and averaged. If the average reading is **LESS THAN 8 BLOWS PER FOOT**, then the Contractor shall prepare the pipe bed in accordance with the procedures contained in this paragraph. The soil to be tested in the bedding zone shall not be allowed to dry, and shall be tested under "in-situ" conditions. If, in the Engineer's opinion the soil has dried, the Penetrometer Test shall be taken by removing some amount of soil from the wall (or bottom) surface in order to obtain a representative sample. Dewatering of the trench must be accomplished and Class I or I-A Material (1/4" to 1-1/2" graded crushed gravel), or approved substitute shall be required in accordance with ASTM Specifications, or Trenching Details contained in the Detailed Project Plans, and no pipe will be laid until stabilization is to the satisfaction of the OWNER/ENGINEER. In addition to the crushed gravel, the CONTRACTOR shall install a GEOTEXTILE material, as specified in SECTION 6.10 herein. Installation shall be accomplished in accordance to AWWA C900 or AWWA C905 for PVC WATER PIPE and ASTM D 2321 (Latest) for FLEXIBLE THERMOPLASTIC SEWER PIPE, ASTM C 12 (Latest) for VITRIFIED CLAY PIPE and as per the corresponding ASTM SPECIFICATION for FIBERGLASS SEWER PIPE, when specified. The crushed gravel material shall be laid to 6" above the top of the pipe or higher as required to prevent flotation in ground water conditions.

6.3. OPEN CUT BACKFILL. Backfilling of excavated trenches in open cut shall be commenced as soon as possible after the water or sewer line is laid and the jointing and alignment are approved, but not until authorized by the OWNER.

6.3.1 Materials. The following materials shall be used to backfill the trenches in accordance with and in the manner indicated by the requirements specified herein, unless otherwise set forth in drawings or proposal.

6.3.1.1. Sandy Backfill Materials. Backfill in trenches for waterlines, sewer lines, property sewer service connections, and structures within the limits of existing or

proposed paved surfaces shall be made with sand or sandy materials containing not more than 20 percent clay, and free from rocks, lumps and debris. The sand or sandy material shall be furnished by the CONTRACTOR, but shall be subject to the approval of the OWNER.

6.3.1.2. Selected Excavated Materials. Backfill in trenches for waterlines, sewer lines, property service connections, and structures outside the limits of existing or proposed paved surfaces, shall be made with selected excavated materials taken from the trench excavation, free from rocks and lumps greater than six (6) inches in their largest dimension, and free from debris. The OWNER will, at his discretion, reject any material he deems unsuitable for backfill.

6.3.2. Final Backfill Above Pipe Zone (6" Above Pipe or Conduit to Top of Ground). The backfill above the pipe zone shall be, unless otherwise indicated on the drawings, in accordance with the following.

6.3.2.1. Class "A" Mechanical Compaction. Trench under flexible pavements and gravel surfaces - place Type "E" excavated select backfill material in layers not to exceed six (6) inches loose measurement. Compact with mechanical tampers to a minimum of 95% of maximum density as determined by ASTM Standard D 698, latest revision. Each layer, before compaction, shall be levelled and evenly distributed on both sides of the pipe so as not to disturb, displace or damage the water or sewer line in any way. Use under existing or proposed road.

6.3.2.2. Class "B" Mechanical Compaction. Trench under unimproved roadways, unsurfaced road shoulders, unimproved driveways and under turfed or seeded lawn areas - place Type "E" excavated material in backfill layers not to exceed twelve (12) inches loose measurement. Compact with mechanical tampers to at least 90% of maximum density as determined by ASTM Standard D 698, latest revision. Each layer, before compaction, shall be levelled and evenly distributed on both sides of the pipe so as not to disturb, displace or damage the water or sewer line in any way. When the material does not contain sufficient moisture to obtain thorough compaction, it shall be moistened or wetted as directed by the OWNER.

6.4. SPECIAL BACKFILL CONDITIONS. The trenches need not be completely backfilled until all required pressure and leakage tests are performed and until the utilities system as installed conform to the requirements specified.

Trenches improperly backfilled shall be reopened to the depth required for proper compaction, and refilled and compacted as specified, or the condition shall be otherwise corrected as permitted by the OWNER. The surface shall be restored to its original condition as nearly as practicable and as hereinafter specified. Immediately after the pipe, or utility lines, is bedded and joined, as indicated on the drawings or specified, the backfill material shall be deposited within the pipe zone in uniform layers not to exceed six (6) inches and at the proper moisture content. The layers shall be compacted with mechanical hand tampers or other approved equipment to the density herein specified. The backfill shall rise the same on each side of the pipe and coincidentally be tamped in layers until there is a cover of 12 inches over the top of the pipe. Walking or working over the pipe will not be permitted until the trench is backfilled to 12 inches above the pipe.

Where pavement on a State Highway is cut, final backfill material and pavement shall be replaced in accordance with State Highway Department requirements.

Where pavement is cut in locations other than State Highways, whether gravel topping or hard surfaced, the surfacing shall be restored to its original finish and in equal condition and quantities as found at the beginning of construction. Trenches on hard surfaced roads shall be backfilled to a density of 95% as determined by the American Association of State Highway Officials Method T99 for compaction and density of soils.

Successful CONTRACTOR shall determine all requirements of various controlling agencies in connection with backfilling, pavement replacement and general construction before starting construction.

In traffic areas including individual driveways, CONTRACTOR shall restore traffic surfaces to usable condition immediately upon completion of pipe installation. In such locations, OWNER will rely upon hydrostatic test to determine acceptability of construction. All excess dirt from all construction work shall be disposed of promptly by CONTRACTOR, either by hauling or at directions of OWNER.

6.5. BACKFILLING AT STRUCTURES. Shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade. All forms, shoring and bracing shall be removed before backfilling is started. Care shall be taken to prevent any wedging action of backfill against a structure, and slopes bounding the excavation shall be stepped or serrated to prevent such wedge action. Backfill shall be placed in uniform layers, dried or moistened as required to obtain approximate optimum moisture content, and tamped with mechanical hand tampers or other approved equipment to a density of at least 95 percent of maximum density at optimum moisture. The thickness of each loose layer shall not exceed six inches.

6.5.1. BACKFILLING WALLS OF LIFT STATION STRUCTURES. During backfilling operations and in the formation of embankments, equipment that will overload the structure in passing over and compacting these fills shall not be used. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 6 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. Backfill shall be brought up to finished elevation indicated on drawings, on each side of the wall. Foundation walls shall be backfilled in a maximum of 3'-0" intervals until finished grade has been established.

6.6. COMPACTION - General. Backfill materials shall be placed in uniform layers and compacted to percentage of density hereinafter specified. Moisture shall be controlled between optimum and 2 percentage points over. Methods to secure optimum moisture content shall be CONTRACTOR's responsibility. Compacting equipment and method of compaction shall be the responsibility of CONTRACTOR and shall be such that uniform density will be obtained over entire area and depth of material being compacted. Fill material shall be thoroughly broken up before being spread into uniform layers.

Backfill not otherwise specified shall be compacted to at least 95% of maximum density as determined by ASTM Specification D 698.

6.7. DETERMINATION OF DENSITY. Determination of density of backfill, shall be made in conformance with the requirements of ASTM D 2922, ASTM D 1556 or ASTM D 2167.

Determination of density of cohesionless material shall be made in accordance with ASTM D 2049. Relative density of 75% shall be considered as satisfactory for cohesionless material.

Testing shall be performed by a soil consultant employed by the OWNER and at no expense to the CONTRACTOR to test compaction of backfill material. When soil tests indicate densities less than those specified by this section, the material shall be recompacted and tested at the CONTRACTOR's expense.

6.8. CONSTRUCTION EQUIPMENT. Ditching machines will be permitted at CONTRACTOR's option, subject to the approval of the OWNER, whenever their use is applicable and practical for work shown on the drawings. A certain amount of hand excavation may be required due to special field conditions and to minimize damage to improvements and trees.

In compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the

pipe shall be avoided. Any pipe damaged thereby shall be repaired or replaced at the option of the OWNER and at the expense of the CONTRACTOR.

6.9. RESTORATION AND CLEANUP. The CONTRACTOR shall restore or replace all removed or damaged paving, curbing sidewalks, gutters, shrubbery, fences, sod, or other disturbed surfaces of structures in a condition equal to that before the work began and to the satisfaction of the OWNER and shall furnish all labor and material incidental thereto, in restoring improved surfaces, new pavement shall be laid. No permanent surface shall be placed within 30 days after the backfilling has been completed, except by order of the OWNER.

Surplus pipeline material, tools and temporary structures shall be removed by the CONTRACTOR. All dirt, rubbish, and excess earth from excavations shall be hauled to a dump provided by the CONTRACTOR, and the construction site shall be left clean, to the satisfaction of the OWNER.

6.10. GEOTEXTILE MATERIAL FOR UNSTABLE TRENCHES. When the ENGINEER determines that unstable wall or trench bottom conditions are present, the CONTRACTOR shall install a GEOTEXTILE material in accordance with the following specifications:

6.10.1. MATERIAL. The GEOTEXTILE shall be a nonwoven, needle point construction and shall consist of long-chain polyethylene or polyamide. The fibers shall be oriented into a stable network whereby they retain their positions with each other. The textile shall be free of any chemical treatment or coating which reduces permeablilty and shall be inert to chemicals and bacteria commonly found in soil. The GEOTEXTILE shall conform to the following properties:

TENSILE STRENGTH ASTM D 4632	130 LBS.
ELONGATION ASTM D 4632	50%
MULLEN BURST STRENGTH ASTM D 3786	250 psi
COEFFICIENT OF PERMEABILITY k-cm/sec.(20 CFMC-GET-2, constant head) ASTM D 4491	0.10cm/sec.
PUNCTURE STRENGTH	80 LBS.

The GEOTEXTILE shall be furnished in protective wrapping to protect the material from ultraviolet radiation, contamination from other substances, and abrasion or shipping damage. Any material received damaged, shall be rejected.

6.10.2. INSTALLATION. The GEOTEXTILE shall be installed in accordance with the manufactures recommendations, and the following conditions:

Prior to installation, the material shall be stretched, aligned, and placed without any wrinkles. If the material is damaged or punctured, the damaged area shall be patched by overlapping and stitching, as recommended by the manufacturer.

Overlaps shall be a minimum of 12 inches, or the material may be stitched in accordance with the manufacturers recommendations.

6.10.3. PAYMENT. Payment for GEOTEXTILE shall be included in the Contract Item

"**TRENCH STABILIZATION FOR SEWER PIPE**" as specified in the Proposal and the "Measurement and Basis of Payment" Section of the Contract Documents.

6.11. CEMENT STABILIZED SAND BACKFILL. When the ENGINEER determines that the backfill of a water or wastewater line or structure is especially critical, whether due to shallow trenches or where settlement control is needed, the CONTRACTOR shall furnish and install Cement Stabilized Sand Backfill in accordance with the following:

6.11.1. MATERIALS.

A. AGGREGATE: Use sand containing deleterious materials not to exceed the following requirements by weight:

Material removed by decantation:	5.0%
Clay Lumps	0.5%
Other deleterious substances, such as coal, shale, coated grains of soft flaky particles	2.0%

Gradation Requirements:

Retained on 3/8 inch sieve	0%
Retained on 1/4 inch sieve	0-5%
Retained on 20 mesh sieve	15-50%
Retained on 100 mesh sieve	80-100%

Color Test: ASTM C 40-73 - color not darker than standard color

B. CEMENT: ASTM C150-77, TYPE I

C. WATER: Fresh and clean

6.11.2. MIXING.
Not less than 1-1/2 sacks of cement shall be used per cubic yard of mixture. Water shall be used in the amount required to provide a mix suitable for mechanical hand tamping, and allowed to mix well in an approved mixer. Tickets shall be stamped at the plant with the time of loading. Material not placed within 1-1/2 hours after loading, or that has obtained an initial set, will be rejected and removed from the site.

6.11.3. PLACING.
Place around concrete structures such as lift stations, manholes, only after they have cured for at least four days. Place in trenches only after the ENGINEER has inspected the pipe bedding, and place in 4 inch lifts and compact each lift with an approved power driven hand tamper. Compaction shall be to a dry density of 102 pounds per cubic foot.

6.11.4. PAYMENT.
Measurement and Payment shall be per cubic yard, as bid in the Proposal Items or as indicated in the Measurement and Payment Section of the Bid Documents.

END OF SECTION 00006

SECTION 00011 - CONTRACTOR'S TRENCH EXCAVATION SYSTEM AND SHORING SAFETY PLAN

11.1. SCOPE

This section shall cover CONTRACTORS furnishing a Safety System Plan, and all labor and materials for installation and maintenance of the Trench Safety System.

11.2. APPLICATION

For any trench excavation at a depth of five (5) feet or greater or where shown on plans, the CONTRACTOR shall provide a trench safety system. The Trench Safety System shall be in accordance with the details shown on CONTRACTOR's Trench Excavation and Shoring Safety Plan, all in accordance with current OSHA Standards, Part 1926, Subpart P.

11.3. QUALITY ASSURANCE

The Trench Safety System shall meet appropriate requirements established in Section 756.022 of the Texas Health and Safety Code and Occupational Safety and Health Administration (OSHA) Safety & Health Regulations, 29 CFR 1926, Subpart P - Excavations, Trenching and Shoring, as may be amended, and OSHA's proposed standards on trenching excavation published in Volume 54, No. 209 of the Federal Register, October 31, 1989; Pages 45959-45991. Those standards are incorporated into these specifications by reference. Should the applicable OSHA standards be modified or amended, the more stringent standards shall apply.

11.4. SUBMITTALS

The CONTRACTOR shall provide three (3) copies of the Trench Safety System Plan to the OWNER for the Project before Award of the Contract. The Plan shall incorporate detailed plans and specifications for a Trench Safety System that conform to OSHA standards, including Part 1926, Subpart P (Latest Edition). The OWNER has existing Soils Investigation Data that may be used by the CONTRACTOR as a reference only. The CONTRACTOR shall be responsible to verify and conduct his own soils investigations as may be necessary in the development of the Trench Safety System Plan. The Plan shall account for project site conditions, CONTRACTOR's trench construction means, methods, techniques or procedures, the relationship of spoil to edge of trench, and CONTRACTOR's equipment to be used in construction of project facilities requiring trench Safety System(s). The CONTRACTOR shall submit a certificate signed and sealed by a Registered Professional Engineer licensed in the State of Texas stating that CONTRACTOR's Trench Safety System Plan has been designed in conformance with appropriate OSHA standards and applicable specifications as required by this item. The CONTRACTOR's Trench Safety System Plan shall demonstrate the type(s) of Trench Safety System to be used on the project.

11.5. MATERIALS

The materials used in the Trench Safety System shall be furnished by the CONTRACTOR, as approved by the OWNER, to comply with the requirements of the work of the CONTRACTOR as specified therein.

11.5.1. TIMBER

Trench sheeting materials to be full size, a minimum of two inches in thickness, solid and sound, free from weakening defects such as loose knots and splits.

11.5.2 STEEL SHEET PILING

Steel sheet piling shall at a minimum conform to one of the following specifications:

a. ASTM A328.
b. ASTM A572, Grade 50.
c. ASTM A690.

Steel for stringers (wales) and cross braces shall conform to ASTM A588.

11.5.3. STEEL TRENCH BOXES

Portable steel trench box shall at a minimum be constructed of steel conforming to ASTM Specification A-36. Connecting bolts used shall conform to Specifications ASTM A-307. Welds to conform to requirements of AWS Specification D1.1.

11.5.4. OTHER MATERIALS

Other materials to be utilized shall at a minimum conform to applicable ASTM standards.

11.6. INSTALLATION

Trench safety system shall be constructed, installed, and maintained in accordance with the Trench Safety System Plan prepared by the CONTRACTOR's Registered Professional Engineer.

11.6.1.TIMBER SHEETING

Timber sheeting and size of uprights, stringers (wales), and cross bracing to be installed in accordance with CONTRACTOR's plan. Place cross braces in true horizontal position, spaced vertically, and secured to prevent sliding, falling, or kickouts. Cross braces to be placed at each end of stringers (wales), in addition to other locations required. Cross braces and stringers (wales) to be placed at splices of uprights, in addition to other locations required.

11.6.2 STEEL SHEET PILING

Steel sheet piling of equal or greater strength may be used in lieu of timber trench shoring shown in the OSHA tables (proposed standards). Drive steel sheet piling to at least minimum depth below trench bottom as recommended by CONTRACTOR's Registered Professional Engineer providing design. Place cross braces in true horizontal position, spaced vertically and secured to prevent sliding, falling, or kickouts. Cross braces to be placed at each end or stringers (wales), in addition to other locations required.

11.6.3.TRENCH BOXES

Portable trench box may be used in lieu of timber trench shoring shown in the OSHA tables (proposed standards) and shall be designed to provide equal or greater protection than timber trench shoring shown in the OSHA tables. In cases where top of portable trench box will be below top of trench, the trench must be sloped to the maximum allowable slope for the soil conditions existing on the Project. In areas where a sloped trench will affect the integrity of existing structures, CONTRACTOR to protect structures prior to sloping trench.

11.6.4 Trench Jacks

When trench jacks are used for cross bracing and/or stringers (wales), the trench jacks shall provide protection greater than or equal to the timber cross bracing shown in the OSHA tables (proposed standards). Trench jacks to be placed at each end of stringers (wales) in addition to other locations required.

11.7. SUPERVISION

CONTRACTOR must provide competent supervisory personnel at each trench while work is in progress to ensure CONTRACTOR's methods, procedures, equipment, and materials pertaining to the safety systems in this Item are sufficient to meet requirements of Texas Law and OSHA Standards.

11.8. MAINTENANCE OF SAFETY SYSTEM

The safety system shall be maintained in the condition as shown on the Trench Excavation and Shoring Safety Plan as designed by the CONTRACTOR's Registered Professional Engineer. The CONTRACTOR shall take all necessary precaution to ensure the safety systems are not damaged during their use. If at any time during its use a safety system is damaged, personnel shall be immediately removed from the trench excavation area and the safety system repaired. The CONTRACTOR shall take all necessary precautions to ensure no loads, except those provided for in the plan, are imposed upon the trench safety system.

11.9. INSPECTION

CONTRACTOR shall make daily inspection of trench safety system to ensure that the system meets OSHA requirements. Daily inspection to be made by competent personnel. If evidence of possible cave-ins or slides is apparent, all work in the trench shall cease until necessary precautions have been taken to safeguard personnel entering trench. CONTRACTOR to maintain permanent record of daily inspections.

11.10. REMOVAL

The CONTRACTOR shall backfill pipe to a point at least one (1) foot above top of pipe or other embedded items prior to removal of any portion of trench safety system. Bedding and backfill to be in accordance to other applicable specification items. Backfilling and removal of trench supports shall be in accordance with CONTRACTOR's Trench Excavation and Shoring Safety Plan. Removal of trench safety system to be accomplished in such a manner to cause no damage to pipe or other embedded items. Remove no braces or trench supports until all personnel have evacuated the trench. Backfill trench to within five (5) feet of natural ground prior to removal of entire trench safety system.

11.11. MEASUREMENT AND PAYMENT

The Trench Safety System and related items shall be measured and paid as follows:

11.11.1. MEASUREMENT

Measurement for the “Trench Safety System" shall be by actual linear foot of trench excavated for trench depths exceeding five (5) feet as measured from natural ground (or prepared subgrade) over the centerline of the pipe, to the invert of the principal carrier pipe. Shoring of trenches at manholes, street and road bores and other line structures are to be included in the lineal foot cost of the "Trench Safety System", and considered subsidiary to this item.

11.11.2. PAYMENT

The work performed in conformance with this specification shall be paid as follows:

11.11.2.1. Pay for "Trench Safety System" measured as stated above by the linear feet of trench excavated and as shown on PROPOSAL for trench depths exceeding five (5) feet as measured from natural ground over the centerline of the pipe, to the invert of the principal carrier pipe. Payment shall be full compensation for all work described herein. There shall be no increase in the Contract price because of the incorporation of CONTRACTOR's Trench Excavation and Shoring Safety Plan or CONTRACTOR's detailed plans and specifications for the trench safety system into the bid documents and the Construction Contract. There shall be no increase in the contract price because of modifications to CONTRACTOR's plans and/or the CONTRACTOR's detail plans and specifications for the trench safety system, whether or not the result of unforeseen or differing site or soil conditions.

11.11.2.2. Pay for "Design of Trench Safety System Plan" developed by CONTRACTOR's Registered Professional Engineer shall be included and subsidiary to the "Trench Safety System" item of the PROPOSAL. Payment shall be full compensation for all professional services relating to the CONTRACTOR's submittal to OWNER of the Trench Safety System Plan.

11.12 INDEMNIFICATION

The CONTRACTOR shall indemnify and hold harmless the **PORT OF BROWNSVILLE**, its employees and agents from any and all damages, costs (including, without limitation, legal fees, court costs, and the cost of investigation), judgments or claims by anyone for injury or death of persons resulting from the collapse or failure of trenches constructed under this contract. The CONTRACTOR acknowledges that this indemnity provision provides indemnity for the Port of Brownsville in case the Port of Brownsville is negligent either by act or omissions in providing for trench safety, including, but not limited to inspections, failure to issue stop work orders, and the hiring of the CONTRACTOR.

END OF SECTION 00011

SECTION 00025 DEWATERING AND DRAINAGE OF EXCAVATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope: The work covered by this section consists of furnishing all plant, labor, materials, equipment, supplies, supervision, and tools and performing all operations in connection with dewatering and drainage of excavation in accordance with the Contract Documents.

1.02 CONTRACTOR'S RESPONSIBILITY

A. Assume sole responsibility for design operation and maintenance of dewatering systems and ground water control, for all loss of damage resulting from partial or complete failure of protective measures, except as otherwise provided in the general and supplementary conditions.

1.03 PLANS AND OTHER DATA TO BE SUBMITTED

A. Submit plans for review of proposed methods of dewatering, foundation drainage and diversion, in accordance with sound engineering practice.

B. Eductor Well Point System. Show the dewatering system of deep wells in clear detail, including the pump capacity, or other proposed method for lowering the water table within the areas where the water main, tunnel section, concrete structures and backfill are to be constructed.

C. Equipment Supplier. Name the supplier of well point or other foundation drainage equipment.

D. Review. Do not start dewatering or other foundation drainage until plans and other data required in this paragraph are reviewed and approved by the Engineer.

PART 2 - PRODUCTS

2.01 EQUIPMENT AND MATERIAL

A. Select equipment and material as necessary and desired.

PART 3 - EXECUTION

3.01 DEWATERING TRENCH

A. No sewer pipe or water line shall be laid in a trench in the presence of water. All water shall be removed from the trench sufficiently ahead of the pipeline installation operation. The Owner's representative shall have full and final authority to require dewatering of the trench to ensure a suitable, firm bed on which to place the sewer or water line.

Suitable firm bed condition is defined as a trench floor condition that possesses the same moisture and density characteristics of a remolded sample taken from the area and compacted to 92% standard proctor density with an allowable variance of two percent on moisture and five percent on density. Trench shall continue to be dewatered until trench backfilling operations have been completed.

B. Removal of water may be accomplished by pumping or pumping in connection with well point installation as the particular situation may warrant.

3.02 REQUIREMENTS FOR EDUCTOR WELL POINTS OR DEEP WELLS

A. Well points, where used, must be furnished, installed, and operated by a reputable contractor regularly engaged in this business, and approved by the Engineer.

B. Install sufficient piezometer to show that all trench excavation in sandy material is pre-drained prior to excavation.

C. Dewatering may be omitted for portions of underdrains or other trenches, only where auger borings and piezometer show that the soil is pre-drained by an exterior system.

3.03 DISCHARGE OF WATER

A. Pumped drainage water shall be discharged downstream into the storm sewer system already laid, or

B. Discharge pumped drainage water into the storm sewer system or drainage ditch as approved by the Engineer.

3.04 REPAIR OF DAMAGE

A. Assume full responsibility for all loss and damage due to flood, rising water or seepage in any part of the work. Repair any damage to partially completed work from these or other causes, including the removal of slides, repair of foundation beds and performance of any other work

necessitated by failure or slippage of cofferdams or lack of adequate dewatering or drainage facilities.

END OF SECTION 00025

SECTION 01510 SEWER BYPASS PUMPING

PART 1 GENERAL

As required, the contractor may have to conduct bypassing of sanitary sewerage in order to accomplish the project. Any bypassing operations must first be approved by the Port of Brownsville before beginning such work.

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required to maintain continuous and reliable wastewater service in all wastewater lines during construction.

B. During various phases of the Work, it will be necessary to construct and maintain temporary bypass sewers to maintain continuous and reliable wastewater flow in all pipes, including individual service connections. Various phases of the Work that shall require the implementation of temporary bypass sewers include, but are not limited to, connections of new sewers to existing sewers, trenchless rehabilitation of existing sewers, and pipeline inspection.

C. Portions of the Work require that upstream pump stations be placed out of service for prolonged periods. In these instances, the Contractor shall construct a temporary bypass sewer that shall discharge into either the original piping DOWNSTREAM of the affected area, or into a neighboring gravity sewer identified that flows to an unaffected pump station.

D. Contractor shall construct and maintain all temporary bypass sewers and be responsible for all bypass pumping of sewage that may be required to prevent backing up of sewage and allow appropriate conditions for proper inspection, rehabilitation, testing or drainage during force main rehabilitation, replacement or reconnections to existing sewers. The Contractor shall immediately remove and dispose of all offensive matter spilled during the bypass pumping at his own expense. The Contractor shall also be responsible for paying any fines imposed as a result of spills or overflows that occur as a result of the bypass pumping operations.

E. Contractor shall provide a redundant bypass pump, intake and discharge conduit, and other equipment necessary to provide continuous wastewater flow and prevent the backing up of sewage in the case of emergencies at all times.

F. Where no alternate sanitary sewer route is available or when twenty-four hours of storage is not feasible, redundant bypass pumping shall be installed.

G. Primary bypass pumps shall be critically silenced when used in residential settings or areas where excessive noise levels would create a disturbance. Redundant bypass pumping does not have to be critically silenced.

1.02 SUBMITTALS

A. The Contractor shall submit to the Engineer a schedule to complete the Work. It will include the sequencing and coordination of connections to existing sewers, pipeline inspection, trenchless rehabilitation and testing of existing sewers, and the handling of wastewater flow during construction. The schedule of work shall also be reviewed and approved by the Port of Brownsville and Engineer.

B. The design, installation, and operation of the temporary pumping system shall be the Contractor's responsibility. The Contractor shall either demonstrate or employ the services of a subcontractor who can demonstrate, to the Owner and Engineer that he specializes in the design and operation of temporary bypass pumping systems.

C. The Contractor shall prepare a specific, detailed description of the proposed pumping system (Bypass Pumping Plan). The Bypass Pumping Plan shall be submitted and approved prior to the mobilization of any of the equipment included in the Bypass Pumping

Plan. The Bypass Pumping Plan shall outline all provisions and precautions to be taken by the Contractor regarding handling of existing wastewater flows. This Bypass Pumping Plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials, and all other incidental items necessary and/or required to ensure proper protection of the facilities, including protection of the access and bypass pumping locations for damage due to the discharge flows, and compliance with the requirements and permit conditions specified herein. No Construction shall begin until all provisions and requirements have been reviewed and accepted by the Port of Brownsville and the Engineer. The plan shall include but not limited to the following details:

1. Staging areas for pumps.
2. Sewer plugging method and types of plugs.
3. Size and location of manholes or access points for suction and discharge hose or piping.
4. Size of pipeline or conveyance system to be bypassed.
5. Number, size, material, location and method of installation of suction piping.
6. Number, size, material, location and method of installation of discharge piping.
7. Bypass pump sizes, capacities, and number of each size to be provided on-site including all primary, secondary, and spare pumping units.
8. Calculations of static lift, friction losses, and flow velocity (pump curves showing pump, operating range shall be submitted).
9. Downstream discharge plan.
10. Method of protecting discharge manholes or structures from erosion and damage.
11. Thrust and restraint block sizes and locations. Provide the details necessary to demonstrate the integrity of all suction and discharge piping including piping and fittings associated with all primary and secondary pumping units.
12. Sections showing suction and discharge pipe depth, embedment, select fill and special backfill.
13. Method of noise control for each pump and any additional equipment that is included in the Bypass Pumping Plan.
14. Any temporary pipe supports and anchoring requirements.
15. Access plans to all bypass pumping locations indicated on the drawings.
16. Calculations for selection of bypass pumping pipe size.
17. Schedule for installation of and maintenance of bypass pumping lines.
18. Plan indicating location of bypass pumping pipe locations.
19. Emergency plan for adverse weather and flooding for various phases of the Work.
20. Contractors plan for providing continuous monitoring of the bypass pumping operation as well as the monitoring persons' qualifications.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 BYPASS PUMPING OF FLOW IN EXISTING SEWERS

A. The Contractor shall supply pumps, conduits, power, and other equipment to divert the flow of sewage around the section in which Work is to be performed. The bypass system shall be of sufficient capacity to handle the wastewater flows in the table located at the end of this section. It is the intent of these Specifications to require the Contractor to establish adequate bypass pumping as required regardless of the flow condition.

B. All bypass pumping piping shall conform shall be HDPE and conform to the following requirements:
   1. All polyethylene (HDPE) pipes shall meet the requirement of ASTM F714. DR rating of the pipe shall be sufficient to withstand the pressure and leakage test outlined below.
   2. HDPE Pipe shall be furnished in standard laying lengths not exceeding 50 feet.

3. Joining system: The HDPE pipe shall be joined with butt, heat fusion joints. All joints shall be made in strict compliance with the manufacturer's recommendations and ASTM 2657. Where required, flange connections, mechanical joint connections and butt connections using bolted mechanical couplers shall be provided from a pipe stub with a polyethylene and steel stiffener. Flanged connections shall be provided from a pipe stub and a steel back-up flange. Back flanges shall be primed and painted in corrosion protected paint. Quick connect couplings will not be permitted on HDPE bypass piping.
4. HDPE fittings shall be fully pressure rated to match the pipe DR pressure rating. All fittings shall be molded or fabricated by the same manufacturer as the pipe. HDPE fittings shall be joined using butt, heat fusion and/or electrofusion. Adhesives and solvent cements shall not be permitted.

C. The Contractor shall perform leakage and pressure tests of the bypass pumping discharge piping using clean water prior to the actual operation. The pressure and leakage test shall be conducted at one-and-a-half times the maximum pressure the system will experience based on the approved Bypass Pumping Plan for a period of two hours. No leakage is permitted during this test. The Engineer will be given 24 hours' notice prior to testing. In addition, the Contractor shall demonstrate that the pumping system is in good working order and is sufficiently sized to successfully handle flows by performing a test run for a period of 24 hours prior to beginning the Work.
D. Each bypass pumping operation shall include the components and systems to accomplish the bypass in accordance with these Specifications and the Special Project Conditions.
E. The Contractor shall provide on-site manual oversight of all bypass pumping operations 24 hours per day, 7 days per week when the bypass pumping system is in operation.
F. Flows from private, commercial, and industrial users shall be handled by the Contractor during the Work without interruption.
G. The Contractor shall be required to repair, at his own expense, any damage to public or private property caused by his operations.
H. Should damage of any kind occur to the existing sewers, the Contractor shall, at his own expense make repairs to the satisfaction of the Port of Brownsville and the Engineer.
I. The Contractor shall immediately notify the Authority should a sanitary sewer overflow (SSO) occur and take the necessary action to clean up and disinfect the spillage to the satisfaction of the Authority and/or other governmental agency. If sewage is spilled onto public or private property, the Contractor shall wash down, clean up, and disinfect the spillage to the satisfaction of the property owner, Authority, and/or other governmental agency.
J. The Contractor shall not be permitted to overflow, bypass, pump or by any other means convey drainage to any land, street, storm drain or water course.
K. The Contractor shall cease bypass pumping operations and return flows to the new and/or existing sewer when directed by the Owner. During bypassing, no wastewater shall be leaked, dumped, or spilled in or onto any area outside the existing wastewater system. When bypass operations are complete, all bypass piping shall be flushed with fresh water and drained into the wastewater system prior to disassembly.
L. Contractor must take care to prevent damage to existing structures. Discharge piping to gravity sewer systems shall be designed in such a manner as to prevent discharge from contacting manhole walls or benching and full discharge shall go into downstream pipe with as minimal turbulence as possible. Contractor is responsible for any damage to manholes. It may be necessary to remove the manhole cone to provide sufficient space for the bypass piping. If this is required, the Contractor shall be responsible for any damage to existing manhole components.
M. The Contractor shall establish adequate bypass pumping adherent to the conditions above and anticipate severe weather conditions and increases in peak flows during rain events.

Available flow and capacity data for Contractor's use in sizing equipment is as follows:

Pipe Name (Pipe Size)	**Average Daily Flow (*mgd*)**	**Maximum Flow (*mgd*)**
Sample Outfall (24")	*2.00*	*4.78*

N. The 24-hour monitoring person shall be properly trained, experienced, and mechanically qualified such that they can quickly and effectively address any potential emergency and non-emergency situations associated with the pumps and bypass pumping system that must remain in operation for an extended period.

PART 4 MEASUREMENT AND BASIS OF PAYMENT

4.01 Bypass pumping shall not be paid directly but shall be subsidiary to the Project.

END OF SECTION 01510

SECTION 01565 STORM WATER MANAGEMENT AND CONTROLS

PART 1 - GENERAL

1.1. DEFINITIONS

1.1.1. BMP – Best Management Practice

1.1.2. CI – Construction Inspector

1.1.3. CSN – Construction Site Notice (Large CSN for sites 5 acres or larger; Small CSN for sites less than 5 acres)

1.1.4. EHS – Environmental Health and Safety department for the institute at which construction is occurring

1.1.5. EPA – United States Environmental Protection Agency

1.1.6. MS4 – Municipal Separate Storm Sewer System

1.1.7. NOI – Notice of Intent for TPDES permits

1.1.8. NOT – Notice of Termination for TPDES permits

1.1.9. OCP – The University of Texas System Office of Capital Projects

1.1.10. ODR – Owners Designated Representative

1.1.11. RCM – Resident Construction Manager

1.1.12. SWPPP – Storm Water Pollution Prevention Plan

1.1.13. TCEQ – Texas Commission on Environmental Quality

1.1.14. TPDES – Texas Pollutant Discharge Elimination System

1.1.15. TPDES General Permit – TCEQ TPDES General Permit No. TXR150000 effective March 5, 2018

1.1.16. Large Construction Activities – Construction activities including clearing, grading, and excavating that result in land disturbance equal to or larger than 5 acres of land

1.1.17. Small Construction Activities – Construction activities including clearing, grading, and excavating that result in land disturbance equal to or larger than 1 acre and smaller than 5 acres of land

1.2. RELATED DOCUMENTS AND APPLICABLE WORK

1.2.1. This specification requires compliance with all provisions of the TCEQ TPDES general permit and the project SWPPP. The TCEQ requirements currently pertain to large construction activities of 5 acres or more and small construction activities that disturb 1 acre to less than 5 acres.

1.2.2. Information to Respondents, Agreement, Uniform General and Supplementary General Conditions for the City of Mission and Special Conditions shall be read carefully for provisions pertaining to this work. In the event of conflict, the better quality or greater quantity shall prevail.

1.2.3. The work described in this section is applicable to any and all sections of the contract documents. Any and all work that would disturb the existing site conditions or present the potential for site runoff shall adhere fully to this specification section.

1.2.4. Unless specifically notified to the contrary and in writing by the Owner, all aspects of this specification shall apply to this project.

1.3. CONTRACTOR RESPONSIBILITIES

1.3.1. This project requires implementation of storm water BMPs for control devices and monitoring by the Contractor to comply with all provisions of the SWPPP developed for the project by the project civil engineer licensed that is in the State of Texas. The Contractor must fulfill all TPDES regulatory requirements, including the filing of the NOI and NOT or signing and posting of the CSN.

1.3.2. The Contractor shall provide signatures of a Corporate Officer, in accordance with 30 TAC 305.44, for the NOI, Large CSN, Small CSN, NOT, and any other forms or applications as required by the TPDES General Permit. The Contractor shall also provide delegated authorization to sign reports per 30 TAC 305.128. Individuals conducting site inspections shall be qualified to the satisfaction of the Owner.

1.3.3. When the Contractor receives the approved SWPPP from the Owner, the Contractor then files the NOI with the TCEQ and provides a copy of the receipt to the City of Mission along with the Large CSN. Or the Contractor signs the Small CSN (see sample forms in Part 4 - Supplemental Documents) and forwards it to the City of Mission and Engineer. The Contractor shall insert a copy of the signed NOI or Small CSN into the SWPPP book to be kept at the jobsite.

1.3.4. The SWPPP book kept at the jobsite shall also contain the following:

1.3.4.1. A letter delegating signature authority to the field personnel for both the Contractor and the Owner,

1.3.4.2. A copy of the TPDES Authorization when received,
1.3.4.3. A copy of the Large or Small CSN, and
1.3.4.4. A copy of the Shared SWPPP Acceptance Certification form.

1.3.5. The Contractor shall review the SWPPP and verify existing conditions at the site before determining scope of implementation of site controls. Site survey and site plan drawings shall be used for additional reference. The Contractor shall notify the Owner, in advance, of this site review to allow for Owner participation.

1.3.6. The Contractor shall construct a Project SWPPP sign and place it at the main entrance to the project site. This sign shall include the NOI and TPDES Authorization along with the TCEQ TPDES Large or Small CSN, depending on the size of the construction project. The sign shall be constructed as detailed in the sample SWPPP sign drawings included in Part 4 - Supplemental Documents.

1.3.7. The Contractor shall contact the City of Mission for review of initial site controls in place prior to commencing site-disturbing activities, to ensure that any unusual circumstances or unforeseen site conditions with regard to erosion and sedimentation have been addressed.

1.3.8. The Contractor shall complete the SWPPP Project Start-up form (see Sample in Part 4 - Supplemental Documents) and review it with the Owner before commencing soil disturbing activities. Both parties shall sign this form when the requirements listed in the SWPPP Project Start-up form have been met.

1.3.9. The Contractor shall provide all material, labor, equipment, and services required to implement, maintain, and monitor all erosion and sedimentation controls in compliance with the SWPPP. All controls implemented by the Contractor shall comply with the TPDES regulations as described in the current TCEQ TPDES General Permit listed in Article 1.1.14. These controls shall remain in operation until project completion and re-establishment of the site or longer as directed by the RCM. The work shall include, but not be limited to, the following:

1.3.9.1. All earthwork as required to implement swales, dikes, basins, and other excavations for temporary routing of utilities to protect against erosion or sediment-laden (polluted) storm water runoff.
1.3.9.2. All structural controls as shown or specified, including silt fences, sediment traps, stabilized construction entrances, subsurface drains, pipe slope drains, inlet protection, outlet protection, reinforced soil retention, gabions, rock berms, etc.
1.3.9.3. All non-structural controls as shown or specified, including temporary or permanent vegetation, mulching, geotextiles, sod stabilization, preservation of vegetative buffer strips, and preservation/protection of existing trees and other mature vegetation.
1.3.9.4. All modifications and revisions to SWPPP necessary to meet changing site

conditions and to address new sources of storm water discharges, as the work progresses.

1.3.9.5. All maintenance and repair of structural and non-structural controls in place shall continue until final stabilization is achieved or as directed by the City of Mission.

1.3.9.6. Weekly site inspections, as required by the SWPPP, of pollutant sources, including hazardous sources, structural and non-structural controls, and all monitoring of SWPPP revisions and maintenance of inspection records.

1.3.9.7. Removal of all structural and non-structural controls as necessary upon completion of the work after final stabilization is achieved.

1.3.9.8. Filing of NOT with the City of Mission within 30 days of final stabilization being achieved and being approved by the Owner or another Operator assuming control of the unstabilized portions of the site.

1.3.9.9. Refer to the SWPPP for additional requirements to ensure compliance with TPDES regulations.

1.4. QUALITY ASSURANCE

1.4.1. To minimize the discharge of pollutants to storm water, the Contractor shall implement all permanent and temporary site controls according to TPDES Guidelines as set forth by the TCEQ.

1.4.2. Implementation of site controls shall be performed by a qualified contractor experienced in the proper installation of such devices in accordance with manufacturers' specifications, in keeping with recognized BMPs, and in keeping with TPDES regulations. Qualification of installing Contractor shall be reviewed with the Owner prior to entering into a contract with them for services.

1.4.3. The Contractor shall inspect all BMPs weekly as specified in the SWPPP for this project. Use standard Owner Inspection forms (Part 4 - Supplemental Documents) for each inspection. Record all deficiencies of site controls and take immediate action to correct any deficiencies recorded. Keep records of inspections current and on file, available for review by EPA, TCEQ, MS4 Operator, or Owner.

1.5. SUBMITTALS

1.5.1. Submittals of products used in structural and non-structural controls shall be made through established procedures for review and approved by the Owner prior to installation on the site. The Contractor shall make available physical samples of and product literature for any material used in structural or non-structural controls during the course of the project prior to its implementation in the field.

PART 2 - PRODUCTS

2.1. MATERIALS

2.1.1. Specific site control devices are identified in the SWPPP. Where such devices are

indicated, their material composition shall comply with this section. Materials to be used in structural and non-structural site controls shall include, but not be limited to the following:

2.1.2. Area Inlets, Curb Inlets, and Silt Fences: implemented to filter and remove sediment from storm water. They shall be composed of the following materials:

2.1.2.1. Geotextile fabric – a non-woven, polypropylene, polyethylene, or polyamide fabric with non-raveling edges. It shall be non-biodegradable, inert to most soil chemicals, ultraviolet resistant, unaffected by moisture and other weather conditions, and permeable to water while retaining sediment. Fabric shall be 36 inches wide with a minimum weight of 4.5 oz./yd.

2.1.2.2. Wire Backing – a galvanized, 2-inch x 4 inch welded wire fencing, 12-gauge minimum. Width shall be sufficient to support geotextile fabric 18 inches above adjacent grades. Chain link fences located along the same lines as silt fences may be used to support geotextile fabric. In this circumstance, the geotextile fabric shall be firmly attached to the fence at regular intervals.

2.1.2.3. Posts for area inlets and silt fences – steel fence posts shall be made of hot rolled steel, galvanized or painted, with a Y-bar or TEE cross-section of sufficient strength and stiffness to withstand forces found on an active construction site.

2.1.3. Rock Berms: shall be composed of the following materials:

2.1.3.1. Rock – clean open graded rock with a maximum diameter of 3 inches.

2.1.3.2. Wire Mesh Support – a galvanized, woven wire sheathing having a maximum opening size of 1 inch, and a minimum wire diameter of 20 gauge.

2.1.3.3. Ties – metal hog rings or standard wire/cable ties.

2.1.4. Triangular filter dikes: for use on surfaces or in locations where standard silt fence cannot be implemented, shall be composed of the following:

2.1.4.1. Geotextile fabric – a non-woven, polypropylene, polyethylene, or polyamide fabric with non-raveling edges, with a minimum width of 60 inches.

2.1.4.2. Dike Structure – 6-gauge, 6 inch x 6 inch welded wire mesh, 60 inches wide, folded into a triangular form. Each side shall be 18 inches with an overlap of 6 inches.

2.1.4.3. Ties – metal hog rings or standard wire/cable ties for attachment of wire mesh to itself and for attachment of geotextile fabric to wire mesh.

2.1.5. Stabilized construction exit: a steel grid that allows the safe passage of vehicles while agitating the tires to loosen and remove the soil buildup. The grid or structures shall conform to the following:

2.1.5.1. Steel grid:

2.1.5.1.1. Shall consist of pipes or tubes spaced such that there is a minimum clear distance between the pipes or tubes of 4.5 inches. It shall be

elevated above the ground surface a minimum of 8 inches to allow water, debris, and soil to drain. Minimum diameter of pipe or tube shall be 3 inches.

2.1.5.1.2. Shall be designed to support any and all vehicles entering and leaving the construction site.

2.1.5.1.3. Shall be firmly placed in the ground at the exit.

2.1.5.1.4. Shall be of sufficient length so that the agitation will remove the soil from the tires, or a minimum of 12 feet.

2.1.5.1.5. Shall be used as the tire wash area. When tire wash is in use (rainy or muddy days), the area shall be staffed and the tires shall be washed using a high-pressure hose/nozzle.

2.1.5.1.6. Shall have an area beneath the grid that is sloped such that debris, soil, and water shall be diverted back onto the construction site or to a sediment basin. No water, soil, or debris shall leave the construction site. The resulting discharge shall be disposed of properly.

2.1.5.2. Approaches to Steel Grid:

2.1.5.2.1. The steel grid will be between the street side approach and the job site crushed stone/rock.

2.1.5.2.2. At the street side approach there shall be an impervious surface or it shall consist of 3 inch to 5 inch diameter <u>angular</u> crushed stone/rock minimum of 5 feet in length and minimum of 8 inches deep.

2.1.5.2.3. At the job site side of the grid, there shall be 3 inch to 5 inch diameter angular crushed stone/rock 15 feet in length, a minimum of 8 inches deep.

2.1.5.2.4. All crushed stone/rock shall have filter fabric beneath the stone/rock.

2.1.6. <u>Concrete/Paint/Stucco/Equipment Washout</u>: shall be used for containment of fluids from various washout wastes and shall be constructed of:

2.1.6.1. Gravel bags, concrete blocks, or open graded rock.

2.1.6.2. 10 mil plastic sheeting.

2.1.7. <u>Temporary Storage Tanks</u>: shall be used for temporary storage of fuels on the construction project site and shall be constructed of:

2.1.7.1. 2 inches of sand on the bottom of the containment area.

2.1.7.2. 6 mil plastic sheeting.

2.1.7.3. 2 inches of sand on top of the plastic sheeting.

2.1.8. <u>Erosion Control Matting</u>: shall be used on steep slopes, in drainage swales, and in high traffic pedestrian areas of barren soil. It shall consist of one or more of the following:

2.1.8.1. Jute Mat – a plain fabric made of jute yarn woven in a loose and simple manner with a minimum unit weight of 2.7 pounds per square yard. Width shall be as required for the dimensions of the area to be covered.

2.1.8.2. Wood Fiber Mat – a mat composed of wood fibers, which are encased in nylon, cotton, or other type of netting

2.1.8.3. Synthetic Webbing Mat – a mat manufactured from polyvinyl chloride or polypropylene monofilaments that are bonded together into a three-dimensional web to facilitate erosion control, re-vegetation, or both.

2.1.9. Organic mulches: shall be used for covering bare soil, retaining moisture under existing vegetation being preserved, and for absorbing the energy of compaction caused by foot or vehicular traffic. Mulch shall be one or more of the following:

2.1.9.1. Straw – from broken straw bales that are free of weed and grass seed where the grass from the seed is not desired vegetation for the area to be protected.

2.1.9.2. Wood Chips – from chipped limbs of cleared trees on site, or delivered in chipped form, in bulk quantities of pine, cedar, or cypress. Wood chips of all species shall be partially decomposed to alleviate nitrogen depletion of the soil in areas where existing vegetation is to be preserved and protected.

2.1.9.3. Shredded Mulches – from pine, cypress, or cedar, mechanically shredded, and capable of forming an interlocking mat following placement, and after sufficient wetting and drying has taken place naturally.

2.1.10. Any other materials indicated in the SWPPP or Site Erosion and Sedimentation Control Drawings and Details.

2.2. ALTERNATIVE MATERIALS

2.2.1. Alternative materials proposed for use by the Contractor shall be reviewed and approved by the Engineer and City of Mission prior to installation on the Site.

PART 3 - EXECUTION

3.1. GENERAL

3.1.1. The Contractor shall provide a complete installation of all site control devices and measures indicated in the SWPPP, the Site Erosion and Sedimentation Control Drawing, and as specified herein. Installed BMPs must be confirmed as fully operational by the Owner before any work that disturbs the site can begin.

3.1.2. As an alternative to the BMPs indicated in the SWPPP, the Site Erosion and Sediment Control Drawing, and as specified herein, the Contractor may propose alternate BMPs that perform the same function as the indicated BMPs but may be of a different configuration, material, or type for review and approval by City of Mission. Installation of alternate BMPs shall not proceed until approved by City of Mission.

3.1.3. The Contractor shall provide inspection and monitoring of in-place controls and shall perform all revisions and updating of SWPPP. An accurate, chronological record of all Contractor inspections, revisions, and additional controls shall be available for review and on file at the project site with a copy of the SWPPP book.

3.1.4. The Contractor shall submit their NOT, with the approval of the City of Mission and Engineer, after all disturbed areas are re-established (stabilized) with vegetative cover following completion of construction. Following acceptance of stabilized areas, all site controls that are no longer necessary shall be removed.

3.2. CONTROL DEVICES

3.2.1. Execution of specific site control devices is described in the following paragraphs. Refer to the SWPPP for applicable devices, extent, and location.

3.2.2. Area Inlet Detail

3.2.2.1. Area inlet fences shall be constructed of materials described in Article 2.1.2 and as shown in Exhibit A.

3.2.2.2. Maintain silt fence daily as necessary to repair breaches in geotextile fabric. Maintain steel posts in the as-specified in tilted condition. When siltation has occurred, it shall be removed when it has reached a depth of 6 inches. Silt that has been removed shall be disposed of offsite.

3.2.2.3. Remove area inlet when the disturbed areas have been completely stabilized as specified. Minimize site disturbance while removing area inlet protection and posts.

3.2.3. Curb Inlet Protection

3.2.3.1. Curb inlet protection shall be constructed of materials described in Article 2.1.2 and as shown in Exhibit B.

3.2.3.2. Maintain inlet protection daily as necessary to repair breaches in geotextile fabric. When siltation has occurred, it shall be removed when it has reached a depth of 2 inches. Silt that has been removed shall be disposed of offsite.

3.2.3.3. Remove curb inlet protection when the disturbed areas have been completely stabilized as specified. Minimize site disturbance while removing curb inlet protection and posts

3.2.4. Rock Berm

3.2.4.1. Rock berm shall be constructed of materials described in Article 2.1.3 and as shown in Exhibit C. Rock berm shall have a minimum flow-through rate of 60 gallons per minute per square foot of berm face.

3.2.4.2. Maintain rock berm in a condition that allows the sediment to be removed, when the depth of sediment has reached one-third of the height of the berm. Berm shall be reshaped as needed and silt buildup removed to maintain specified flow through berm.

3.2.4.3. Rock berm shall be removed when the disturbed areas served have been stabilized as specified.

3.2.5. Silt Fence

3.2.5.1. Silt fences shall be constructed of materials described in Article 2.1.2 and as shown in Exhibit D.

3.2.5.2. Maintain silt fence daily as necessary to repair breaches in geotextile fabric. Maintain steel posts as specified in tilted condition. When siltation has occurred, it shall be removed when it has reached a depth of 6 inches. Silt that has been removed shall be disposed of offsite.

3.2.5.3. Remove silt fence when the disturbed areas protected by silt fence have been completely stabilized as specified. Minimize site disturbance while removing silt fence and posts.

3.2.6. Triangular Dike

3.2.6.1. Triangular dikes shall be constructed of materials described in Article 2.1.4 and as shown in Exhibit E.

3.2.6.2. Maintain triangular dikes daily as necessary to repair breaches in geotextile fabric. Maintain wire mesh to retain intended shape of triangular dikes. When siltation has occurred, it shall be removed when it has reached a depth of 6 inches. Silt that has been removed shall be disposed of offsite.

3.2.6.3. Remove triangular dikes when the disturbed areas protected by them have been completely stabilized as specified. Minimize site disturbance while removing triangular dikes.

3.2.7. Stabilized Construction Exit

3.2.7.1. Stabilized construction exits shall be constructed of materials described in Article 2.1.5 and as shown in Exhibit F.

3.2.7.2. The stabilized construction exit shall be properly maintained throughout the entire construction process until removal is approved by the City of Mission.

3.2.7.3. Remove stabilized construction exit traffic when into and out of the site has finished. Minimize site disturbance while removing stabilized construction exits.

3.2.8. Concrete/Paint/Stucco/Equipment Washout (Self-Installed)

3.2.8.1. Concrete/Paint/Stucco/Equipment Washout shall be constructed of materials described in Article 2.1.6 and as shown in Exhibit G.

3.2.8.2. The washout containment area shall be maintained in a condition that will not allow concrete buildup within the containment area to exceed 50 percent of the storage capacity.

3.2.8.3. The washout area will be removed when it is no longer necessary to wash out concrete trucks, paint, stucco, or other potentially hazardous materials on the site.

3.2.8.4. Clean equipment in a manner that does not create any discharge of cleaning agents, paints, oil or solvents to a storm sewer, waterway, or onto the ground. Soaps and detergents must never be discharged to the ground. Cement handling

equipment must be rinsed in a contained area and there must be no drainage off- site or onto to ground.

3.2.8.5. When rinsing painting equipment or tools outside, rinse water must be contained in a bucket or other container for appropriate disposal. Water-based or latex paint rinse water may be discharged to the sanitary sewer only with permission and approval from the City of Mission.

3.2.8.6. Oil based paint wastes, including solvents and thinners, must not be disposed of in the sanitary sewer; they must be collected and disposed of through the contractor's disposal company in accordance with applicable laws and regulations.

3.2.8.7. Discharges from pressure washing using soaps or chemicals must not be allowed to enter a storm sewer. The wastewater will need to be collected and transported to the appropriate disposal site. If the rinse only contains water and soil or sediment, it may be spread on a grass area or contained and filtered with clean water allowed to enter storm sewer. In some cases, it may also be possible to discharge to a sanitary sewer with permission from the City of Mission.

3.2.9. Temporary Storage Tanks

3.2.9.1. Must be located in a bermed containment area. The volume contained within the berm must be adequate to contain the maximum contents of the largest tank plus 8 inches of fluid depth (approximately 110 percent of the tank capacity). The containment area is constructed by beginning with a 2-inch sand pad, and then covered with 6-mil plastic or rubber sheeting. The sheeting is then covered with another 2-inch layer of sand. The plastic sheeting is secured to the outer berm.

3.2.9.2. Storage tanks are to be placed no closer than 50 feet from a building or property line.

3.2.9.3. If using tanks with a gravity feed setup, the containment must be of sufficient size to contain the tank if it should fall over.

3.2.9.4. There must be a fusible link at the valve that will shut off the flow to the hose in the event of a fire.

3.2.9.5. There must be sufficient cover for the tank and the containment area to prevent potential storm water runoff.

3.2.9.6. The area within the containment area is to be kept free and clear of spills. If a spill occurs, the sand is to be removed and replaced with a fresh layer of sand.

3.2.9.7. The storage tank containment area is to be removed from the site once it has been determined that it will no longer be used.

3.2.10. Diversion Dike

3.2.10.1. Diversion dikes shall be formed and shaped using compacted fill and shall not intercept runoff from more than 10 acres. The dike shall have a minimum top width of 24 inches and a minimum height of 18 inches. Soil shall have side slopes of 3H:1V or flatter and shall be placed in 8-inch lifts. Compact soil to 95 percent standard proctor density. Where protected slopes exceed 2 percent, the uphill side of diversion dike shall be stabilized with crushed stone or erosion

control matting to a distance of not less than 7 feet from toe of dike. The channel that is formed by the diversion dike must have positive drainage for its entire length to a stabilized outlet, such as a rock berm, sandbag berm, or stone outlet structure. Storm water shall not be allowed to overflow the top of diversion dike at any point other than the stabilized outlet.

3.2.10.2. Maintain the diversion dike in a condition that allows the storm water runoff to be diverted away from exposed slopes. Repair any failures at top of dike and remove sediment as necessary behind the dike to allow positive drainage to a stabilized outlet.

3.2.10.3. Remove diversion dike when the exposed slopes being protected are stabilized with vegetation or other permanent cover.

3.2.11. Interceptor Swale

3.2.11.1. An interceptor swale shall be implemented to prevent storm water from entering a disturbed area or prevent sediment-laden runoff from leaving the site or disturbed area. The interceptor swale shall be excavated as required by the SWPPP drawings with side slopes of 3H:1V or flatter. The Contractor shall include all labor and equipment associated with the installation and maintenance of the swale as shown on the construction documents. Constructed swale may be v-shaped or trapezoidal with a flat bottom, depending on the volume of water being channeled. Sediment laden runoff from swale shall be directed to a stabilized outlet or sediment-trapping device. Flow line of swale shall have a continuous fall for its entire length and shall not be allowed to overflow at any other points along its length.

3.2.11.2. Maintain interceptor swale in a condition that allows the storm water runoff to be channeled away from disturbed areas. Remove sediment in swale as necessary to maintain positive drainage to a stabilized outlet.

3.2.11.3. Fill in or remove swale after the disturbed area or areas being protected are completely stabilized as specified.

3.2.12. Erosion Control Matting

3.2.12.1. Remove all rocks, debris, dirt clods, roots, and any other obstructions which would prevent the matting from lying in direct contact with the soil. 6 inch by 6 inch anchor trenches shall be dug along the entire perimeter of the installation. Bury matting in trenches by backfilling and compacting soil. Fasten matting to the soil using 10-gauge wire staples, 6 inches in length and 1 inch wide. Use a minimum of 1 staple per 4 square feet of matting, and at 12 inches on center along all edges. Install parallel to flow of water and overlap joining strips a minimum of 12 inches.

3.2.12.2. Maintain erosion control matting by repairing any bare spots. Missing or loose matting shall be promptly replaced or re-anchored.

3.2.12.3. Remove matting where protection is no longer required. In areas where permanent vegetation is established along with matting, matting can be left in place permanently.

3.2.13. Mulches

3.2.13.1. Apply specified mulches in areas identified on the SWPPP to a depth of 3 inches or as otherwise specified on the SWPPP drawings.

3.2.14. Alternative BMPs

3.2.14.1. Alternative BMPs proposed for use by the Contractor shall be reviewed and approved by the City of Mission and Engineer prior to installation on the Site.

3.3. INSPECTIONS AND RECORD KEEPING

3.3.1. Contractor shall inspect all BMPs on 7-day intervals. Coordinate inspections with the City of Mission, who is also required by TPDES to regularly inspect the site. Use standard Owner Inspection forms (see form in Part 4 - Supplemental Documents) for each inspection. Record all deficiencies of site controls and take appropriate action to correct any deficiencies recorded. Exception is rock berms located in a streambed. Any rock berm located in a streambed shall be inspected on a daily basis. Keep records of inspections current and on file, available for review by EPA, TCEQ, MS4 Operator Representative, City of Mission, or a combination thereof.

3.3.2. Contractor shall keep records of all Contractor inspections on file with SWPPP book at project site and make available for review by Owner's Representative or EPA, TCEQ, or MS4 Operator officials requesting review of SWPPP inspection records. One copy of each inspection report shall be delivered to the City of Mission and the Engineer.

3.3.3. Contractor shall keep records of all major grading and stabilization activities on file with the SWPPP book at the project site and make available for review by Owner's representative, EPA, TCEQ, or MS4 Operator officials requesting review of the SWPPP.

3.3.4. Contractor shall retain their copy of the SWPPP and copies of all inspection records and the Major Grading and Stabilization Log (Part 4 - Supplemental Documents) along with SWPPP book for 3 years from NOT date per TCEQ regulations.

3.4. MAINTENANCE

3.4.1. All erosion and sediment control measures and other protective measures identified in the SWPPP must be maintained in effective operating condition for the duration of the Work. If through inspections the it is determined that BMPs are not operating effectively, maintenance must be performed before the next anticipated storm event or as necessary to maintain the continued effectiveness of storm water controls. If maintenance prior to the next anticipated storm event is impracticable, maintenance

must be scheduled and accomplished as soon as practicable. Erosion and sediment controls that have been disabled (intentionally or unintentionally), run over, removed, or otherwise rendered ineffective must be replaced or corrected immediately upon discovery.

3.5. WASTE DISPOSAL

3.5.1. Contractor is responsible for proper disposal of hazardous materials. Hazardous wastes (such as flammable petroleum products, solvents, and thinners) and materials contaminated with hazardous wastes are considered regulated wastes and should be containerized for transport and disposal by a permitted company in accordance with applicable laws and regulations.

3.5.2. Any trash or debris must be contained on site and disposed of in a recycling bin or waste receptacle in accordance with applicable laws and regulations to prevent wind or rain from carrying it off-site. Non-hazardous solid wastes such as general construction debris may be recycled or disposed of in the trash container. Never dispose of liquid wastes of any kind in dumpsters.

PART 4 - SUPPLEMENTAL DOCUMENTS

4.1. SAMPLE FORMS

4.1.1. The following forms are to be used by the Contractor in the execution of the work in this Section in compliance with TPDES requirements and the SWPPP.

4.1.1.1. UT System City of Mission SWPPP Project Start-up Form,
4.1.1.2. Major Grading and Stabilization Log,
4.1.1.3. SWPPP Posting Sign for Main Construction Entrance for large construction site (5 acres or larger),
4.1.1.4. SWPPP Posting Sign for Main Construction Entrance for small construction sites (larger than 1 acre and less than 5 acres), and
4.1.1.5. Form for reporting Weekly SWPPP Inspections.

4.2. EXHIBITS

4.2.1. Sketches/additional details of BMPs described in Articles 3.2.2 through 3.2.8 are provided as exhibits to this specification section:

4.2.1.1. Exhibit A – Area Inlet Detail,
4.2.1.2. Exhibit B – Curb Inlet Detail,
4.2.1.3. Exhibit C – Rock Berm Detail,
4.2.1.4. Exhibit D – Silt Fence Detail,
4.2.1.5. Exhibit E – Triangular Dike Detail,
4.2.1.6. Exhibit F – Stabilized Construction Exit, and
4.2.1.7. Exhibit G – Concrete/Paint/Stucco/Equipment Washout.

4.3. DOCUMENTS IN ELECTRONIC FORMAT

4.3.1. Contact the Owner's representative for electronic copies of the forms to be used in the execution of work in this section:

4.3.1.1. TCEQ TPDES Notice of Intent (NOI),
4.3.1.2. TCEQ TPDES CSN (Large CSN or Small CSN),
4.3.1.3. TCEQ TPDES Notice of Termination (NOT),
4.3.1.4. UT System City of Mission Notice of Termination (City of Mission NOT),
4.3.1.5. Shared SWPPP Acceptance Certification form and
4.3.1.6. UT System City of Mission SWPPP Inspection form, and
4.3.1.7. Exhibits A through G.

ATTACHMENT 1 – START-UP FORM

Port of Brownsville

1000 Capt. Donald L. Faust Rd.
Brownsville, Texas 78526
956.831.4592

Storm Water Pollution Prevention Plan Project Start-up

Contractors must meet four TPDES requirements before soil-disturbing activities can commence on City of Mission construction projects. This form provides the Contractor and Owner an acceptance of compliance with initial BMPs and required paperwork for commencement of work on the project site.

The Contractor is to initial items that are certified as complete and then review for concurrence with the Owner's Designated Representative.

1. **BMPs applicable to this project has been inspected to ensure correct placement in accordance with the SWPPP for proper installation according to specifications**.

   _____
   Initial by Contractor

2. **The SWPPP is approved on site.**

   _____
   Initial by Contractor

3. **The TCEQ NOI Posting Notice forms (and permits if received) or the TCEQ CSNs are complete and posted for all permittees at the main entrance of the project site.**

   _____
   Initial by Contractor

4. **Inspector qualifications and letter of delegation of authority are inserted in the SWPPP.**

   _____
   Initial by Contractor

Having met the above requirements and in recognition of prior receipt of Notice to Proceed, the Contractor is authorized to commence work on site.

_____
Contractor

_____ Date: _____
Owner's Designated Representative

ATTACHMENT 2 – SWPPP INSPECTION REPORT

Port of Brownsville

1000 Capt. Donald L. Foust Rd.
Brownsville, Texas 78526
956.831.4592

Project Name: _____

Contractor: _____ **Date of Inspection:** _____

Inspection Conducted by: _____ _____
Printed Name ***Signature***

Qualifications of the Inspector: _____

_____

Report prepared by: (Circle One) **Contractor / Owner**

Inspection Issue	Y	N	N/A	Comments
Are TPDES NOIs permits, or CSNs for all permittees posted at the construction entrance?				
Is contact information for all permittees posted at the construction entrance?				
Are copies of inspection reports included with the SWPPP?				
Is a copy of the NOI, TPDES Permit and Posting Notice or CSN for all permittees included with SWPPP?				
If the BMPs have been modified, has the SWPPP been modified?				
Are there any signs of discharge leaving the site?				
Are all BMPs functioning as intended?				
Any additional BMPs required?				
Are stabilized entrances/exits preventing street contamination?				
Are any BMPs in need of repair and/or maintenance?				

Are any hazardous materials being exposed to storm water runoff?				
Have there been any reportable spills of hazardous materials?				
Are all soil-disturbing activities complete?				
Has a Notice of Termination (NOT) been filed?				

NOTE: All items of non-compliance shall be repaired/installed within seven (7) calendar days of inspection. Repairs/installation shall be completed immediately if storm conditions are imminent.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of a fine and imprisonment for knowing violations.

Signature: _____ **Date:** _____

Printed Name: _____

Title: _____

ATTACHMENT 3 – SWPPP MAJOR GRADING AND STABILIZATION LOG

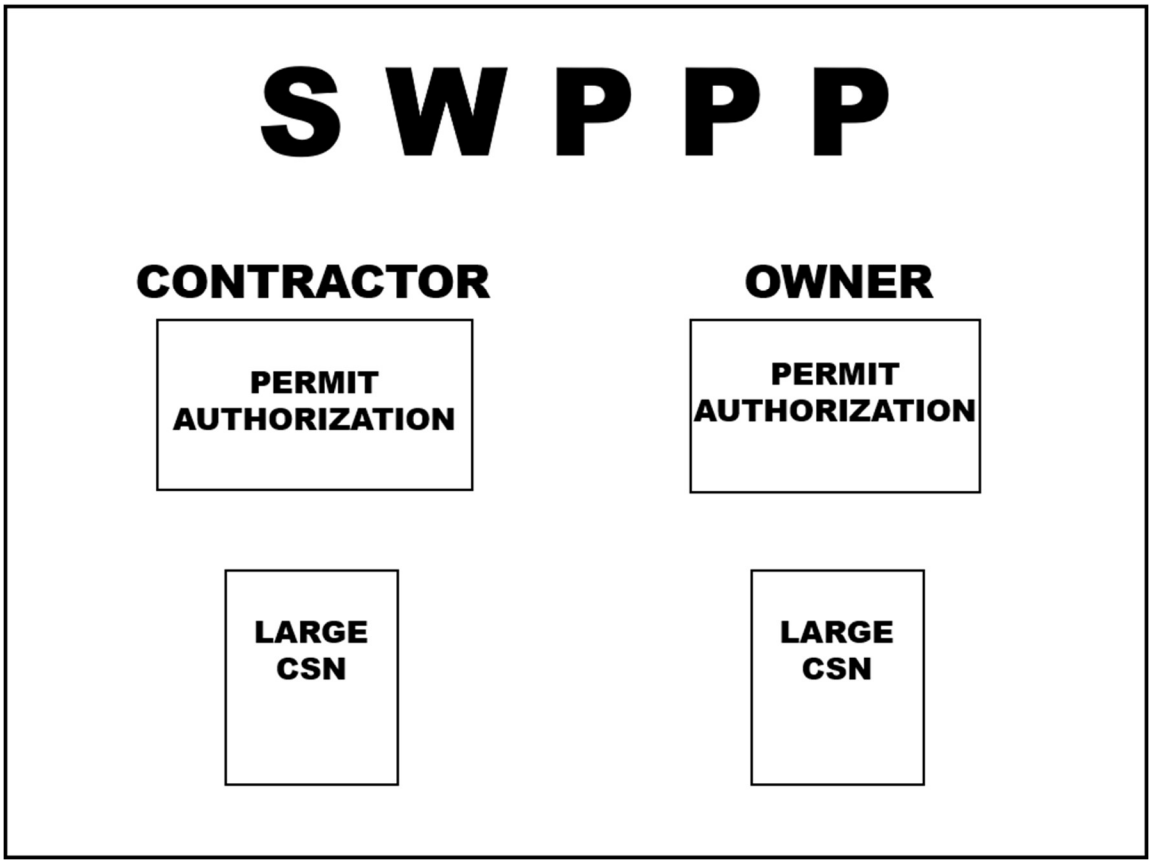
Port of Brownsville

1000 Capt. Donald L. Foust Rd.
Brownsville, Texas 78526
956.831.4592

Start Date	End Date*	Type and Location of Activity

- End date does not pertain to stabilization activities.

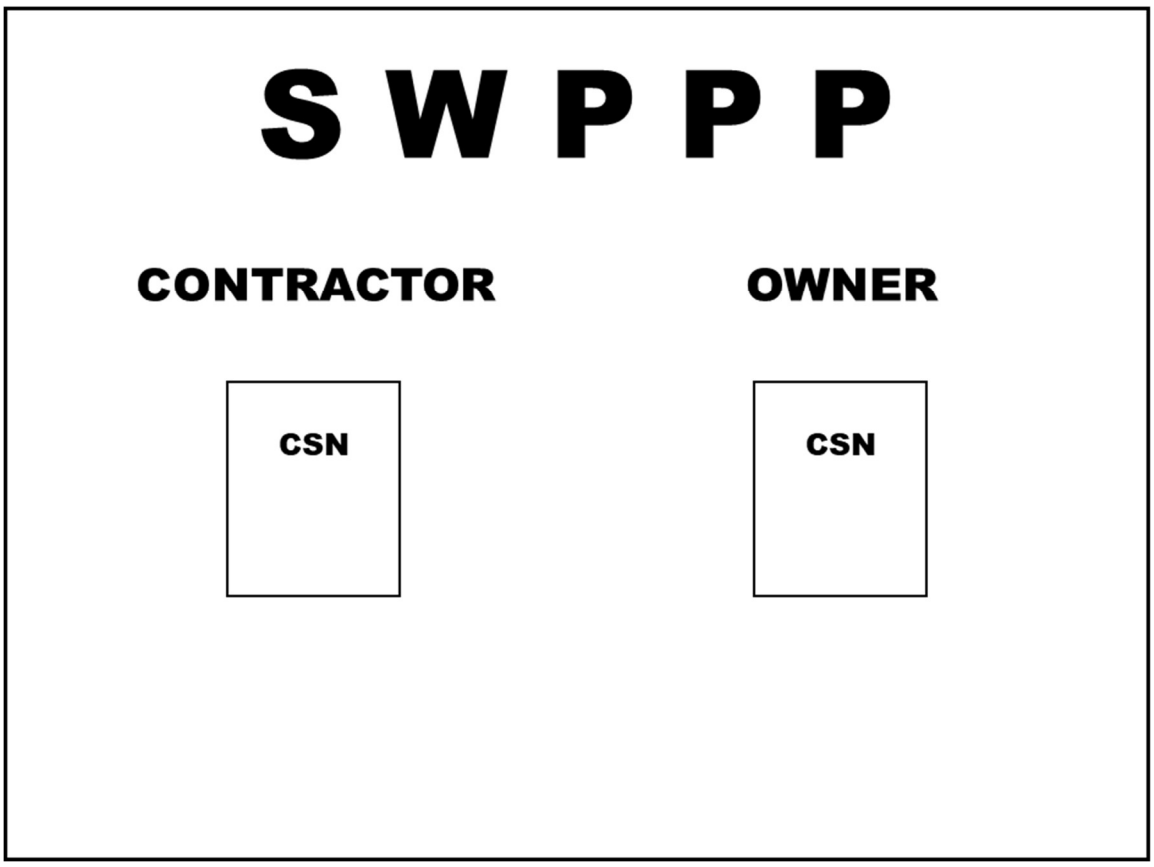
ATTACHMENT 4 – SIGN FOR LARGE CONSTRUCTION SITE



MINIMUM SIGN SPECIFICATIONS: Sites 5 acres or larger

SIGN:	Exterior grade 3/4 in. plywood cut 4 ft x 4 ft, with red painted letters, background painted white – DISPLAY ON CONSTRUCTION FENCE AT MAIN ENTRANCE TO PROJECT SITE
S W P P P:	10-inch painted letters, 3 inches from top of sign, centered
CONTRACTOR; OWNER:	3-inch painted letters, 4 inches below SWPPP letters, centered on each half of sign
PERMIT; CSN:	8-1/2 in. X 11 in. TCEQ forms, laminated beyond edges of documents, stapled to plywood.

ATTACHMENT 5 – SIGN FOR SMALL CONSTRUCTION SITE



MINIMUM SIGN SPECIFICATIONS: Sites larger than 1 acre and less than 5 acres

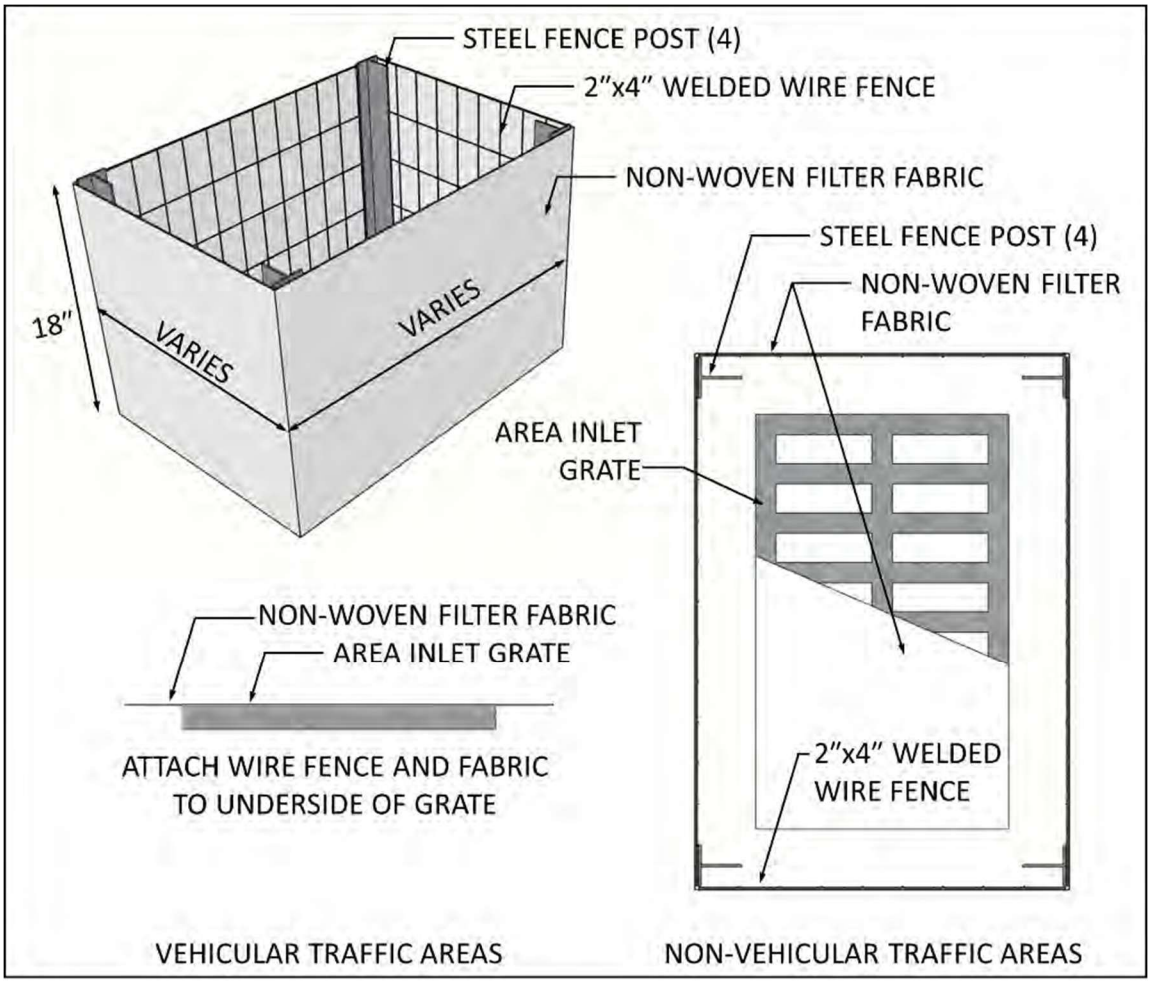
SIGN: Exterior grade 3/4 in. plywood cut 4 ft x 4 ft, with red painted letters, background painted white – DISPLAY ON CONSTRUCTION FENCE AT MAIN ENTRANCE TO PROJECT SITE

S W P P P: 10-inch painted letters, 3 inches from top of sign, centered

CONTRACTOR; OWNER: 3-inch painted letters, 4 inches below SWPPP letters, centered on each half of sign

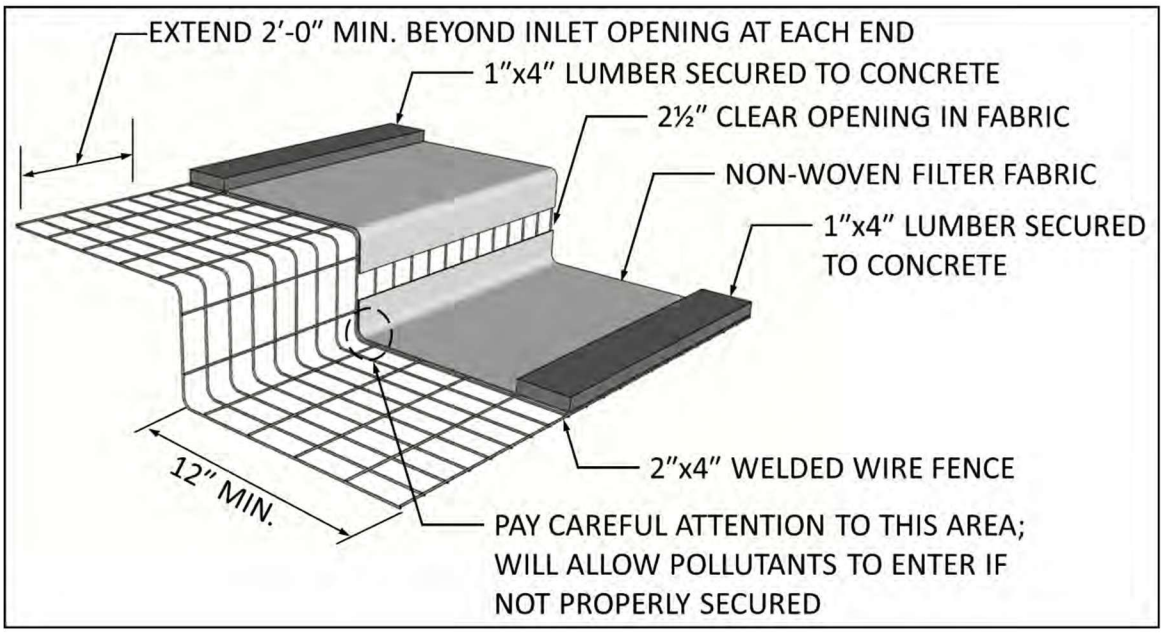
CONSTRUCTION SITE NOTICE: 8-1/2 in. X 11 in. TCEQ forms, laminated beyond edges of documents, stapled to plywood.

EXHIBIT A – AREA INLET DETAIL



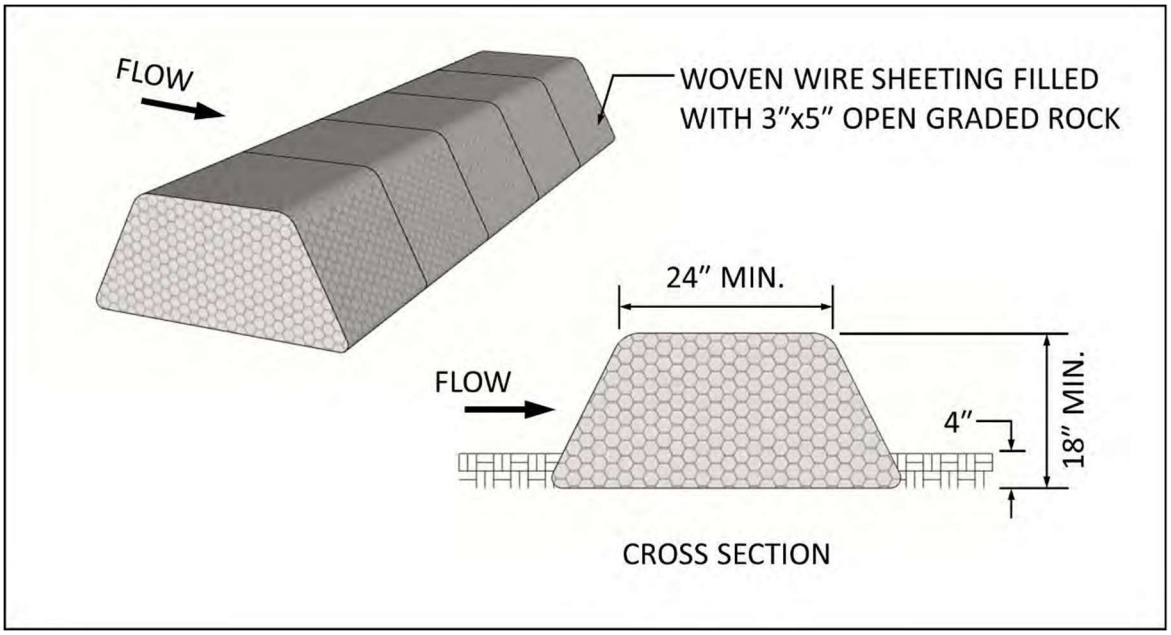
1. INSTALL STEEL POSTS THAT SUPPORT THE SILT FENCE AT EACH CORNER, AND ALSO BETWEEN CORNERS IF THE DISTANCE IS GREATER THAN 6 FEET BETWEEN CORNER POSTS.
2. USE SILT FENCE DETAIL FOR INSTALLATION OF THE SILT FENCE AROUND THE AREA INLET.
3. LIFT THE METAL AREA INLET GRATE, WRAP THE FILTER FABRIC AROUND IT, AND THEN REPLACE THE GRATE.
4. IN VEHICULAR TRAFFIC AREAS, LIFT THE METAL GRATE AND PLACE WIRE FENCE MATERIAL UNDER IT WITH FILTER FABRIC PLACED BETWEEN THE GRATE AND THE WIRE FENCE. THEN ATTACH THE WIRE FENCE TO THE GRATE.
5. REMOVE ACCUMULATED SILT WHEN THE FILTER FABRIC OVER THE GRATE COMPLETELY COVERS THE GRATE AREA OR THE SILT AROUND THE SILT FENCE REACHES A HEIGHT OF 6 INCHES.
6. REMOVE AREA INLET PROTECTION WHEN THE SITE IS COMPLETELY STABILIZED.

EXHIBIT B – CURB INLET DETAIL



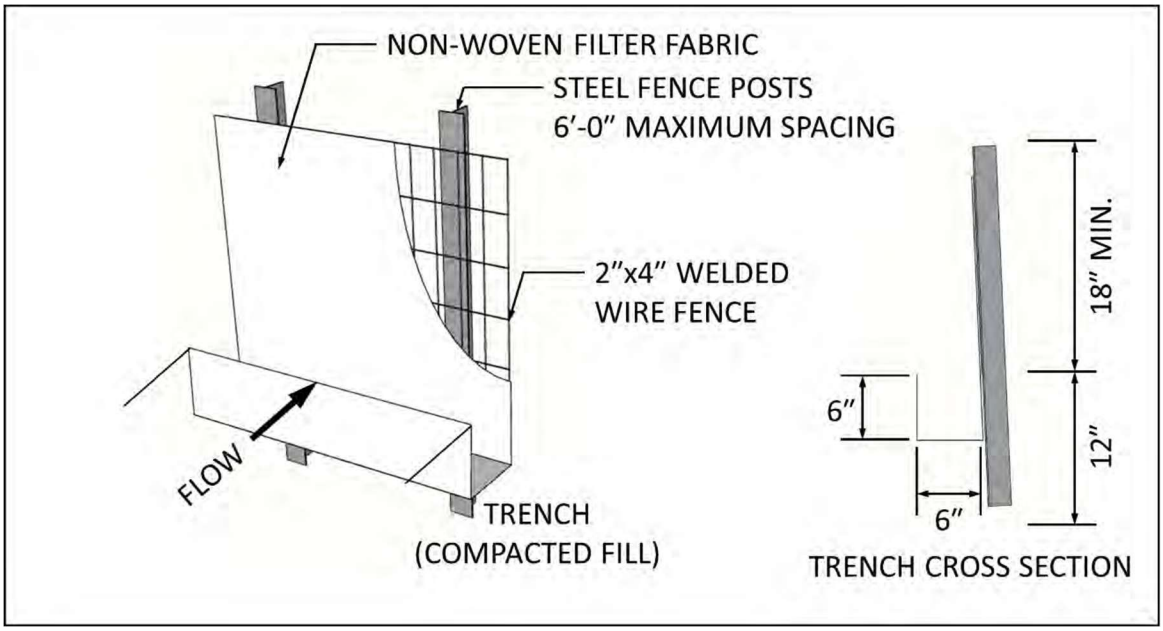
1. WHERE MINIMUM CLEARANCES CAUSE TRAFFIC TO DRIVE IN THE GUTTER, USE 1 INCH BY 4 INCH LUMBER SECURED WITH CONCRETE NAILS 3 FEET ON CENTER NAILED INTO THE CONCRETE. IF THERE IS PEDESTRIAN TRAFFIC ONLY, THE USE OF 20-POUND GRAVEL BAGS TO SECURE MATERIAL IS PERMITTED.
2. REMOVE SECTION OF FILTER FABRIC AS SHOWN IN THIS DETAIL.
3. SECURE FABRIC TO WIRE BACKING WITH CLIPS OR HOG RINGS.
4. INSPECT DAILY AND REMOVE SILT ACCUMULATION WHEN THE DEPTH REACHES 2 INCHES.
5. MONITOR THE PERFORMANCE OF THE INLET PROTECTION DURING EACH RAINFALL EVENT AND REMOVE PROTECTION IMMEDIATELY IF THE STORM WATER BEGINS TO OVERTOP THE CURB.
6. REMOVE INLET PROTECTION AS SOON AS THE SOURCE OF SEDIMENT IS STABILIZED.
7. OVERLAP FABRIC BY 3 INCHES MINIMUM AT EDGES OF FILTER FABRIC.

EXHIBIT C – ROCK BERM DETAIL



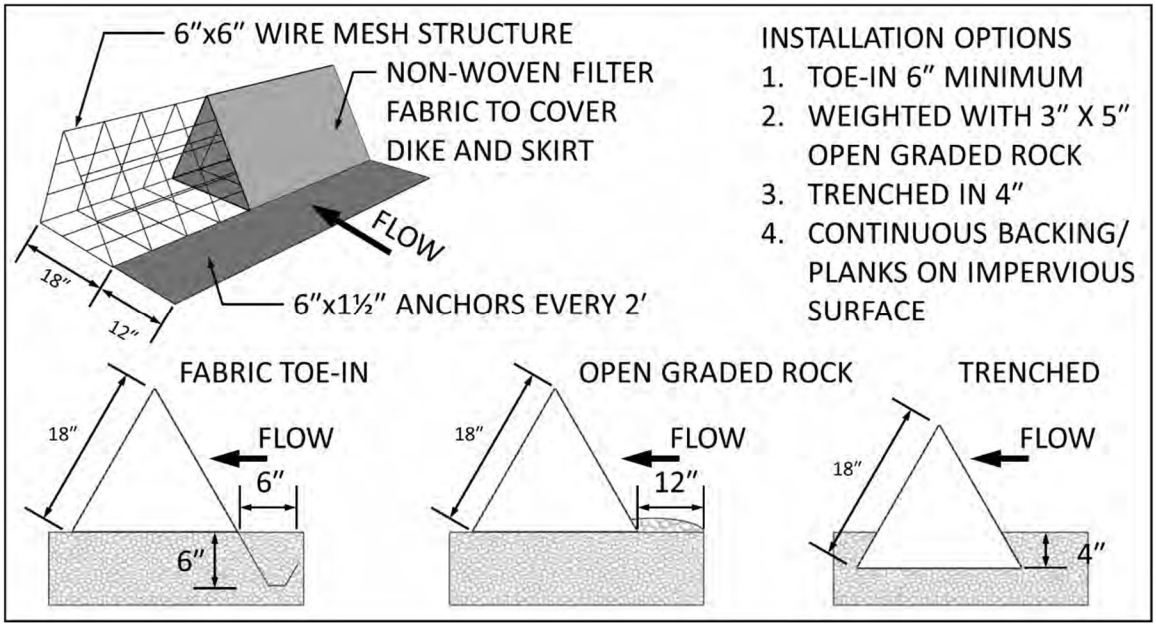
1. USE ONLY OPEN GRADED 3 INCH X 5 INCH ROCK FOR STREAM FLOW CONDITIONS. USE 3 INCH X 5 INCH OPEN GRADED ROCK FOR OTHER CONDITIONS.
2. SECURE THE ROCK BERM WITH A WOVEN WIRE SHEATHING HAVING A MAXIMUM 1 INCH OPENING AND A MINIMUM 20-GAUGE WIRE DIAMETER. ANCHOR ROCK BERMS IN CHANNEL APPLICATIONS FIRMLY INTO THE SUBSTRATE A MINIMUM OF 6 INCHES WITH TEE POSTS OR WITH #5 OR #6 REBAR WITH A MAXIMUM SPACING OF 48 INCHES ON CENTER.
3. INSPECT THE ROCK BERM WEEKLY. REPLACE THE STONE, FABRIC CORE-WOVEN SHEATHING, OR BOTH WHEN THE STRUCTURE CEASES TO FUNCTION AS INTENDED DUE TO SILT ACCUMULATION AMONG THE ROCKS, WASHOUT, CONSTRUCTION TRAFFIC, ETC.
4. WHEN SILT REACHES A DEPTH EQUAL TO ONE-THIRD THE HEIGHT OF THE BERM OR 6 INCHES, WHICHEVER IS LESS, REMOVE THE SILT AND DISPOSE OF ON AN APPROVED SITE AND IN A MANNER THAT WILL NOT CREATE A SILTATION PROBLEM.
5. INSPECT SEVERE SERVICE ROCK BERMS DAILY AND REMOVE SILT WHEN ACCUMULATION REACHES 6 INCHES.
6. WHEN THE SITE IS COMPLETELY STABILIZED, REMOVE THE ROCK BERM AND ACCUMULATED SILT AND DISPOSE OF IN AN APPROVED MANNER.

EXHIBIT D – SILT FENCE DETAIL



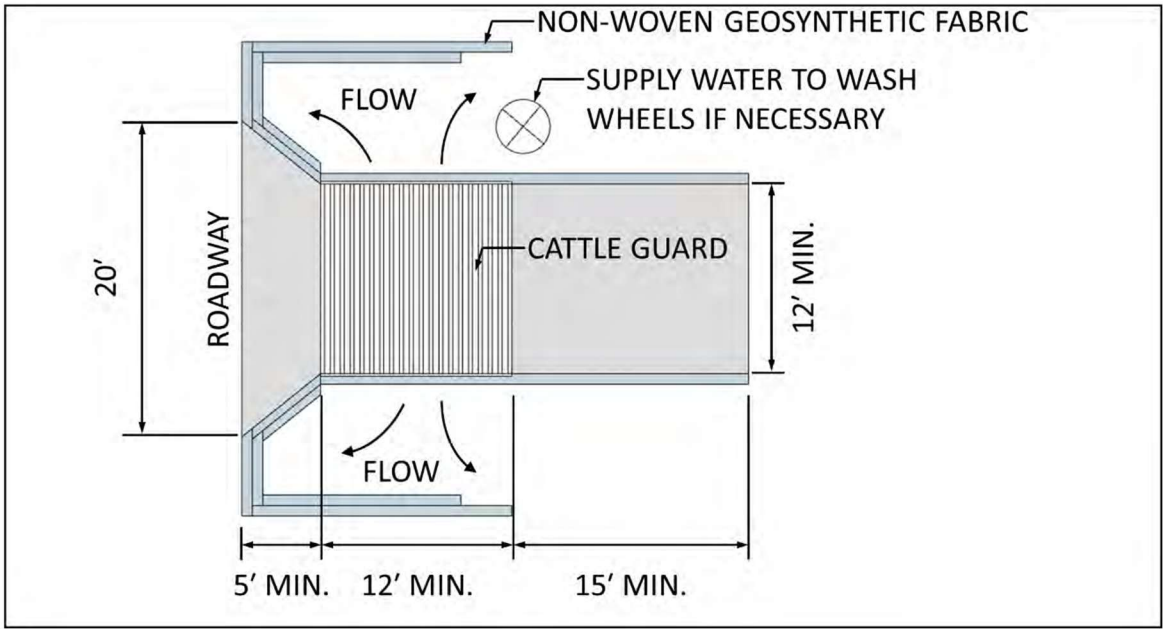
1. INSTALL STEEL POSTS THAT SUPPORT THE SILT FENCE ON A SLIGHT ANGLE TOWARD THE ANTICIPATED RUNOFF SOURCE. POSTS MUST BE EMBEDDED A MINIMUM OF 12 INCHES.
2. TRENCH IN THE TOE OF THE SILT FENCE WITH A SPADE OR MECHANICAL TRENCHER SO THAT THE DOWNSLOPE FACE OF THE TRENCH IS FLAT AND PERPENDICULAR TO THE LINE OF THE FLOW. WHERE FENCE CAN NOT BE TRENCHED INTO THE SURFACE, (E.G., PAVEMENT), WEIGHT THE FABRIC DOWN WITH ROCK OR 1” X 4” LUMBER SECURELY FASTENED TO THE SURFACE. PLACE ON THE UPSTREAM SIDE TO PREVENT FLOW UNDER THE FENCE.
3. THE TRENCH MUST BE A MINIMUM OF 6 INCHES DEEP AND 6 INCHES WIDE TO ALLOW FOR THE FILTER FABRIC TO BE LAID IN THE GROUND AND BACKFILLED WITH COMPACTED MATERIAL.
4. FASTEN THE FILTER FABRIC SECURELY TO THE WOVEN WIRE BACKING, AND IN TURN FASTEN IT SECURELY TO THE STEEL FENCE POST.
5. REMOVE ACCUMULATED SILT WHEN IT REACHES A DEPTH OF 6 INCHES, DISPOSE OF THE SILT ON AN APPROVED SITE AND IN SUCH A MANNER THAT IT WILL NOT CONTRIBUTE TO ADDITIONAL SILTATION.
6. INSPECT THE SILT FENCE WEEKLY AND REPAIR OR REPLACE PROMPTLY IF NEEDED.
7. WHEN THE SITE IS COMPLETELY STABILIZED, REMOVE THE SILT FENCE.

EXHIBIT E – TRIANGULAR DIKE DETAIL



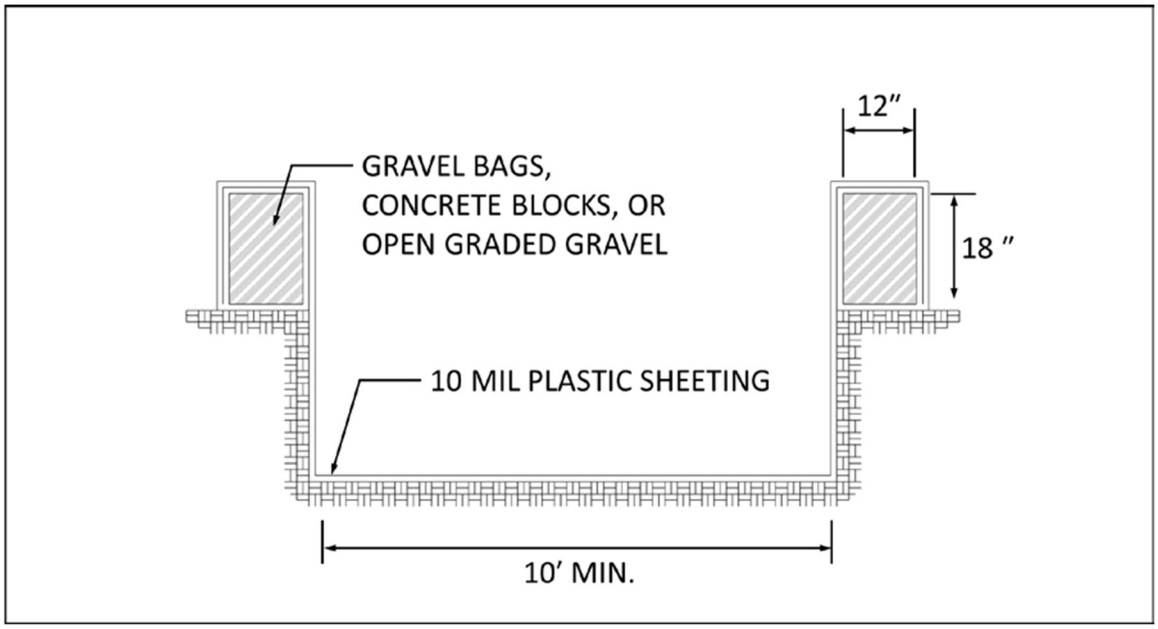
1. PLACE DIKES IN A ROW WITH EACH END TIGHTLY ABUTTING THE ADJACENT DIKE.
2. THE FABRIC COVER AND SKIRT SHALL BE A CONTINUOUS WRAPPING OF NON-WOVEN GEOTEXTILE. THE SKIRT SHALL BE A CONTINUOUS EXTENSION OF THE FABRIC ON THE UPSTREAM FACE.
3. WEIGHT THE SKIRT WITH A CONTINUOUS LAYER OF 3 INCH X 5 INCH OPEN GRADED ROCK, 1 INCH X 4 INCH SECURELY FASTENED LUMBER, OR TOED-IN 6 INCHES WITH MECHANICALLY COMPACTED MATERIAL. OTHERWISE, TRENCH IT IN 4 INCHES IN DEPTH.
4. ANCHOR DIKES AND SKIRT SECURELY IN PLACE USING 6 INCH WIRE STAPLES ON 2 FOOT CENTERS ON BOTH EDGES OF SKIRT, OR STAKE USING 3/8 INCH REBAR WITH TEE ENDS.
5. LAP FILTER MATERIAL OVER ENDS 6 INCHES TO COVER DIKE TO DIKE JOINTS. FASTEN JOINTS WITH GALVANIZED HOG RINGS.
6. THE DIKE STRUCTURE SHALL BE 6-GAUGE 6 INCH X 6 INCH WIRE MESH, 18 INCHES ON A SIDE.
7. REMOVE ACCUMULATED SILT WHEN IT REACHES A DEPTH OF 6 INCHES, AND DISPOSE OF IT IN A MANNER THAT WILL NOT CAUSE ADDITIONAL SILTATION.
8. INSPECT DIKES WEEKLY AND REPAIR OR REPLACE PROMPTLY AS NEEDED.
9. AFTER THE SITE IS COMPLETELY STABILIZED, REMOVE THE DIKES AND ANY REMAINING SILT.

EXHIBIT F – STABILIZED CONSTRUCTION EXIT



1. THE GRID CONSISTS OF PIPES OR TUBES WITH A MINIMUM DIAMETER OF 3 INCHES AND SPACED SUCH THAT THERE IS A MINIMUM CLEAR DISTANCE OF 4 1/2 INCHES BETWEEN THEM. ELEVATE THE GRID ABOVE THE GROUND SURFACE A MINIMUM OF 8 INCHES TO ALLOW WATER, DEBRIS AND SOIL TO DRAIN.
2. THE GRID SHALL BE DESIGNED TO SUPPORT THE WEIGHT OF ANY AND ALL VEHICLES ENTERING AND LEAVING THE CONSTRUCTION SITE.
3. THE GRID SHALL BE FIRMLY PLACED IN THE GROUND AT THE EXIT AND SHALL BE OF SUFFICIENT LENGTH THAT THE AGITATION WILL REMOVE THE SOIL FROM THE TIRES, OR A MINIMUM OF 12 FEET.
4. AT THE STREET SIDE APPROACH OF THE GRID, THERE SHALL BE AN IMPERVIOUS SURFACE OR IT SHALL CONSIST OF 3" X 5" ANGULAR CRUSHED STONE/ROCK 5 FEET IN LENGTH MINIMUM, AND 8 INCHES DEEP, MINIMUM. ON THE JOB SITE SIDE OF THE GRID, THERE SHALL BE 3" X 5" ANGULAR CRUSHED STONE/ROCK 15 FEET IN LENGTH, MINIMUM, 8 INCHES DEEP, MINIMUM. THE STEEL GRID WILL BE BETWEEN THE STREET SIDE APPROACH AND THE JOB SITE CRUSHED STONE/ROCK. ALL CRUSHED STONE/ROCK SHALL HAVE FILTER FABRIC PLACED BENEATH IT.
5. THE STEEL GRID AREA SHALL BE USED AS THE TIRE WASH AREA. WHEN TIRE WASH IS IN USE (RAINY OR MUDDY DAYS), THE AREA SHALL BE STAFFED AND THE TIRES SHALL BE WASHED USING A HIGH-PRESSURE HOSE/NOZZLE.
6. THE AREA BENEATH THE GRID SHALL BE SLOPED SUCH THAT DEBRIS, SOIL AND WATER SHALL BE DIVERTED BACK ON TO THE CONSTRUCTION SITE OR TO A SEDIMENT BASIN. NO WATER, SOIL OR DEBRIS SHALL LEAVE THE CONSTRUCTION SITE, AND THE RESULTING DISCHARGE SHALL BE DISPOSED OF PROPERLY.

EXHIBIT G – CONCRETE/PAINT/STUCCO/EQUIPMENT WASHOUT



1. THE EXCAVATION FOR THE CONCRETE TRUCK WASHOUT SHALL BE A MINIMUM OF 10 FEET WIDE AND OF SUFFICIENT LENGTH AND DEPTH TO ACCOMMODATE 7 GALLONS OF WASHOUT WATER AND CONCRETE PER TRUCK PER DAY AND/OR 50 GALLONS OF WASHOUT WATER AND CONCRETE PER PUMP TRUCK PER DAY.
2. IN THE EVENT THAT THE CONCRETE TRUCK WASHOUT IS CONSTRUCTED ABOVE GROUND, IT SHALL BE 10 FEET WIDE AND 10 FEET LONG, WITH THE SAME REQUIREMENTS FOR CONTAINMENT AS DESCRIBED IN ITEM 1.
3. THE CONTAINMENT AREA SHALL BE LINED WITH 10 MIL PLASTIC SHEETING WITHOUT HOLES OR TEARS. WHERE THERE ARE SEAMS, THESE SHALL BE SECURED ACCORDING TO MANUFACTURERS' DIRECTIONS.
4. THE BERM CONSISTING OF GRAVEL BAGS, CONCRETE BLOCKS OR OPEN GRADED ROCK SHALL BE NO LESS THAN 18 INCHES HIGH AND NO LESS THAN 12 INCHES WIDE.
5. THE PLASTIC SHEETING SHALL BE OF SUFFICIENT SIZE SO THAT IT WILL OVERLAP THE TOP OF THE CONTAINMENT AREA AND BE WRAPPED AROUND THE GRAVEL BAGS, CONCRETE BLOCKS OR OPEN GRADED ROCK AT LEAST 2 TIMES.
6. THE GRAVEL BAGS OR CONCRETE BLOCKS SHALL BE PLACED ABUTTING EACH OTHER TO FORM A CONTINUOUS BERM AROUND THE OUTER PERIMETER OF THE CONTAINMENT AREA.
7. THE WASHOUT MATERIAL IN THE CONTAINMENT AREA SHALL NOT EXCEED 50 PERCENT OF CAPACITY AT ANY ONE TIME.
8. SOLIDS SHALL BE REMOVED FROM CONTAINMENT AREA AND DISPOSED OF PROPERLY. ANY DAMAGE TO THE PLASTIC SHEETING SHALL BE REPAIRED OR SHEETING REPLACED BEFORE THE NEXT USE.

END OF SECTION 01565

SECTION 02020 SITE DEMOLITION

PART 1 – SCOPE

1.01 This work shall consist of the removal and satisfactory disposal of all buildings, above or below ground structures, old pavements, sidewalks, curbs, pavement, flatwork, fences, and abandoned pipe lines. It shall also include the salvaging of designated materials and backfilling the resulting trenches, holes, and pits; the preservation from injury or defacement of all vegetation and objects designated to remain; and all necessary replacement of fences, trees, hedges, shrubs, and flowers.

1.02 Work shall be performed in accordance with the codes and ordinances of the agency having jurisdiction over the place of record.

PART 2 – EQUIPMENT

2.01 Contractor shall furnish all labor, materials, equipment and incidentals necessary for every type of required demolition and shall furnish equipment of every type required to demolish and transport construction debris from the site.

PART 3 – CONSTRUCTION REQUIREMENTS

3.01 REMOVAL OF STRUCTURES AND OBSTRUCTIONS

A. The Contractor shall raze, remove, and dispose of all buildings, foundations, bridges, drainage structures, curbs, curbs and gutters, pavements, sidewalks, and other obstructions, except for those for which other provisions have been made. Demolition of buildings shall be done in accordance with all applicable sections of the City Building Code and Specification 02050.

B. Structures and obstructions shall be removed to a depth of not less than one (1) foot below natural ground except that within construction limits removal shall be to a depth of not less than two (2) feet below subgrade elevation. Cavities left shall be filled to the level of the surrounding ground and compacted in accordance the provisions of section 3.01 Subsection G of this specification. With the approval of the Owner, sewer and drainage pipes and structures may be abandoned in place and filled with sand or grout. Where property line adjustments are required by the Work, existing fencing shall be removed from the original property lines, replaced with in-kind fencing along the new property lines, and tied back to the old fence.

C. All pavements, base courses, sidewalks, curbs, gutters, and other improvements designated for removal shall be removed and the material disposed.

D. All salvageable pipe, frames and grates, manhole rims and covers, precast manhole sections, cobblestones, or granite curbs shall be carefully removed and every precaution taken to avoid damage. These salvaged items shall become the property of the Contractor.

E. Compaction – [Compaction required for voids greater than two (2) feet deep.] Begin rolling longitudinally at the sides and proceed toward the center, overlapping on successive trips by the least ½ the width of the roller. Compact fill with approved rolling equipment complying with ITEM 210 “Rolling” (Texas Department of Transportation 2004 Standard Specifications). Do not allow the loose depth of any layer to exceed 12 inches loose and 8 inches compacted material, unless otherwise approved by the owner or engineer. Before and during rolling operations, bring each layer to its optimum moisture content. Compact each layer until there is no evidence of further consolidation. Maintain a level layer to ensure uniform compaction. If the required stability or finish is lost for any reason, recompact and refinish the subgrade at no additional expense to the owner.

3.02 DISPOSAL OF DEBRIS

A. All material removed from the site, including suitable, unsuitable, contaminated, or salvaged shall become the property of the Contractor. All unsuitable and contaminated material shall be disposed at a State of Texas approved and permitted landfill site. The Contractor shall haul off all salvaged material from the site.

PART 4 – BACKFILLING

A. Backfill cavities resulting from demolition. Fill cavities occurring within the limits of building, structures, or pavements in accordance with the requirements of other sections of the specifications. Backfill and compact cavities outside the construction limits to the same density as the surrounding earth. No testing is required for this type of fill.

PART 5 – SCHEDULING

A. Work shall be started and completed within the Contract Specified Time.

PART 6 – MEASUREMENT

A. This item will be paid from a lump sum basis and no measurement will be made.

PART 7 – PAYMENT

A. Payment will be made for the work, completed and accepted by the Owner, at the contract lump sum price, which price will be full compensation for removal and disposal of structures and obstructions; backfilling of depressions below subgrade elevation, protection of trees to remain; restoration of fences, trees, hedges, shrubs, flowers, or other growth as required; and moving salvageable materials to Contractor or Owners storage locations in accordance with the stipulations and provisions of the contract.

END OF SECTION 02020

SECTION 02102 CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 GENERAL DESCRIPTION OF WORK

A. Cleaning and grubbing on project site of trees, stumps, brush, roots, vegetation, logs rubbish and other objectionable matter within limits described in specifications or as shown on plans.

B. Cleaning and grubbing shall be in advance of grading operation except that in cuts over 3 feet in depth, grubbing may be done simultaneously with excavation, provided objectionable matter is removed as specified.

C. Disposal of all debris resulting from clearing and grubbing work.

D. PROTECTION OF ADJACENT WORK:

E. Protect all areas outside indicated construction areas.

F. Protect existing improvements, adjacent property, utilities and other facilities, and trees and plants not to be removed from injury or damage.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Provide materials required to perform work as specified.

PART 3 - EXECUTION

3.01 CLEARING:

A. Clear all areas covered by dikes, roads, structures and embankments within project limits unless otherwise shown in plans.

B. Remove all saplings, brush, down-timber and debris unless shown or directed otherwise.

C. Use tree wound paint to treat scars, gashes or limbs stubs on trees not removed.

D. GRUBBING:

E. Trees, stumps, root systems, rocks and other obstructions shall be removed to the depths shown when they fall within the construction templates for the following items:

1.	Footings	18-inches below bottom of footing (or as specified on Structural Plans, whichever is greater).
2.	Sidewalks/other types of walks	12-riches below bottom of walk.
3.	Roadways or Streets	18-inches below bottom of sub-grade
4.	Parking Areas	18-inches below bottom of sub-grade
5.	Grassed Areas	18-inches below topsoil
6.	Fills	24-inches below bottom of fill

F. Blasting not permitted.

G. REMOVAL OF DEBRIS AND CLEANUP

H. Dispose of all waste materials not burned by removal from site.

I. Materials cleared and grubbed shall be the property of the Contractor and shall be his responsibility for disposal.

J. CLEARING AND GRUBBING:

K. When not listed as separate contract pay item, Clearing and Grubbing shall be considered as incidental work, and the cost thereof shall be included in such contract pay items as are provided in the proposal contract.

L. Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor equipment, tools and in incidentals required for the work, all in accordance with the plans and these specifications.

END OF SECTION 02102

SECTION 02210 GRADING AND EARTHWORK

Part 1 - General

1.1 Section Includes:

A. Grading and earthwork which occurs in areas other than under structures, under paving, or trenching for utilities.

B. Earthwork consists of operations required for the excavation of materials on site; excavation of borrow material from designated areas; compaction of natural or improved sub-grades: finish grading; disposal of excess or unsuitable materials; and other required operations. Earthwork shall conform with dimensions and typical sections shown, and within lines and grades.

1.2 Related Sections:

A. Trenching, structure excavation, backfilling and grading - Section 02221.

B. Excavating, backfilling and compacting for utilities - Section 02225.

1.3 References:

A. ASTM D698 - Laboratory Compaction Characteristics of Soil Using Standard Effort (12, 400 lbg/ft3).

B. ASTM D4972 - pH of Soil.

C. ASTM G57 - Field Measurement of Soil Resistivity Using the Wenner Four Electrode Method.

D. ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils.

1.4 Existing Utilities:

A. Where pipes, ducts and structures are encountered in the excavation but are not shown on the Drawings, immediately notify the ENGINEER.

1.5 Definitions:

A. Classification: Earthwork materials are classified in accordance with definitions in the Article.

B. Topsoil: Top 6 inches of natural surface soil possessing the characteristics of representative soils on the site that produce growths of grass or other vegetation. Topsoil includes roots and other vegetation.

C. General Site Fill: Suitable, clean material excavated on-site or off-site may be used as fill material. Suitable material shall consist of clay soils classified as CH according to the unified soil classification system. Clay soil used as fill shall have a liquid limit of less than 55 and a Plasticity Index comparable with on-site soils.

D. Select Fill: Select fill material, as required for construction, defined in the plans and/or Sections 02221 and 02225, shall consist of inorganic silty or sandy clay.

E. Subgrade: Consists of that portion of the surface on which a compacted fill, backfill or topsoil is placed.

F. Borrow: Material taken from on-site designated areas or approved off-site sources to make up any deficit of excavated material. Obtain from area that is normally dry and well drained. Borrow does not include top soil.

G. Finish Grading: Operations required for smoothing disturbed areas that are not overlaid with pavement.

H. Excavation: Excavation of every description and of whatever substances encountered within the limits of the project to the lines and grades indicated on the drawings.

I. Compaction: Compaction of soil materials shall be measured as a percent of Standard Proctor density as determined by ASTM D698.

Part 2 - Products

2.1 Select Fill:

A. Source: Obtain select fill material from required excavation, or if excavated material is not adequate, from borrow areas approved by the ENGINEER. Material from source shall be tested for compliance with project requirements and approved by the Owner and Testing Laboratory.
B. Suitability: Use the best material available from excavation or borrow, suitability of select fill is subject to the ENGINEER's approval.
C. Quality: Select fill material must be free of rock and clay lumps or excessive silts. Do not use soil containing brush, roots, sod or similar organic materials.
D. Characteristics: Select fill material shall consist of inorganic silty or sandy clay. Additional select fill requirements are described in Section 02225.

2.2 Fill and Backfill under Topsoil:

A. Source: Obtain site fill from required excavation or, if excavated material is not sufficient, from borrow areas approved by the ENGINEER.
B. Suitability: Use the best material available from excavation or borrow. Suitability of fill material is subject to the Testing Laboratory/Engineer's approval.
C. Quality: Fill material shall be free of excessive silts. Do not use soil containing brush, roots, sod or similar organic materials.
D. Characteristics: Fill material shall have a plasticity index between 6 and 25, inclusive, and shall generally be similar character to the existing soil at the site.

Part 3 - Execution:

3.1 Strip and Stockpile:

A. Remove topsoil at all non-paved areas when excavation of topsoil is required or where fill material will be added for site grading. Remove top 6 inches of topsoil where necessary and stockpile on the property as directed by the Owner. Protect stockpiled topsoil from other excavated materials, dumping of unwanted materials, dumping by the public, and erosion. Upon completion of rough grading, replace topsoil in 4-inch minimum layer to finish grade elevations as shown on the grading plan.
B. Removal of topsoil in building areas and paving areas is further described under provisions of Section 02225.

3.2 Excavation:

A. Objective: As shown on the Drawings, excavate to lines, grades and elevations required for subsequent construction. All excavation shall be made in such manner as to permit all surfaced to be brought to final line and grade within plus or minus 0.1 foot. Over excavation shall be restored by the Contractor at his own expense. Finished grades consistently high or low will not be acceptable and shall be corrected by the Contractor at this expense and no additional cost to the Owner.
B. Drainage: During excavation, maintain grades as required to provide positive drainage away from structures; or, as directed by the Engineer, install temporary drains or drainage ditches to intercept or divert surface water and prevent interference or delay of the work.
C. Stockpiling: If, at time of excavation, it is not possible to place material in the proper section of permanent construction, CONTRACTOR shall stockpile the material in Owner or Architect approved areas for later use.
D. Stone or Rock: Stone or rock fragments greater than 6" will not be allowed in fills or embankments. Stones or rock fragments larger than 2 inches in their greatest dimension will be permitted in top 6 inches of subgrade.
E. Dressing: Uniformly dress, cut and fill slopes to slope, cross section and alignment, as shown.

3.3 Treatment of Subgrades:

A. All topsoil and vegetation shall be stripped from the ground surface and stockpiled, exposing sound undisturbed subgrade soils.
B. After stripping the topsoil in areas to receive fill or cut areas, the exposed ground surface

shall be scarified to a depth of 6 inches, the moisture adjusted, and then recompact to a minimum density of 95 percent of the maximum density as obtained in the Standard Proctor Compaction Test (ASTM D698), at a moisture content between minus 1 to plus 3 percent of optimum. Any soft or compressible areas detected during the recompaction process shall be undercut such that sound subgrade soils are exposed and recompacted. Site excavated or select fill shall then be used to bring all areas to grade. Allow for placement of minimum 4-inch layer of top soil in areas not covered by building or pavement.

C. Finished subgrade shall be inspected by Testing Laboratory for determination that subgrade meets requirements of Contract Documents.

3.4 Placing fill and backfill:

A. Examination of Subgrade: Do not place fill on any part of the subgrade until the subgrade preparation has been accepted by the Engineer.
B. Removing Debris: During the dumping and spreading process, remove all roots, stones and debris that are uncovered in the fill material.
C. Spreading Fill and Backfill: After dumping, spread the material in horizontal layers over the entire fill area. The thickness of each layer before compaction shall not exceed 8 inches unless otherwise directed by the Engineer. Maintain positive drainage throughout construction. The combined excavation and fill placing operation shall be such that the material when compacted in the fill will be blended sufficiently to secure the best practicable degree of compaction. The suitability of the materials shall be subject to testing by the Testing Laboratory and approval of the Engineer. After each layer of fill has been spread to the proper depth, it shall be thoroughly manipulated with a disc plow or other suitable and approved equipment until the material is uniformly mixed, pulverized and brought to uniform approved moisture content.
D. Attaining Proper Bond: If, in the opinion of the Testing Laboratory, the compacted surface of a layer is too smooth to bond with succeeding layers, loosen the surface by harrowing or other approved method before continuing the work.
E. Place materials to proper elevation allowing do depth of topsoil furnished under this Contract.

3.5 Moisture Control:

A. Intent: Developing the maximum density obtainable with the natural moisture of the material is preferred. However, the moisture content shall not vary from the optimum, as determined by ASTM D698, by more than minus 1 to plus 3 percent of optimum.
B. Adjustment: If the moisture content is too high, adjust to within the specified limits by spreading the material and permitting it to dry. Assist the drying process by discing or harrowing if necessary. When the material is too dry, sprinkle each layer with water. Work the moisture into the soil by harrowing or other Engineer approved method.

3.6 Compaction:

A. Rough Grade: Compact each layer of fill material with suitable equipment as necessary to secure 95% to 98% Standard Proctor Density (ASTM D698) within the specified range of the moisture content.
B. Finish Grade: Place and lightly compact topsoil to achieve finish grades.

3.7 Distribution of Topsoil:

A. Perform rough grading and topsoil/finish grading work.
B. Preparation:
    1. Prior to placing topsoil, scarify the subgrade to a depth of 2 inches to provide effective bonding of the topsoil with the subgrade.
    2. Shall all areas designated for grading, including cut and fill areas, to receive a minimum of 4 inches of topsoil.
C. Placement:
    1. Do not haul or place wet topsoil. Also prohibited is placement of topsoil on a subgrade that is excessively wet, extremely dry, or in a condition otherwise

detrimental to proper grading or proposed planting.

2. Distribute topsoil uniformly and spread evenly. Correct irregularities in the surface to prevent formation of depressions where water could stand.
3. Perform the spreading operation so that planting can proceed with little additional tillage or soil preparation. Leave the area smooth and suitable for lawn planting.
4. Lightly compact topsoil to obtain proper bond with previously placed or prepared material.

D. Maintenance: Where any portion of the surface becomes eroded or otherwise damaged, repair the affected area to establish the condition and grade prior to topsoil placement; then replace topsoil.

3.8 Material Disposal:

A. Excess Excavation Material (soil material free of trees, stumps, logs, brush, roots, rubbish and other objectionable matter which has been accepted by the Geotechnical Engineer.): Remove excess excavated material from the construction site or place on the property as directed by the ENGINEER.

B. Waster Material (soil material including trees, stumps, logs, brush, roots, rubbish and other objectionable matter which has not been accepted by the Geotechnical Engineer): Remove waster material from the project site before Final Inspection. Legally dispose of material at a licensed site or with written and notarized permission from the property owner for a private disposal site. All costs associated with waste material removal and disposal shall be paid for by the Contractor.

Part 4 - Testing:

A. The testing laboratory will make tests of in-place density in accordance with ASTM Standards. Backfill operations will be monitored continuously by the testing laboratory at structures. It will be the responsibly of the CONTRACTOR to notify the testing laboratory before backfill operations begin.

Part 5 - Measurement and Payment:

A. No separate payment shall be made to the CONTRACTOR for the work described in this Section. Such work shall be considered incidental to the project and the payments made under specific Pay Items shall be considered as full compensation for these requirements.

END OF SECTION 02210

SECTION 02220 SUB-GRADE PREPARATION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

A. This work shall consist of scarifying, blading and rolling the sub-grade to obtain a uniform texture and provide as nearly as practical a uniform density for the 6 inches of the sub-grade.

PART 2 - EXECUTION

2.01 CONSTRUCTION METHODS:

A. All preparing of the right-of-way and/or clearing and grubbing shall be completed before starting the sub-grade preparation.
B. The sub-grade shall be scarified and shaped in conformity with the typical sections and the lines and grades indicated or as established by the ENGINEER by the removal of existing material or addition or approved material.
C. All unsuitable material shall be removed and replaced with approved material.
D. All foundations, walls or other objectionable material shall be removed to a minimum depth of 18-inches under all structures and 12-inches under areas to be vegetated. All holes, ruts and depressions shall be filled with approved material.
E. The surface of the sub-grade shall be finished to the lines and grades as established and be in conformity with the typical sections indicated.
F. Any deviation in excess of ½ inch cross section and in a length of 10 feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and compacting by sprinkling and rolling.
G. Sufficient sub-grade shall be prepared in advance to insure satisfactory prosecution of the work.
H. The CONTRACTOR will be required to set blue tops for the sub-grade on centerline, at quarter points and curb lines or edge of pavement at intervals not exceeding 50 feet.
I. All suitable material removed may be utilized in the sub-grade with the approval of the ENGINEER. All other material required for completion of the sub-grade shall also be subject to approval by the ENGINEER.
J. Sub-grade materials on which structures shall be placed shall be compacted by approved mechanical tamping equipment to a dry density of the total material of not less than 95 percent nor more than 100 percent of the maximum dry density as determined in accordance with SDHPT Test Method Tex-114-E.
K. Sub-grade materials on which planting or turf will be established shall be compacted to a minimum of 85 percent of the maximum dry density as determined in accordance with SDHPT Test Method Tex-114-E.
L. Tests for density will be made as soon as possible after compacting operations are completed. If the material fails to meet the density specified, it shall be reworked as necessary to obtain the density required.
M. Just prior to placing any base materials, density and moisture content of the top 6 inches of compacted sub-grade shall be checked and if tests show the density to be more than 2 percent below the specified minimum or the moisture content to be more than 3 percent above or below the optimum, the sub-grade shall be reworked as necessary to obtain the specified compaction and moisture content
N. Proof Rolling is required before placing base material in conformity with Item 02686 "Proof Rolling".
O. When lime stabilization of the sub-grade is specified, the lime is to be added in accordance with Section 02240, Lime Stabilization.

PART 3 - MEASUREMENT AND PAYMENT

3.01 MEASUREMENT:

A. All acceptable sub-grade preparation will be measured by the square yard.
B. The measured area includes the entire width of the roadway for the entire length as indicated.

3.02 PAYMENT:

A. The accepted quantities of sub-grade preparation will be paid for at contract unit bid price per square yard.
B. When not listed as separate contract pay item, sub-grade preparation shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provided in the proposal contract.
C. Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

END OF SECTION 02220

SECTION 02221 TRENCH EXCAVATION, BACKFILL AND COMPACTION

PART 1 - GENERAL

1.01 GENERAL DESCRIPTION OF WORK

A. Excavation, shoring, dewatering, pipe bedding, trench backfill, compaction, grading and cleanup of all pipeline trenching.

B. All work must be performed in accordance with these specifications and the safety requirements of the State and OSHA standards.

1.02 JOB CONDITIONS

A. Site Acceptance

1. Contractor shall accept the site conditions existing during the Contract Time.
2. Ground water and surface water are conditions of the contract and the responsibility of Contractor.

B. Adverse Weather

1. Place no backfill that is wet or frozen.
2. Place no backfill in wet or frozen trenches.

PART 2 – PRODUCTS

2.01 PIPE BEDDING AND BACKFILL

The types of material to be used for bedding and backfill are identified on the Drawings or in the Special Provisions of the contract documents. Material types are defined either by class in accordance with ASTM D2321, or by product description. Contractor is responsible for determination of source of materials and shall submit characterization analysis and physical sample of proposed bedding material for approval prior to construction.

A. Class Designations Based on Laboratory Testing (ASTM D2321 and by reference ASTM D2487 and D653).

1. Class IA: Manufactured aggregates (angular crushed rock/gravel), open- graded, clean.
   a. Plasticity Index: Non-plastic.
   b. Gradation: 100% passing 1½" sieve, ≤ 10% passing No. 4 sieve, and < 5% passing No. 200 sieve.
2. Class IB: Mixture of manufactured aggregates (Class 1A) and sand, dense- graded, clean.
   a. Plasticity Index: Non-plastic.
   b. Gradation: 100% passing 1½" sieve, ≤ 50% passing No. 4 sieve, and < 5% passing No. 200 sieve.
3. Class II: Well and poorly graded gravels and sands, clean or with little to moderate fines (silt and clay).
   a. Plasticity Index: Non-plastic.
   b. Gravel: 100% passing 1½" sieve, < 5% passing No. 200 sieve (i.e. <5% fines), and < 50% of the non-fines passing a No. 4 sieve.
   c. Sand: 100% passing 1½" sieve, < 5% passing No. 200 sieve (i.e. <5% fines), and > 50% of the non-fines passing a No. 4 sieve.
   d. Gravel, Sand with Fines: 100% passing 1½" sieve, and 5% to 12% passing No. 200 sieve (i.e. 5% to 12% fines).
4. Class III: Silty/clayey gravels and sands, gravel-sand-silt/clay mixtures.
   a. Plasticity Index: (Refer to ASTM D2321)
   b. Gradation: 100% passing 1½" sieve, 12% to 50% passing No. 200 sieve.

- NOTE: Dense-graded (i.e. well graded) and open-graded (i.e. poorly graded) materials are defined on the basis of the coefficient of uniformity, Cu = D60/D10, and the coefficient of curvature, Cc = (D30)2/(D10×D60), where D60, D30, and D10 represent the sieve opening dimensions through which 60%, 30%, and 10% of the material would pass, respectively:
  Dense-graded: 1 ≤ Cc ≤ 3 for both gravel and sand, plus Cu ≥ 4 for gravel; Cu ≥ 6 for sand.
  Open-graded: Either Cc or Cu criteria for dense gradation are not met.

B. Designations Based on Product Descriptions:
   1. Excavated Material Backfill: Excavated material may be used in the trench backfill, provided that all hard rock and stones having any dimensions greater than 6" and frozen earth, debris and roots larger than 2" are removed for the initial backfill. Plasticity Index shall be less than 30. Excavated backfill material must be approved by Engineer.
   2. Select Backfill: Select Backfill shall be gravel, fine rock cuttings, sand, sandy loam or loam free from excessive clay. Rock cuttings shall have no dimensions greater than 2 inches. Plasticity Index shall be between 7 and 22. Select backfill must be approved by Engineer.
   3. Sand Backfill: Sand backfill shall be clean, hard, durable, uncoated grains, free from lumps and organic material. All materials must pass a No. 8 sieve with less than 5% passing a No. 200 sieve (equivalent to ASTM 2321 Class II Sand Gradation excluding material captured on No. 8 sieve).
   4. Granular Backfill: Granular backfill shall be free flowing, such as sand or hydraulically graded stone fines, or mixed sand and gravel, or sandy loam. The material shall be free from lumps, stones over 2 inches in diameter, clay and organic matter.
   5. Controlled Density Fill: Use high slump mixture of portland cement, fly ash and fine aggregate formulated, licensed and marketed as K-Krete or equal. Provide mixture having 28-day compressive strength of 70 psi minimum and 150 psi maximum with no measurable shrinkage or surface settlement.

2.02 CRADLING ROCK

A. Use crushed rock or stone with 70-100% passing 1½ inch sieve and no more than 50% passing 1 inch sieve.

2.03 GEOTEXTILE MATERIAL FOR UNSTABLE TRENCHES

A. Where unstable wall or trench bottom conditions are present as determined by the Engineer, a geotextile material shall be installed.
B. The geotextile shall be designed to prevent loss of trench support caused by migration of sand and fines into the embedment matrix and secure the embedment around the pipe.
C. The geotextile shall be a nonwoven, needle point construction and shall consist of long-chain polyethylene or polyamide. The fibers shall be oriented into a stable network whereby they retain their positions with each other. The textile shall be free of any chemical treatment commonly found in soil. The geotextile shall conform to the following properties:

Tensile Strength: ASTM D 4632	130 LBS.
Elongation: ASTM D 4632	50%
Mullen Burst Strength: ASTM D 3786	250 psi
Coefficient of Permeability: K-cm/sec. (20 CFMC-GET-2, Constant Head) ASTM D 4491	0.10cm/sec.
Puncture Strength:	80 LBS

D. The geotextile shall be furnished in protective wrapping to protect the material from ultraviolet radiation, contamination from other substances, and abrasion or shipping damage. Any material received damaged, shall be rejected.

PART 3 - EXECUTION

3.01 GENERAL

A. Dewatering

1. Execute work "dry". No pipe or conduits shall be laid or concrete poured on wet soil.

2. Prevent surface water from flowing into excavation.

3. Provide equipment for handling water encountered as required. Obtain Engineer's prior approval of proposed method of dewatering.

4. No sanitary sewer shall be used for disposal of trench water.

B. Protection of Existing Utilities

1. Notify all utility companies of location and schedule of work.

2. Locations and elevations of utilities shown on plans are to be considered approximate only. Notify utility companies and Engineer of conflicts between existing and proposed facilities.

3. Repair, relay or replace existing utilities damaged, destroyed or disrupted during work. Unless specified otherwise, replacement will be at the Contractor's expense.

C. Sheeting, Shoring and Bracing

1. All sheeting, shoring, and bracing shall be in accordance with the Contractor's Excavation Safety System Plan and the safety requirements of the State and OSHA Standards.

2. Provide as necessary to hold walls of excavation, prevent damage to adjacent structures, and to protect workmen and property.

3. Leave Sheeting and shoring in place where removal might cause personal injury or damage to the work.

4. When movable trench shield is used below spring line of pipe, it shall be lifted prior to any forward movement to avoid pipe displacement.

D. Changes in Grade

1. Grades may be adjusted by written field order from the Engineer to suit unforeseen construction conflicts or conditions. Where the bid includes a single bid price for all depths, no additional compensation will be made for adjustments within 1.5 feet of the plan grades.

3.02 EXCAVATION AND TRENCHING

A. General

1. Method of excavation is Contractor's option.

2. Allow no more than 300 feet of trench to be open at one time.

3. Excavate by hand under and around structures, utilities, and roots of trees required to be left in place.

4. Stockpile and replace topsoil to a minimum of 8 inches for surface restoration in grassed or agricultural areas.

B. Trench Characteristics

1. Depth: As indicated for pipe installation to lines and grades required with proper allowance for thickness of pipe and type of bedding specified.

2. Width: Trench width shall be no less than pipe O.D. plus 16 inches or pipe O.D. × 1.25 + 12 inches, whichever is greater.

3. Trench walls must be vertical below top of pipe and may be vertical or sloped above pipe to conform to excavation codes.

4. Trench boxes and shoring shall not be set below the top of the embedment zone.

5. Provide bell holes for each pipe joint where pipe bears on undisturbed earth.

6. Trench bottom shall be free of large stones and other foreign material.

3.03 SOFT, SPONGY OR UNSTABLE MATERIALS (e.g. peat, muck, and highly expansive soils)

A. Stop work and notify Engineer.

B. Perform remedial work as directed.

C. If material is judged unsuitable and removal is authorized, remove and replace with trench stabilizing material as directed by Engineer.

3.04 ROCK EXCAVATION

A. Excavate any rock to maintain minimum 6-inch clearance around pipe.

B. Dispose of rock material not suitable for backfill as directed by Engineer.

C. Use of explosives not permitted without prior written authorization from Owner and Engineer.

D. Provide Special Hazard Insurance covering liability for blasting operations.

3.05 PIPE EMBEDMENT

Pipe embedment includes materials placed in the zone surrounding the pipe including bedding, haunching, and initial backfill over the top of pipe. Refer to the pipe bedding details on the Drawings for material types to be used in the pipe embedment zone.

A. Bedding

1. Place after bottom of trench has been excavated to proper depth and grade.

2. Place, compact and shape bedding material to conform to barrel of pipe and bell to insure continuous firm bedding for full length of pipe.

B. Haunching (bottom of pipe to springline)

1. Place after pipe has been bedded and checked for alignment, grade and internal obstructions.

2. Do not backfill until any required concrete or mortar has sufficiently cured.

3. Work bedding material under pipe haunches and compact by hand to springline of pipe in 6-inch lifts.

C. Initial Backfill

1. From springline to not less than 12 inches above top of pipe, place backfill and compact in 6-inch layers using vibratory compactors.

2. Backfill simultaneously on both sides of pipe to prevent displacement.

3. Record location of connections and appurtenances before backfilling.

D. Embedment in Unstable Soils

1. Where the Engineer determines that the trench bottom or wall is unstable at the bedding zone, special pipe embedment material stabilization shall be required.

2. Unstable bedding zone conditions shall be determined immediately after trench excavation by checking soil bearing strength capacities at the bedding zone using a Standard Pocket Penetrometer or other appropriate means. A minimum of three readings shall be obtained and averaged. The soil to be tested in the bedding zone shall not be allowed to dry, and shall be tested under “in-situ” conditions. If, in the Engineer’s opinion, the soil has dried, the Penetrometer Test shall be taken after removing a sufficient amount of soil from the wall or bottom surface in order to obtain a representative sample.

3. If the average reading is less than 8 blows per foot, then the pipe bed shall be prepared as follows:

a. The trench shall be dewatered to the greatest extent possible and rock shall be placed and compacted to form a firm trench bottom. No pipe shall be laid until stabilization is to the satisfaction of the Engineer.

b. A geotextile material shall be placed in the trench and the embedment material and pipe installed as indicated on the Drawings. Overlap geotextile around the top of the pipe envelope a minimum of 12 inches.

c. The geotextile shall be installed in accordance with the manufacturer’s recommendations. Prior to installation, the geotextile shall be stretched, aligned, and placed without any wrinkles. If the material is damaged or punctured, the damaged area shall be patched by overlapping and stitching.

4. Where the trench wall is unable to support trench boxes at a level above the top of the embedment zone, sheeting shall be used for trench wall stabilization to enable such use of trench boxes or as stand-alone trench protection in lieu of trench boxes. Sheeting installed below the top of the embedment zone shall be extracted vertically in incremental steps of one (1) foot or less. Embedment material shall be placed in loose lifts before each extraction step and thoroughly compacted immediately after each step to ensure that no compacted lift is disturbed by subsequent extraction. Contractor shall ensure the soils of the trench walls on both sides of the embedment zone remain as dense as the original unexcavated condition so that the pipe embedment remains firmly supported. In no case shall a trench box be permitted to rest below the top of the embedment zone.

E. Embedment of Flexible Pipe in Saturated Soils (Sewer Pipe Only)

1. Consolidated Soils: Pipe embedment may be installed using least restrictive, open-graded material.

2. Unconsolidated, Stable Soils: Dense-graded material shall be used to prevent loss of trench support caused by migration of soil into the embedment matrix. Alternately, open-graded embedment may be used in combination with geotextile fabric as specified for unstable soil.

3.06 TRENCH BACKFILL

A. Final Backfill

1. Place backfill into trench at an angle so that impact on installed pipe is minimized.

2. Compaction of all backfill material shall be performed in a manner that shall not crack, crush, or cause the installed pipe to be moved from the established grade and alignment.

3. Place minimum cushion of 3 feet of compacted backfill above pipe envelope before using heavy compacting equipment.

4. Use excavated material for final backfill subject to the requirements for Excavated Backfill unless otherwise specified.

5. Areas under or within 5 feet of pavement, and under or within 2 feet of utilities, buildings, or walks shall be backfilled with sand and mechanically compacted to the top of the subgrade in 8-inch lifts to a minimum of 95% Standard Proctor Density.

6. Areas not subject to vehicular traffic shall be backfilled in layers not more than 12 inches.

7. Structural and non-structural backfill shall be mechanically compacted. Compaction method is at discretion of Contractor with following exceptions:

a. If in Owner's opinion compaction method presents potential damage to pipe, it will not be allowed.

b. Flooding or water jetting may be permitted only if a geotechnical report justifying the use of water jetting is submitted to the City Engineer and approval is granted.

8. Mound excavated materials no greater than 6 inches in open areas only.

9. Fill upper portion of trench with topsoil as specified hereinbefore.

B. Controlled Density Fill

1. Use where shown on plans.

2. Provide suitable forms to limit volume of control density fill material.

3. Prevent flow of material into existing drain lines.

4. Protect exposed utility lines during placement.

5. Place material in accordance with suppliers' written recommendations unless directed otherwise by Engineer.

3.07 EXCESS MATERIAL

A. Disposal of excess excavated material shall be the responsibility of the Contractor.

3.08 TESTING

A. Unless specified elsewhere, testing will be responsibility of Owner.

B. Standard Proctor Density

1. ASTM D698.

2. One (1) required for each type of material encountered.

C. In Place Density

1. ASTM D1556 (Sand Cone)

2. ASTM D2167 (Balloon)

3. ASTM D3017 (Nuclear)

D. One (1) test per 250 linear feet of trench on alternating lifts, with a minimum of three tests per visit, for non-structural areas. One (1) test per 100 linear feet of trench on alternating lifts, with a minimum of three tests per visit, for structural areas.

E. Contractor will be responsible for any costs associated with testing performed as a result of failed tests

PART 4 - MEASUREMENT AND PAYMENT

4.01 TRENCH EXCAVATION

A. Trench excavation shall be considered incidental to pipeline installation.

B. Payment shall be made at the contract unit price per cubic yard only if a bid item is established in the contract.

4.02 BACKFILL

A. Backfill shall be considered incidental to pipeline installation.

B. Payment for backfill shall be made at the contract unit price per cubic yard only if a separate bid item is established in the contract.

C. No allowance for waste shall be made.

D. If Engineer orders a bedding backfill material other than that specified in contract, it shall be paid for as an extra in price per cubic yard as compacted in place, EXCEPT if a higher class embedment is ordered by Engineer because the Contractor has over-excavated the trench.

E. If the Engineer orders the excavated material to be removed and disposed of and replaced with another material and a separate bid item for that material has not been established, the material shall be paid as an extra.

F. If the Contractor fails to compact the backfill to the density requirements, the Engineer may order the material removed and replaced at no cost to the Owner.

G. The disposal of rejected material shall be at no cost to the Owner.

H. Payment for geotextile envelopment in unstable trench soils shall be made at the bid price for "Trench Stabilization in Unstable Soils" in the bid form.

END OF SECTION 02221

SECTION 02556 WATER TRANSMISSION LINES AND/OR PRESSURE SEWER LINES

PART 1 - GENERAL

1.01 RELATED REQUIREMENTS SPECIFIED ELSEWHERE:

A. Trenching, Backfilling and Compacting: Section 02221.

1.02 SUBMITTALS:

A. Manufacturer's Literature: Manufacturer's descriptive literature and recommended method of installation.

B. Certificates: Manufacturer's certification that products meet specification requirements.

1.03 PRODUCT DELIVERY, STORAGE, AND HANDLING:

A. Deliver materials on manufacturer's original skids or in original unopened protective packaging. OWNER reserves the right to reject material left from another job.

B. Store materials to prevent physical damage.

C. Protect materials during transportation and installation to avoid physical damage.

1.04 GENERAL DESCRIPTION OF WORK COVERED:

A. Furnish and install all pipe, fittings, structures and accessories required for water transmission line and/or pressure sewer lines.

1.05 QUALITY ASSURANCE:

A. Comply with the latest published edition of American Water Works Association (AWWA) Standards:
   1. AWWA C110 & C11Oa - Gray Iron and Ductile-Iron Fittings, 2 inch through 48 inch for water and other liquids.
   2. AWWA Clll - Rubber Gasket Joints for Cast Iron Pressure Pipe and Fittings.
   3. AWWA C150 - Thickness Design of Ductile-Iron Pipe.
   4. AWWA C151 - Ductile-Iron Pipe, centrifugally cast in metal mold or sand lined molds, for water or other liquids.
   5. AWWA C153 - Ductile-Iron Compact fittings, 3 inch through 12 inch for water and other liquids.
   6. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe 4 inch through 12 inch for water.
   7. AWWA C301-79 - Prestressed Concrete Pressure Pipe - Steel Cylinder Type, for water and other liquids.

B. Comply with the latest published editions of the American Society for Testing and Materials (ASTM) Standards:
   1. D 2241 - Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR).
   2. D 3139 - Joints for PVC Pressure Pipes using Flexible Elastomeric Seals.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS:

A. Pipe furnished may be either PVC or steel cylinder as specified herein for water mains unless shown otherwise on the plans or bid documents.

B. Use PVC pipe for all pressure sewer lines unless shown otherwise on the plans.

C. All pipe shall be marked in accordance with the applicable standard specification under which the pipe is manufactured unless otherwise specified.

D. Steel cylinder pipe manufactured shall have had a successful experience record in the design and manufacture of steel cylinder pipe with substantial footage in successful operation for at least five years.

2.02 POLYVINYL CHLORIDE PIPE (PVC):

A. Provide pipe meeting AWWA C900 PVC 1120 or ASTM D2241 Type 1 Grade 1 PVC 1120 Standards.
   1. Minimum requirements:

Pressure Size	Pressure DR	Class(psi)	Rating(psi)
4"-12"	18	150	150
2"- 4"	26	95	160
6"-12"	21	120	200

   2. Use pipe meeting minimum requirements unless shown otherwise on plans.

B. Provide push-on joints with bell integrally cast into pipe or with coupling of same material as pipe.

C. Use elastomeric gaskets, as provided in AWWA C900 or ASTM D3139.

D. Provide either cast-iron or PVC 1120 fittings as indicated or required. Use long radius fittings where possible.

E. Provide fittings with materials and pressure class equal to or greater than that specified for pipe.

F. Provide sleeve type or anchored coupling where indicated or required to join pipe or provide restraint to offset internal or hydrostatic test pressures.

G. Provide pipe marked to indicate the following:
   1. Nominal Pipe Size.
   2. Material Code Designation.
   3. Standard Dimension Ratio.
   4. Pressure Rating.
   5. Manufacturer's name or trademark.
   6. National Sanitation Foundation Seal.
   7. Appropriate ASTM designation number.

2.03 STEEL CYLINDER PIPE (SCP):

A. Provide pipe meeting AWWA C301-79.

B. All pipe and fittings shall have the approval of the Underwriter's Laboratories, Inc.

C. Provide pipe with minimum pressure class of 150 psi or as shown on plans or in Special Conditions.

D. Provide fittings with materials and pressure class equal to or greater than that specified for pipe.

   Joint wrappers:
   1. Shall be of quality manufactured by Mar-Mac-Manufacturing Company or approved equal.
   2. Shall be hemmed at each edge to allow threading with a steel strap to securely fasten the wrapper around the pipe by means of a stretcher and sealer.
   3. Minimum width of 7 inches for pipe with diameter of 33 inches or smaller; 9 inches for pipe with diameter greater than 33 inches.
   4. Length sufficient to circle pipe.

   Cement Mortar:
   1. Mortar used at joint shall consist of 1 part portland cement to 2 1/2 parts fine, sharp clean sand mixed with water.
   2. Interior joint mortar shall be mixed with as little water as possible to produce a very stiff but workable mixture.
   3. Exterior joint mortar shall be mixed with water to a consistency of thick cream.

E. Provide pipe marked to indicate the following:
   1. Pressure for which the pipe or fitting is designed.
   2. Identification marks to show proper location.
   3. All beveled pipe shall be marked with the amount of the bevel.

4. Manufacturer's name.
5. Material code designation.
6. National Sanitation Foundation Seal.

2.04 DUCTILE IRON PIPE FITTINGS (DIP):

A. Shall be in accordance with AWWA C-llO with pressure rating of not less than that specified for adjacent pipe.

B. Shall be compatible with joint type of adjacent pipe.

C. All specials, taps, plugs, flanges and wall fittings shall be as required.

D. Shall have cement mortar lining in accordance with AWWA C104.

E. Shall be coated with manufacturer's standard coating.

2.05 VALVES, HYDRANTS AND METERS:

A. Gate Valves:
1. Design: AWWA C-509, CRS-80 by American Darling, Metroseal by U.S. Pipe, Mueller, or equal.
2. Type: Compression Resilient Seated.
3. Material: Cast iron body with epoxy coated interior.
4. Rating: 200 psi working pressure class.
5. Stem: Double "O" ring stem seal.
6. Operators: Open counterclockwise with 2 inch square operating nut.
7. Flange: x push-on valves must be used on all fire hydrants installed on water main 10 inches or larger.

B. Valve Boxes:
1. Provide for all buried valves.
2. Use nominal 6 inch cast-iron sliding type pipe shaft with cover and base casting.
3. Set box top at finished grade.
4. Furnish drop cover appropriately marked "WATER".

C. Corporation Stops:
1. Conform with AWWA C-800.
2. Use 3/4 inch unless indicated otherwise.

D. Hydrants:
1. Design: latest edition of AWWA C502, traffic model with break flange.
2. Mueller Centrurion - A423
   a. American-Darling - B-84-B
   b. Kennedy Guardian - K-81A
   c. U.S. Pipe - Metropolitan
   d. Others as approved by OWNER in writing
3. Provide 6 inch inlet, 2 - 2> inch hose nozzles, 1 - 4> inch pumper.
4. Provide compression type main valve, minimum size 5< inches.
5. Pentagon operating nut.
6. Design to open counterclockwise.
7. Provide mechanical joint bell on footpiece.
8. Furnish depth as noted on plans.
9. Furnish National (American) Standard Fire Hose Coupling Screw Thread (NH).

E. Polyethylene Wrapping:
1. Material: AWWA C105.
2. Thickness: 8 mils.

F. Polyethylene Plastic Pipe (PE):
1. Material: ASTM D2737.

2. Fittings: ASTM D2683.
3. Size: 3/4 inch unless shown otherwise on plans.

G. Copper Pipe (CU):
1. Material: seamless, Type K, ATM B88.
2. Fittings: wrought copper solder joint or flared.
3. Size: 3/4 inch unless shown otherwise on plans.

PART 3 - EXECUTION

3.01 GENERAL:

A. Provide all labor, equipment and materials and install all pipe fittings, special and appurtenances as indicated or specified.

3.02 PIPE INSTALLATION:

A. Handling:
1. Handle in a manner to insure installation in sound and undamaged condition.
a. Do not drop or bump.
b. Use slings, lifting lugs, hooks and other devices designed to protect pipe, joint elements, and coatings.
2. Ship, move and store with provisions to prevent movement or shock contact with adjacent units.
3. Handle with equipment capable of work with adequate factor of safety against overturning or other unsafe procedures.

B. Installation:
1. Utilize equipment, methods, and materials insuring installation to lines and grades as indicated.
a. Do not lay on blocks unless pipe is to receive total concrete encasement.

C. Accomplish horizontal and vertical curve alignments of ductile iron pipe with bends, bevels or deflection joints.
1. Limit joint deflection with ductile iron pipe to conform with AWWA C600.
2. Use short specials preceding curves as required.
3. Obtain approval of ENGINEER of method proposed or transfer of line and grade from control to the work.
4. Install pipe of size, material, strength class, and joint type with embedment as shown on plans or specified herein.
5. Clean interior of all pipe, fittings, and joints prior to installation. Exclude entrance of foreign matter during discontinuance of installation.
a. Close open ends of pipe with snug fitting closures.
b. Do not let water fill trench. Include provisions to pre-vent flotation should water control measures prove inadequate.
c. Remove water, sand, mud and usher undesirable materials from trench before removal of end cap.
6. Pipe shall be inspected prior to installation to determine if any pipe defects are present.
7. Brace or anchor as required to prevent displacement after establishing final position.
8. Perform only when weather and trench conditions are suitable.
a. Do not lay in water.
9. Observe extra precaution when hazardous atmospheres might be encountered.
10. Sanitary sewer relation to water mains:
a. Maintain 9 feet horizontal separation whenever possible.
b. When conditions prevent a lateral separation of 9 feet, sewer may be installed closer to a water main if:

1) sewer constructed of PVC pipe meeting AWWA Specifications and having a minimum working pressure rating of 150 psi or greater and equipped with pressure type joints, and
2) the sewer line and water main are separated by a minimum vertical distance of 2 feet and a minimum horizontal distance of 4 feet, measured between the nearest outside diameters of the pipes.

c. When a sanitary sewer crosses a water line and that portion of the sewer is constructed as described is 3.02 B.9.b.(1), the sewer may be placed no closer than 6 inches from the water line. The separation distance must be measured between the nearest outside pipe diameters. The sewer line shall be located at a lower elevation than the water line whenever possible and one length of the sewer pipe must be centered on the water line.

11. Separation of water mains from sewer manholes:
    a. No water pipe shall pass through or come in contract with any part of a sewer manhole.
    b. A minimum horizontal separation of 9 feet shall be maintained.
12. Construct service lines where shown on plans in accordance with Standard Detail Drawing D-48 or D-49. Use pipe material specified on plans or in contract documents.
13. Wrap pipe, fittings and tie rods with polyethylene where shown on plans in accordance with AWWA C105.

D. Jointing:
1. General requirements:
    a. Locate joint to provide for differential movement at changes in type of pipe embedment, at changes from rock to soil trench bottom, and structures.
        1) Not more than 18 inches from structure wall, or
        2) Support pipe from wall to first joint with concrete cradle structurally continuous with base slab or footing of structure.
        3) Perform in accordance with manufacturer's recommendations.
        4) Clean and lubricate all joint and gasket surfaces with lubricant recommended.
        5) Utilize methods and equipment capable of fully homing or making up joints without damage.
        6) Check joint opening and deflection for specification limits.
2. Special provisions for jointing cast-iron and ductile iron:
    a. Conform to AWWA C600.
    b. Visually examine while suspended and before lowering into trench.
        1) Paint bell, spigot, or other suspected portions with turpentine and dust with cement to check for cracks invisible to the eye.
        2) Remove turpentine and cement by washing when test is satisfactorily completed.
        3) Reject all defective pipe.
3. Special provisions for jointing and laying PVC pipe:
    a. Conform to AWWA C600 and ASTM D2321.
    b. Allow pipe to reach trench soil temperature prior to installation in ditch.
4. Special provisions for jointing steel cylinder pipe:
    a. Before laying each joint, the bell and spigot rings shall be cleaned by wire brush and wiped clean and dry.
    b. Inside cement mortar joint:
        1) the inside joint recess shall be filled immediately prior to placing the pipe together by buttering the bell end with mortar.
        2) the joint mortar of pipe 18 inch diameter and smaller shall be smoothed and cleaned with a swab.
        3) the joint mortar of pipe diameters larger than 18 inches shall be finished off smooth by hand trowel.
        4) Outside cement mortar joint:
            (a) encircle joint with wrapper after joint found satisfactory.

(b) leave enough space between wrapper ends to allow cement mortar to be poured.
(c) the entire joint shall be poured with cement mortar and consolidated and rodded or agitated to eliminate voids.

E. Cutting:
1. Cut in neat workmanlike manner without damage to pipe.
2. Cut cast-iron with carborundum saw or other approved method.
   a. Smooth cut by power grinding to remove burrs and sharp edges.
   b. Repair lining as required and approved by ENGINEER.

F. Closure Pieces:
1. Connect two segments of pipelines or a pipeline segment and existing structure with short sections of pipe fabricated for the purpose.
2. Observe specifications regarding location of joints, type of joints and pipe materials and strength classifications.
3. May be accomplished with sleeve coupling for water pipe:
   a. Of length such that gaskets are not less than 3 inches from pipe ends.
   b. Include spacer ring identical to pipe end such that clear space does not exceed 1/4 inch.

G. Temporary Plugs:
1. Install whenever installed pipe is left unattended.
2. Use water tight plug.

H. Thrust Blocks:
1. Provide for all horizontal or vertical turns utilizing fittings.
2. Use on all dead-end and tee fittings.
3. Install as indicated on Standard Detail Drawing D-7
4. Construct to undisturbed edge of trench for bearing.
5. Provide minimum bearing area in S.F. as follows based on 150 psi test pressure and 2000 psf soil bearing:

Pipe Size	Plug, T's	11-1/4º Bend	22-1/2º Bend	45º Bend	90º Bend
4"	1.0	.5	.5	.8	1.3
6"	2.2	.5	.9	1.6	3.0
8"	3.8	.8	1.5	2.9	5.3
10"	6.0	1.12	2.3	4.5	8.4
12"	8.5	1.7	3.3	6.5	12.1
14"	11.6	2.3	4.5	8.9	16.4
16"	15.2	3.0	5.9	11.6	21.4
other	Submit Calculations	Submit Calculation	Submit Calculations	Submit Calculations	Submit Calculations

I. VALVE AND APPURTENANCE INSTALLATION:
1. Valves:
   a. Install with stems vertical when installation is horizontal.
   b. Set valves on concrete thrust block having four (4) square feet of bearing area on undisturbed earth.
2. Valve Boxes:
   a. Center on valves.
   b. Carefully tamp earth around each valve box to a distance of 4 feet on all sides of box or to undisturbed trench face, if less than 4 feet.
3. Hydrants:
   a. Set hydrants where shown on plans in accordance with Standard Detail Drawing D-12.
   b. Install gravel, blocks and anchors in accordance with Standard Detail Drawing D-12.

c. Set reference elevation 3 inches above existing grade or to elevation established by ENGINEER (not to exceed 6 inches).
d. Break-a-way flange to be either ground level where applicable or between 3 inches and 6 inches above curb as established by ENGINEER.

3.03 ACCEPTANCE TESTS FOR PRESSURE MAINS:

A. Perform hydrostatic pressure and leakage test.
   1. Conform to AWWA C600 procedures.
      a. As modified herein.
      b. Shall apply to all pipe materials specified.
      c. Perform after backfilling.

B. Test separately in segments between sectionalizing valves, between a sectionalizing valve and a test plug, or between test plugs.
   1. CONTRACTOR to furnish and install test plugs, including all anchors, braces and other temporary or permanent devices to withstand hydrostatic pressure on plugs, at no additional cost to the OWNER.
   2. CONTRACTOR responsible for any damage to public or private property caused by failure of plugs.

C. Limit fill rate of line to available venting capacity. Fill rate shall be regulated to limit velocity in lines when flowing full to not more than 1 fps.

D. OWNER will make water for testing available to contractor at nearest source. Valves of existing system will at all times be operated by Port of Brownsville personnel only.

E. Pressure test:
   1. Conduct at pressure at least 1.5 times than normal working pressure (not less than 150 psi test pressure).
   2. Maintain pressure for a minimum of two (2) hours.
   3. Test pressure shall not vary by more than +5 psil'6 (-- 9C.1Y)

F. Leakage Test:
   1. Conduct concurrently with the pressure test.
   2. Maintain pressure for a minimum of two (2) hours.
   3. Acceptable when leakage does not exceed that determined by the following formula:

$$L = \frac{N \cdot D \cdot P^{0.5}}{7400}$$

      L = Maximum permissible leakage in gallons per hour.
      N = Number of pipe joints in segment under test.
      D = Nominal internal diameter of pipe being tested in inches.
      P = Average actual leakage test pressure, psig.
   4. Repeat leakage test as necessary.
      a. After location of leaks and repair or replacement of defective joints, pipe or fittings.
      b. Until satisfactory performance of test. c. At no increase in cost to the OWNER.

G. Refit and replace all pipe not meeting the leakage or pressure requirements. Repair clamp is not permitted.

H. Repair all visible leaks regardless of the amount of leakage.

I. OWNER or ENGINEER will observe all tests.

3.04 DISINFECTION OF PIPELINES FOR CONVEYING POTABLE WATER:

A. CONTRACTOR provide all equipment and materials and perform in accordance with AWWA C601.
   1. As modified herein.
   2. Include chlorination and final flushing.

B. Add chlorine to attain an initial concentration of 50 mg/l chlorine with 10 mg/l remaining after 24 hours.

C. Flush main until concentration is 2 mg/l or less prior to placing main in service.

D. Obtain approval of materials and methods proposed for use.

E. May be conducted in conjunction with acceptance tests.

F. Dispose of flushing water without damage to public or private property.

G. Repeat disinfection procedure should initial treatment fail to yield satisfactory results.
   1. At no additional cost to the OWNER.
   2. OWNER will provide water under terms specified for acceptance tests.

H. Do not exceed 500 gpm rate in flushing.

I. Provide safe bacterial sample results before placing main into service.

PART 4 - MEASUREMENT AND PAYMENT

4.01 PRESSURE LINES:

A. Line shall be measured along the center of the pipe without considering fittings or other pipe connections. The line will be paid at the contract bid price per linear feet.

B. Compensation will be for furnishing all materials, labor, equipment, tools and incidental work required by the construction of the pressure line, all in accordance with the plans and these specifications.

C. If pressure line fails any test procedure, trouble spot is to be corrected all as incidental to the construction of the pressure line.

END OF SECTION 02556

SECTION 02570 SANITARY SEWER

RELATED REQUIREMENTS SPECIFIED ELSEWHERE

1.01 TRENCHING, BACKFILLING AND COMPACTING: SECTION 02221

A. Water Transmission and/ Pressure Sewers: Section 02556
B. Fiberglass Manholes and Wetwells: Section 02602

1.02 SUBMITTALS

A. Conform to requirements of Submittals.
B. Manufacturer's Literature: Manufacturer's descriptive literature and recommended method of installation.
C. Certificates: Manufacturer's certification that products meet specification requirements.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials on manufacturer's original skids or in original unopened protective packaging. OWNER reserves the right to reject surplus material from a different project/jobsite.
B. Protect materials during transportation, storage, and installation to avoid physical damage.

1.04 GENERAL DESCRIPTION OF WORK COVERED

A. Furnish and install all sewer pipe, fittings and structures, and accessories required for sanitary sewer construction as required by TCEQ Chapter 217 and as specified herein.

1.05 QUALITY ASSURANCE

A. Comply with latest published editions of American Society of Testing and Materials (ASTM) Standards:
   1. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
   2. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
   3. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
   4. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
   5. ASTM F679 - Standard Specification for Poly (Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings.
   6. ASTM D3753 - Standard Specification for Glass Fiber Reinforced Polyester Manholes.
   7. ASTM C-923 - Standard Specification for Resilient Manhole Connectors.
   8. ASTM C-1244 - Specification for Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.
   9. ASTM D-1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds, and Chlorinated Poly (Vinyl Chloride) (CPVC) Compound.
   10. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe 4-inch through 12-inch for water distribution.
   11. AWWA C905 - Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameter 14-inch through 36-inch.
   12. ASTM 2241 - Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR PR Series).

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Provide PVC pipe and fittings as standard material unless specifically identified otherwise on the Drawings. PVC fittings shall have rating and thickness equal to or greater than that for the pipe on which they are installed. Ductile iron fittings are not acceptable and will be rejected unless specifically indicated on the Drawings and approved beforehand by the Utility Engineer.
B. All pipe shall be marked in accordance with applicable standard specification under which pipe is manufactured.

2.02 POLYVINYL CHLORIDE PLASTIC PIPE (PVC)

A. Unless otherwise required for trenchless installation or for water line crossings, provide pipe and fittings complying with ASTM D3034 or ASTM F679, manufactured using material

conforming to ASTM D1784, and having wall thickness equivalent to SDR 26. Joints shall be single elastomeric gasket push-on type complying with ASTM F477 and D3212.

B. Where PVC gravity sewers cross water lines and where indicated on the plans, sewer shall conform to the following standards and have a minimum pressure rating of 150 psi for pipe, joints, and fittings:
   1. AWWA C900 (DR 18)
   2. AWWA C905 (DR 25)
   3. ASTM 2241 (SDR 26)

C. Where PVC gravity sewer is installed using non-encased, trenchless methods, pipe may be one of the following having minimum wall thickness corresponding to SDR 18:
   1. Jointless PVC. Pipe shall conform to the requirements of AWWA C900/C905 and PPI TR2. The pipe shall be extruded with plain ends square to the pipe and free of any bevel or chamfer. Pipe shall be Fusible C900™ or Fusible C905™ as manufactured by Underground Solutions, Sarver, PA.
   2. Restrained Joint PVC. Couplings shall be non-metallic and incorporate high-strength, flexible thermoplastic splines which shall be inserted into mating, precision-machined grooves in the pipe and coupling to provide full 360º restraint with evenly distributed loading. Couplings shall be designed for use at or above the pressure class/rating of the pipe with which they are installed and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F 477. Joints shall be designed to meet the zero leakage test requirements of ASTM D3139. Pipe shall be C900/RJ™ or C905/RJ™ as manufactured by CertainTeed Corporation, Valley Forge, PA.

D. All PVC pipe for sewer service shall be green in color.

E. Lubricant for jointed pipe to be in accordance with the requirements of ASTM D3212. Lubricant to be suitable for lubricating the parts of the joints in the assembly. The lubricant shall not have any deteriorating effects on the gasket and pipe materials.

F. Service laterals shall be Schedule 40 PVC in accordance with ASTM D1785 and D2665.

G. Mark all pipe and fittings.

2.03 DUCTILE IRON PIPE AND FITTINGS

A. Ductile iron pipe and fittings for sanitary sewer service shall be provided only where specifically indicated on the Drawings or in the Proposal or Contract Documents.

B. Comply with the latest published edition of American Water Works Association (AWWA) Standards:
   1. AWWA C110 & C110a - Gray Iron and Ductile-Iron Fittings, 2-inch through 48-inch for water and other liquids.
   2. AWWA C111 - Rubber Gasket Joints for Cast Iron Pressure Pipe and Fittings.
   3. AWWA C150 - Thickness Design of Ductile-Iron Pipe.
   4. AWWA C151 - Ductile-Iron Pipe, centrifugally cast in metal mold or sand lined molds, for water or other liquids.
   5. AWWA C153 - Ductile Iron Compact Fittings, 3-inch through 12-inch for water and other liquids.
   6. Polyethylene encasement for the protection of ductile and cast iron pipes, fittings valves, and appurtenances shall be furnished and installed in accordance with the requirements of AWWA C105.

C. Linings and Coatings
   1. Interior Lining: Ductile iron pipes, fittings, valves, and appurtenances for sanitary sewer service shall be furnished with corrosion resistant interior lining furnished by the manufacturer. Lining shall be ceramic-epoxy "Protecto 401" as manufactured by Induron Protective Coatings and applied by certified applicator.
   2. Exterior Coating: Buried ductile iron pipe and fittings shall have a prime coat and outside asphaltic coating conforming to the applicable AWWA standard for the pipe or fitting being installed. Pipe to be installed in potentially contaminated areas shall have coatings and linings recommended by the manufacturer and approved by the Engineer as resistant to the contaminants identified. Refer to Section 02556 for requirements related to above-ground or exposed ductile iron piping.

2.04 MANHOLES, STRUCTURES AND PIPE ACCESSORIES

A. Fiberglass Manholes
   1. Fiberglass manholes shall be in accordance with ASTM D3753. Refer to Section 02602 FIBERGLASS MANHOLES AND WETWELLS for manhole structure requirements.
   2. Manhole shall be of one-piece design including bottom, invert, bench, barrel, cone, and stubouts.
   3. The inside diameter of the manhole barrel shall be either 48-inches or 1.5 times the nominal pipe diameter of the largest pipe, which ever is larger, or as indicated on the Drawings.
   4. A concentric cone over the barrel of the manhole shall have an internal, clear opening diameter as required to accommodate grade adjustment rings and a frame and cover with a 30-inch clear opening. Cone shall have minimum 4-inch wide brick ledge.
   5. Pipe Connections: Connections to manholes shall be via factory-installed pipe stubouts of length equal to the pipe diameter or 12 inches, whichever is greater. Attachment of pipe to stubouts shall be by means of a bell-and-spigot pipe segment having the same material and rating of the pipe to be connected. Outlet stubouts and drop connection stubouts shall be spigot end; inlet stubouts shall be bell end.
   6. Bottom, Invert, and Bench:
      a. The bottom of the manhole shall be designed to withstand the hydrostatic head pressure, empty and water-to-grade, and include a 3-inch wide anchoring flange for embedment in the concrete slab foundation.
      b. The invert shall be a "U" shaped channel that is a smooth continuation of the inlet and outlet pipes. Channel dimensions shall be as follows based on outlet pipe diameter:
         1) 12-inch and smaller: channel depth shall be at least 1/2 the outlet diameter.
         2) 15 to 24-inch: channel depth shall be at least 3/4 the outlet diameter.
         3) 24-inch and greater: channel depth shall be at least equal to the outlet diameter.
      c. In manholes with pipes of different sizes, the crown of the pipes shall be placed at the same elevation and flow channels in the invert shall be evenly sloped from pipe to pipe.
      d. The bench provided above the channel shall be sloped at a minimum of 1-inch per foot.
      e. Invert and bench shall be constructed of non-corrosive materials encapsulated in minimum ¼” thick fiberglass.

B. Fittings
   1. Fittings allowed only on manhole/wetwell drop connections.
   2. Fittings shall equal or exceed quality and rating of pipe.
   3. Fittings shall be heavy wall PVC conforming to ASTM D3034 (SDR 26) and F1336.
   4. Joints shall be single elastomeric gasket push-on type complying with ASTM F477 and D3212. Gaskets shall meet the same performance requirements of the sewer pipe to be installed.

C. Manhole Accessories
   1. Manhole Frame and Cover:
      a. Frames and covers shall conform to the requirements of AASHTO standard M-306, be designed for H-25/HS-25 loading, and be proof-load tested to 74,000 lbs. Refer to the standard details for dimensional requirements.
      b. Frame shall be gray cast iron conforming to AASHTO M 105 Class 35B or ASTM A48 Class 35B. Frame clear opening shall be 30 inches. Frame shall have a 1” mud ring to ensure proper centering on grade rings.
      c. Cover shall be ductile iron conforming to ASTM A536 Grade 80-55-06, weigh no more than 150 lbs, and shall be cast with the City of Brownsville logo and designation of “SANITARY SEWER”.
      d. Provide anchor bolt holes for manholes required to be bolted where indicated.
      e. Frame and covers shall be as manufactured by East Jordan Iron Works or equal.
      f. Manhole openings shall be 30” diameter.
   2. Manhole Grade Adjustment Rings:

a. For final grade adjustment, provide a minimum of two grade rings (5" min. total) between cone seating surface (brick ledge) and frame up to a maximum total of 15 inches. Frames shall not be set directly on fiberglass cone. Adjustment rings shall be High Density Polyethylene grade rings, nominal 34-inch size, as manufactured by LadTech® or approved equal.
b. Each ring face shall be sealed to adjacent rings, manhole cone, and cast iron frame using 1/2-inch minimum butyl rope sealant (ASTM C990) in strict accordance with manufacturer's instructions to provide an airtight seal.

3. Coating: Internal surfaces of iron ring and cover shall be coated with coal tar. Coatings shall be installed and applied in accordance with the manufacturer's instructions and as approved by Engineer.
4. Infiltration Inserts (Rain Guards): Provide infiltration insert to fit the manhole frame rim upon which the manhole cover rests.
   a. Insert body shall be made of high density polyethylene copolymer material that meets ASTM D 1248, Class A, Category 5, Type III. Minimum thickness 1/8-inch.
   b. Gasket shall be of closed cell neoprene and have pressure sensitive adhesive on one side and be placed under the weight-bearing surface of the insert by the manufacturer.
   c. Lift strap of 1-inch woven polyethylene (seared on all cut ends to prevent unraveling. Strap shall be attached to the rising edge of the bowl off the insert by means of stainless steel rivet and washer.
   d. Vent shall have 1/8-inch hole located on the side wall of the insert 3/4-inch below the lip.
   e. Load capacity insert shall have certified test data verifying minimum collapse load of 1500 lbs. minimum applied to a 5.50-inch square area in the center of the insert.

PART 3 - EXECUTION

3.01 GENERAL

A. Provide all labor, equipment and materials and install all pipe, fittings, specials and appurtenances as indicated or specified.
B. Verify the elevation and location all tie-in points and other critical elevations prior to construction.

3.02 PIPE INSTALLATION

A. Handling
   1. Handle in a manner to insure installation in sound and undamaged condition.
      a. Do not drop or bump.
      b. Use slings, lifting lugs, hooks and other devices designed to protect pipe, joint elements, and coatings.
   2. Ship, move and store with provisions to prevent movement or shock contact with adjacent units.
   3. Handle with equipment capable of work with adequate factor of safety against overturning or other unsafe procedures.
B. Installation
   1. Installation, jointing and testing of pipe, fittings, and accessories shall be in accordance with the provisions of the applicable reference standard and in accordance with the requirements of this specification and related specifications referenced or contained in the contract documents for pressure or gravity sewers.
   2. Lay pipe with uniform grade and straight alignment between manholes.
      a. Maximum allowable deviation from uniform grade between manholes is 1.0 inches.
      b. Maximum allowable deviation from straight alignment between manholes is 3.0 inches.
   3. Utilize equipment, methods, and materials insuring installation to lines and grades as indicated.
      a. Do not lay on blocks unless pipe is to receive total concrete encasement.
      b. Use laser or minimum of 3 batter boards for control of line and grade.

c. Obtain approval from Engineer for method proposed for transfer of line and grade from control to the work.

4. Install pipe of size, material, strength class, and joint type with embedment shown for plan location.
5. Insofar as possible, commence laying of pipe at downstream end of line, and, install pipe with bell ends in direction of pipe laying. Sewer pipe shall have spigot ends on the downstream end. Deviations therefrom must be approved in writing beforehand by the Utility Engineer.
6. Clean interior of all pipe, fittings and joints prior to installation. Exclude entrance of foreign matter during discontinuance of installation.
   a. Close open ends of pipe with snug fitting closures.
   b. Do not let water fill trench. Prevent flotation of pipe where potential for trench flooding is present.
   c. Remove water, sand, mud and other undesirable materials from trench before removal of end cap.
7. Inspect pipe prior to installation to determine if any pipe defects are present.
8. Brace or anchor as required to prevent displacement after establishing final position.
9. Perform only when weather and trench conditions are suitable. Do not lay pipe in water.
10. Observe extra precaution when hazardous atmospheres might be encountered.
11. Sanitary sewer separation distance from water mains:
    a. Maintain 9-foot horizontal separation whenever possible.
    b. When conditions prevent a lateral separation of 9 feet, sewer may be installed closer to a water main subject to the following:
       1) Crossings: sewer shall be constructed of PVC pipe meeting the requirements of AWWA C900/C905 or ASTM 2241 and have a minimum working pressure rating of 150 psi or greater for pipe and fittings. The sewer may be placed no closer than 6 inches from the water line. The separation distance shall be measured between the nearest outside pipe diameters. The sewer line shall be located at a lower elevation than the water line whenever possible and one length of the sewer pipe must be centered on the water line;
       2) Parallel Alignment: the sewer line and water main shall be separated by a minimum vertical distance of 2-feet (water line above sewer) and a minimum horizontal distance of 4-feet, measured between the nearest outside diameters of the pipes.
12. Separation of water lines from sewer manholes:
    a. No water pipe shall pass through or come in contract with any part of a sewer manhole.
    b. A minimum horizontal separation of 9 feet shall be maintained.
13. Auger or jack casing pipe in place where shown on plans.

C. Jointing
   1. General requirements:
      a. Locate joint to provide for differential movement at changes in type of pipe embedment, at changes from rock to soil trench bottom, and within 18 inches of structure walls or manholes.
      b. Perform in accordance with manufacturer's recommendations.
      c. Clean and lubricate all joint and gasket surfaces with lubricant recommended.
      d. Utilize methods and equipment capable of fully homing or making up joints without damage.
      e. Check joint opening and deflection for specification limits.

D. Closure Pieces
   1. Connect two segments of pipelines or a pipeline segment and existing structure with short sections of pipe fabricated for the purpose.
   2. Observe specifications regarding location of joints, type of joints and pipe materials and strength classifications.
   3. May be accomplished with sleeve coupling of rating equal to or greater than that of pipe:
   4. Of length such that gaskets are not less than 3 inches from pipe ends.

5. Include spacer ring identical to pipe end such that clear space does not exceed ¼ inch.

E. Temporary Plugs
1. Furnish and install temporary plugs at each end of work for removal by others where indicated.
2. Remove plug on existing line to perform tie-in indicated in coordination with Utility operations staff.
3. Plugs:
   a. Use test plugs as manufactured by pipe supplier, or
   b. Fabricate by Contractor of substantial construction.
   c. Must be watertight against heads up to 20 feet of water.
   d. Secure in place in a manner to facilitate removal when required to connect pipe.

3.03 MANHOLE INSTALLATION

A. Install fiberglass manholes and appurtenances in strict accordance with manufacturer's recommendations. Refer to Section 02602 for additional installation requirements.

B. Concrete manhole base shall be formed and poured in place or above ground with lifting hooks. Concrete base shall be reinforced. See standard details shown on the Drawings.

C. Heat materials for casting in place in freezing weather and protect work from cold; maintain temperature of work at 40° F. for at least 24 hours after placing.

D. Drop Connections: A drop connection as shown on the Drawings shall be provided for a sewer entering a manhole more than 24-inches above the invert or as shown on the plans for special conditions.
1. Drop pipe shall be of the same material and size as sewer pipe.
2. Drop shall be constructed on the outside of the manhole using compatible PVC fittings to provide a smooth drop and a clean out leg as shown on the detail drawings. The drop shall constructed to match its crown elevation to the crown elevation of the outlet pipe.
3. The drop pipe shall be encased with 100 psi flowable fill or cement stabilized sand. Cement encasement shall extend from the bottom of the manhole concrete base up to the bottom of the inlet sewer pipe or as shown otherwise on the Drawings.
4. The manhole concrete base shall be extended to completely underlie the drop.
5. Internal drops are not allowed.

E. Pipe Connections
1. All connections shall be made to factory-installed stubouts except drop connection clean-out legs which may be field fabricated using fiberglass layup for sizes 15-inch and smaller.
2. Cutting of the manhole wall for field installation of stubouts shall be by means of a masonry saw only and cutouts shall be no greater than 1/2-inch larger than the pipe diameter. All other methods are not allowed.
3. All connections to be subject to manhole vacuum testing.
4. Construction of manholes over existing pipe shall be made by cutting and removing pipe segment, setting the manhole and foundation, and connecting pipe to manhole subouts using appropriate couplings.
5. Coordinate flow stoppages with the Engineer and Utility operations personnel 48 hours prior to installing manholes on existing lines.
6. Setting manholes with doghouse cut-outs over existing pipeline is not allowed except in special cases where specifically required by the Drawings AND approved by the Utility Engineer. In such cases, the manhole shall be installed over existing pipe and sealed tight by working the foundation concrete over the top of pipe to a minimum depth of 6 inches. Install a continuous strip of hydrophilic waterstop around the pipe circumference on the exterior side of the manhole prior to placement of concrete to provide a continuous waterstop between pipe and concrete.

F. Exterior Pipe Support (Rigid Pipe): Provide pipe joint within 18 inches of manhole wall or support vitrified clay pipe on reinforced concrete cradle integral with manhole foundation to first joint on each side of manhole as indicated.

G. Coatings shall be applied after Engineer's approval of structure.

3.04 ACCEPTANCE TESTS FOR SEWER PIPELINES

A. General

1. Lines shall pass a leakage and deflection test. A low pressure air test shall be used for leakage testing. Deflection testing shall be by passage of an approved mandrel.
2. If infiltration is observed, lines will be rejected regardless of air test results.
3. After backfilling and removing debris from each section of sewer line, conduct line acceptance tests under observation of the Engineer. Copies of all test results shall be made available to the Engineer upon request.
4. Perform test on piping systems including piping installed between or connected to existing pipe.
5. Conduct tests on buried pipe after the trench is completely backfilled but before any surface course of permanent pavement is installed. If field conditions permit and if approved by the Engineer, partially backfill the trench and leave the joints open for inspection and for conducting the initial service leak test. Do not conduct the acceptance test until backfilling is complete.
6. On exposed, non-buried piping, conduct the test after the piping is completely installed, including supports, hangers, and anchors.
7. Do not perform testing on pipe with concrete thrust blocking until the concrete has cured at least five (5) days.
8. Determine and remedy the cause of the excessive leakage for any pipe failing to meet the specified requirement for water or air tightness, and retest until the installation is proven satisfactory.
9. Tests must be successfully completed and reports filed before piping is accepted. Submit test reports to the Engineer. Any failed tests will need to be corrected at the Contractor's expense.
10. Submit the plan for testing to the Engineer for review at least 10 days before starting a test.
11. Remove and dispose of temporary blocking material and equipment after completion and acceptance of the piping test.
12. Repair any damage to the pipe coating.
13. Clean pipelines so they are completely free of debris, mud, or soil prior to final acceptance.
14. Test piping independently from tests on structures.

B. Low Pressure Air Test
   1. Perform low-pressure air tests, using equipment specifically designed and manufactured for the purpose of testing sewer pipelines using low-pressure air.
   2. Pipelines 27-inch and smaller: Air test shall conform to either the procedure described in ASTM F 1417 or the procedure described below for 30-inch lines and larger.
      a. Provide the equipment with an air regulator valve or air safety valve set to an internal air pressure in the pipeline that cannot exceed 6 psig. Monitoring pressure gauge shall have minimum divisions of 0.10 psi with an accuracy of ±0.04 psi.
      b. Pass air through a single control panel.
      c. Provide pneumatic plugs that have a sealing length equal to or greater than the circumference of the pipe to be tested.
      d. Provide pneumatic plugs that resist internal test pressures without requiring external bracing or blocking.
      e. Provide an air compressor of adequate capacity for charging the system.
      f. Check air connections for leakage with a soap solution. If leaks are found, release the air pressure, repair the leak, and retest with soap solution until results are satisfactory, before resuming air test.
      g. Introduce low pressure air until internal air pressure is 4.0 psi greater than the average back pressure of ground water above the pipe flow line. Unless demonstrated otherwise in a test pit, ground water shall be assumed at the natural ground surface.
      h. Allow two minutes for air pressure to stabilize, and then disconnect air supply hose from the control panel.

i. The minimum allowable time for the pressure to drop from 3.5 psig to 2.5 psig greater than average back pressure of any ground water above the pipe shall be determined as follows:
   1) K = 0.000419·D·L or 1.0, whichever is greater
      (a) T = time in seconds for the pressure to drop 1.0 psi
      (b) D = average inside diameter in inches
      (c) L = length of line of the same pipe size in feet
      (d) Q = 0.0015 cubic feet per minute per square foot of internal surface.

j. Alternately, the following table may be used to calculate allowable times based on the preceding formula:

Pipe Diameter (inches)	**Minimum Time** (i.e. K = 1.0) (seconds)	**Length for Minimum Time** (i.e. K = 1.0) (feet)	**Time for Long Length** (i.e. K > 1.0) (seconds)
6	340	398	0.855 (L)
8	454	298	1.520 (L)
10	567	239	2.374 (L)
12	680	199	3.419 (L)
15	850	159	5.342 (L)
18	1020	133	7.693 (L)
21	1190	114	10.471 (L)
24	1360	100	13.676 (L)
27	1530	88	17.309 (L)
30	1700	80	21.369 (L)
36	2040	66	30.768 (L)

C. Pipelines 30-inch and larger: Air test individual joints.
   1. Perform test using a testing device (packer) that is:
      a. Capable of isolating individual joints by creating a sealed void space around the joint being tested.
      b. Constructed such that low pressure air can be admitted into the void area.
      c. Contain a pressure gauge accurate to 0.1 psi in-line with the air supply line to monitor the void pressure.
      d. Center the tester on the joint, ensuring the joint will not be obstructed during the test.
      e. Inflate sleeves on each end of the tester.
      f. Pressurize the joint to 4.0 psi greater than the average back pressure of ground water above the pipe flow line.
      g. Shut off and disconnect the air supply once the pressure has stabilized.
      h. The test shall be considered to have passed if the pressure drops no more than 0.5 psi in 30 seconds.

D. Deflection Testing
   1. Perform deflection tests on flexible and semi-rigid pipe in accordance with ASTM D3034.
      a. Perform test by pulling a mandrel through the line to demonstrate deflection does not exceed the following limits:

Pipe Diameter	Maximum Deflection	Mandrel Size (% Pipe ID)
8” – 15”	5%	95%
18” – 17”	3%	97%
30” and Larger	2%	98%

E. Mandrel shall meet the requirements of TCEQ Chapter 217. Mandrel dimensions shall be determined based on the published average internal pipe diameter. Standard mandrels designed for pipe of larger dimension ratio (thinner wall) are not allowed (e.g. SDR 35).

F. Conduct test after the final backfill has been in place a minimum of 30 days.

G. Thoroughly clean the lines before testing.
H. Use no mechanical pulling devices.
I. Uncover all irregularity or pipe deformation exceeding the allowable limits. Replace all damaged pipe, re-round non-damaged pipe, and tamp the embedment and initial backfill.
J. Any pipe removed shall be replaced by use of gasketed repair couplings having a rating equal to or exceeding the pipe being joined/repaired.
K. Conduct deflection test in the presence of the Owner's or Engineer's representative.
L. When pipeline must be placed into service prior to 30 days after final backfill, perform the deflection test using a mandrel that will not pass more than one-half of the deflection limit specified in the table above or as otherwise approved by the Engineer.

3.05 ACCEPTANCE TESTS FOR SEWER MANHOLES

A. Manhole Testing: Successful passage of a vacuum test shall be required for acceptance of sanitary sewer manholes and sanitary sewer structures. If a manhole fails a leakage test or visible leaks are observed, the manhole must be repaired, made watertight, and retested.
    1. Vacuum testing shall be performed in accordance with the requirements of ASTM C-1244, Specification for Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.
        a. Perform test after installation with all connections in place. Final acceptance in accordance with the requirements of this specification will consist of a vacuum test of the completed and backfilled manhole including manhole, adjustment rings, and manhole frame and cover.
        b. Materials: Vacuum testing apparatus shall consist of a minimum of the following: Engine, Vacuum Pump, Hose, Test Head device capable of sealing opening in manhole frame as required, and Pneumatic Test Plugs having a sealing length equal to or greater than the diameter of the connecting pipe to be sealed.
        c. Test Procedure:
            1) The test head shall be placed at the top of the manhole frame in accordance with the manufacturer's recommendations.
            2) A vacuum of 10 in. of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off.
            3) The vacuum pressure shall be monitored for a period of 120 seconds. The test shall be considered to pass the vacuum test if the vacuum reading drops no more than 0.5 inches of mercury.
            4) If the manhole fails the initial test, necessary repairs shall be made by an approved method. The manhole shall then be retested until a satisfactory test is obtained.
        d. Testing and Certification: Testing shall be done by the contractor and witnessed by the Engineer or his representative. All manholes and structures shall be tested as finished and completed for final acceptance. Any defective work or materials shall be corrected or replaced by the Contractor and retested. This shall be repeated until all work and materials are acceptable.
B. Manhole Survey
    1. Manholes shall be subject to a post-construction survey for centerline location and invert elevations.
    2. The maximum allowable vertical tolerance is 1/3-inch per 100 horizontal feet.
    3. In no event will reverse grade of any magnitude be accepted.
    4. Manholes that do not meet the specified elevations shall be reinstalled, and connecting pipelines upstream and downstream shall be re-installed to up to the nearest conforming manhole. Re-installed work must be re-tested.
    5. Manholes, pipe, and appurtenances damaged during re-excavation shall be replaced with new materials.

3.06 SERVICE CONNECTIONS

A. Install service connections at each dwelling or business place, or as directed by Engineer.
B. Services wyes: Install wyes of minimum 4-inch diameter unless shown otherwise on plans. See standard details on the Drawings.
C. Clean Outs: Provide clean out inside the Right of Way at the property line for each service line.

D. Risers: Use risers in lieu of wyes for service connections where invert of sewer is 15 feet or more below ground surface or where shown on plans.
E. Place suitable stopper in end of connection, cement stopper in place with cold bituminous joint compound.
F. Backfill trench only after recording exact location of service connection. Place Engineer-approved marker tape above service piping in excavation within 3-feet of the surface.
G. Make no connections to house sewers or extend service connections beyond the limits shown on the Drawings or indicated in the specifications without written permission of Engineer.
H. Backfill trench only after entire service line and wye connection has been inspected and approved by Engineer. Compact as specified in Section 02221 TRENCHING, BACKFILLING AND COMPACTING.
I. Street crossings shall have a minimum of 3 feet of cover to sub-grade.
J. No payment for service lines will be made until all specified requirements have been met.

3.07 CONNECTIONS TO EXISTING SEWERS

A. Connect existing sanitary service drains which cross new sewer line using Wyes of the same size as the new line and service drain.
B. Connect no storm drains to sewers.
C. Connections to existing manholes:
    1. Cut hole in existing manhole at required elevation using appropriately sized hole saw. All other means of cutting are not allowed unless approved by the Engineer.
    2. New pipe shall protrude from the manhole wall no more than 2 inches.
    3. Complete connection using watertight compression connection or by fiberglass layup surrounding the entire connection on inside and outside of manhole. Fiberglass layup shall be in conformance with manhole manufacturer's standard recommendations.
    4. At concrete manholes, grout new pipe in place.
    5. Reconstruct manhole bottom to suit new connection.

3.08 PART 4 - MEASUREMENT AND PAYMENT

3.09 SANITARY SEWER PIPE

A. Sanitary sewer pipe shall be measured from center of manhole to center of manhole or end of line. The sewer pipe shall be measured along the center of the pipe without considering fittings or other pipe connections. Sanitary sewer pipe will be paid at the contract bid price per linear foot, complete in place at various depths for the type, size and depth constructed.
B. Compensation will be for furnishing all materials, labor, equipment, tools and incidentals required by the construction of the sanitary sewer pipe, all in accordance with the Drawings and specifications.
C. If sanitary sewer pipe fails or does not pass required tests, Contractor shall remove and replace that part of the sewer pipe at no cost to the Owner.

3.10 SANITARY SEWER MANHOLE

A. Sanitary sewer manhole will be measured from the top of the ground to the sanitary sewer invert. Manholes shall be paid at the contract bid price per each at the various depths or as described in the bid proposal form. The size shall be the nominal inside diameter.
B. Compensation will be for furnishing all materials, labor, equipment, tools and incidentals required including excavation, dewatering, concrete foundation, backfill, removal and disposal of excess material, frame and cover, manhole insert, grade rings, testing, and any specified protective coatings if not included as a separate pay item.

END OF SECTION 02570

SECTION 02601 FLEXIBLE BASE

PART 1 - GENERAL

1.01 GENERAL DESCRIPTION OF WORK:

1. This work shall consist of furnishing and placing a foundation course for surface courses or for other base courses.
2. Flexible base shall be composed of either caliche (argillaceous limestone, calcareous or calcareous clay particles, with or without stone, conglomerate, gravel, sand or other granular materials), crushed stone, gravel, crushed gravel, iron, or topsoil, shell, or crushed slag.
3. Flexible base shall be constructed as specified herein in one or more courses in conformance with typical sections, details, lines and grades shown on the plans, or as established by the ENGINEER.

PART 2 - PRODUCTS

2.01 MATERIALS

1. Materials for flexible base shall be crushed or uncrushed as necessary to comply with the requirements hereinafter specified.
2. Materials shall consist of durable course aggregate particles mixed with approved binding materials.

2.02 Physical Requirements:

1. All types shall meet the physical requirements for the specified grade(s) as set forth in Table 02601-1.
   Additives, such as, but not limited to, lime, cement or fly ash, shall not be used to alter the soil constants or strengths shown in Table 02601-1, unless otherwise shown on the plans.
   Unless otherwise shown on the plans, the base material shall have a minimum Bar Linear Shrinkage of 2 percent as determined by Test Method Tex-107-E, Part II.
2. The flexible base shall be one of the following types, as follows:
   a) **Type A** - Crushed or broken stone produced form oversized quarried aggregate (excluding gravel aggregate), sized by crushing and produced from a naturally occurring single source. No blending of sources and/or additive materials will be allowed in Type A material.
   b) **Type B** – Crushed or Uncrushed Gravel Aggregate
   c) **Type C** – Crushed Gravel, having minimum of 60 percent of the particles retained on the No. 4 sieve with two (2) or more crushed faces as determined by Test Method Tex-460-A, Part I.
   d) **Type D** – Caliche

Unless otherwise noted on the plans, the CONTRACTOR may use any one type of these types provided the material used meet the requirements set forth in the specification test limits herein.

TABLE 02601-1
PHYSICAL REQUIREMENTS FOR FLEXIBLE BASE MATERIALS

GRADE 1		**GRADE 2**		**GRADE 3**	
Triaxial Class 1: Min. Compressive strength, psi 45 at 0 psi lateral pressure and 175 at 15 psi lateral pressure		Triaxial Class 1 to 2.3: Min. compressive strength, psi: 35 at 0 psi lateral pressure and 175 at 15 psi lateral pressure		Triaxial Class – Unspecified	
Master Grading		Mater Grading		Master Grading	
1 ¾”	0	2 ½”	0	2 ½”	0
7/8”	10-35	1 ¾”	0-10	1 ¾”	0-10
3/8”	30-50	No. 4	45-75	No. 4	30-75
No. 4	45-65	No. 40	60-85	No. 40	50-85
No. 40	70-85				
Max LL	35	Max LL	40	Max LL	40
Max PI	10	Max PI	12	Max PI	12
Wet Ball Mill		Wet Ball Mill		Wet Ball Mill	
Max	40	Max	45	Max	50
Max increase in passing		Max increase in passing		Max increase in passing	
No. 40	20	No. 40	20	No.	4020

GRADE 4		**GRADE 5**		**GRADE 6**	
Triaxial Class Unspecified		Triaxial Class Unspecified		Triaxial Class 1: Min. 150 at 15 psi lateral pressure.	
Master Grading		Master Grading		Master Grading	
1 ¾”	0	1 ¾”	0	2”	0
No. 4	45-75	No. 40	50-85	1/2”	20-60
No. 40	50-85			No. 4	40-75
				No. 40	75-85
Max LL	40	Max LL	40	Max PI	15
Max PI	12	Max PI	12	Max. Wet Ball PI	15
				Wet Ball Mill	
				Max	50

Notes:

1) Gradation requirements are percent retained on square sieves.
2) When a magnesium soundness value is shown on the plans the material will be tested in accordance with Test Method Tex-411-A.
3) When lightweight aggregates are used, the wet ball mill requirements will not apply and the lightweight aggregates shall meet the Los Angeles Abrasion, Pressure Slaking and Freeze Thaw requirements of Item 303, “Aggregate for Surface Treatment (Lightweight)” TxDOT Standard Specifications.

3. Unless otherwise shown on the plans or directed by the ENGINEER, the final course of base material shall consist of Grades 1, 2, 3, 4, 5, or 6 as specified in Table

02601-1.

4. Base courses or sub-base materials, unless otherwise noted on the plans or directed by the ENGINEER, may consist of Grades 1, 2, 3, 4, 5, or 6 as specified in Table 02601-1.
5. All grades shall, when tested in accordance with standard laboratory test procedures, meet the physical requirements set forth in Table 02601-1.
6. Testing of flexible base materials shall be in accordance with the following test procedures:

TEST	**TESTING PROCEDURE**
Moisture Content	TEX-103-E
Liquid Limit	TEX-104-E
Plasticity Index	TEX-106-E
Bar Linear Shrinkage	TEX-107-E, Part II
Sieve Analysis	TEX-110-E
Moisture Density Determination	TEX-113-E
Roadway Density	TEX-115-E
Wet Ball Mill	TEX-116-E
Triaxial Tests (Part I or II as selected by the Engineer)	TEX-117-E
Particle Count	TEX-460-A, Part I

7. Unless otherwise shown on the plans, the limits establishing reasonably close conformity with the specified gradation and plasticity index are defines by the following:
   a) Gradation. The Engineer may accept the material, providing not more than one (1) out of the most recent five (5) consecutive gradation tests performed are outside the specified limits for master grading, on any individual sieve by no more than five (5) percentage points.
   b) Plasticity Index. The engineer may accept the material providing not more than one (1) out of the most recent five (5) consecutive plasticity index samples tested are outside the specified limit by no more than two (2) percentage points.
8. Unless otherwise specified on the plans, samples for testing the base material for Triaxial class, Soil constants, Gradation and Wet Ball Mill shall be taken prior to the compaction operations.
9. Unless otherwise specified on the plans, samples for triaxial tests shall be taken from the stockpile or from production, as directed by the ENGINEER, where stockpiling is required and from production where stockpiling is not required.

2.03 STOCKPILING:

1. When specified on the plans, the material shall be stockpiled prior to delivery on the road. The stockpile shall be not less than the height indicated and shall be made up of layers of material not to exceed the depth shown on the plans.
2. Unless otherwise shown on the plans, the stockpile shall not be less than 10 feet in height and shall be made up of layers not greater than two (2) feet in thickness.

After a sufficient stockpile has been constructed the Contractor may proceed with loading from the stock pile for delivery.

3. In loading form the stockpile for delivery to the road, the material shall be loaded by making successive vertical cuts through the entire depth of the stockpile.
4. Blending of materials from more than one (1) source to produce Type B, C or D flexible base will be allowed when approved by the Engineer.
5. The materials shall be combined in a central mixing plant in the proportions determined by the ENGINEER to produce a uniform mixture which meets all of the requirements of the specification. In the event that combinations of the materials produced fail to meet all of the specification requirements, the CONTRACTOR will be required to secure other materials which will meet specifications requirements.
6. The central mixing plant shall be either the batch or continuous flow type, and shall be equipped with feeding and metering devices which will add the materials into the mixer in the specified quantities.
7. Mixing shall continue until a uniform mixture is obtained.
8. Any stockpile that has been sampled and accepted shall not have material added or removed unless otherwise approved by the Engineer.
9. The Contractor will be charged for additional sampling and testing required as a result of material being removed from a previously approved stockpile without the approval of the Engineer. Such charges will be deducted from the Contractor's estimates.

PART 3 - EXECUTION

3.01 PREPARATION OF SUBGRADE

1. Type roadbed shall be excavated and shaped in conformity with the typical sections shown on the plans and to the lines and grades as established by the ENGINEER.
2. All unstable or otherwise objectionable material shall be removed from the subgrade and replaced with approved material.
3. All holes, ruts and depressions shall be filled with approved material and, if required, the subgrade shall be thoroughly wetted with water and reshaped and rolled to the extent directed in order to place the subgrade in an acceptable condition to receive the base material.
4. The surface of the subgrade shall be finished to line and grade as established and in conformity with the typical section shown on the plans, and any deviation in excess of 2 inch in cross section and in a length of 16-feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.
5. Sufficient subgrade shall be prepared in advance to insure satisfactory prosecution of the work.
6. Material excavated in the preparation of the subgrade shall be utilized in the construction of adjacent shoulders and slopes or other-wise disposed on as directed, and any additional material required for the completion of the shoulders and slopes shall be secured from sources indicated on plans or as directed by the ENGINEER.
7. When shown on the plans and directed by the Engineer, the Contractor shall proof roll the roadbed in accordance with the provisions of section 02786, "Proof Rolling". Soft spots shall be corrected as directed by the Engineer.

3.02 PLACEMENT OF FIRST COURSE - TYPE A, TYPE B, TYPE C, AND TYPE D MATERIAL:

1. Immediately before placing the base material, the subgrade shall be checked as to conformity with grade and section.
2. The material shall be delivered in approved vehicles of a uniform capacity, and it shall be the charge of the CONTRACTOR that the required amount of specified material shall be delivered in each 100-foot station.
3. Material deposited upon the subgrade shall be spread and shaped the same day.

4. In the event inclement weather or other unforeseen circumstances render impractical the spreading of the material during the first 24-hour period, the material shall be scarified and spread as directed by the ENGINEER.
5. The material shall be sprinkled, if directed, and shall than be bladed, dragged and shaped to conform to typical sections as shown on the plans.
6. All areas and "Nests" of segregated coarse or fine material shall be corrected to removed and replaced with well graded material, as directed by the ENGINEER.
7. If additional binder is considered desirable or necessary after the material is spread and shaped, it shall be furnished and supplies in the amount directed by the ENGINEER. Such binder material shall be carefully and evenly incorporated with the material in place by scarifying, harrowing, brooming or by other approved methods.
8. The course shall be compacted by method of compaction hereinafter specified as the "Ordinary Compaction" method or the "Density Control" method of compaction as indicated on the plans, or as directed by the ENGINEER.
    a) When the "Ordinary Compaction" method is to be used, the following provisions shall apply:
        i) The course shall be sprinkled as required and rolled as directed until a uniform compaction is secured. Throughout this entire operation, the shape of the course shall be maintained by blading and the surface upon completion shall be smooth and in conformity with the typical sections shown on the plans and to established lines and grades.
        ii) In that area on which pavement is to be placed, any deviation in excess of 1/4 inch in cross section in a length of 16-feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping, and recompacting by sprinkling and rolling.
        iii) All irregularities, depressions or weal spots which develop shall be corrected immediately by scarifying the areas affected, adding suitable material as required, reshaping and recompacting by sprinkling and rolling.
    b) When the "Density Control" method of compaction is to be used, the following provisions shall apply:
        i) The course shall be sprinkled as required and compacted to the extent necessary to provide not less than the percent density as hereinafter specified under "Density" as determined by Test Method Tex-113-E
        ii) In addition to the requirement specified for density, the full depth of the flexible base shown on the plans shall be compacted tot he extent necessary to remain firm and stable under construction equipment.
        iii) After each section of flexible base is completed, tests as necessary will be made by the ENGINEER in accordance with Test Method Tex-115-E. If the material fails to meet the density requirements, it shall be reworked as necessary to meet this requirement.
        iv) Throughout this entire operation, the shape of the course shall be maintained blading, and the surface upon completion shall be smooth and in conformity with the typical sections shown on the plans and to established lined and grades.
        v) In that area on which pavement is to be placed, any deviation in excess of 1/4 inch in cross section in a length of 16 feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.
        vi) All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding suitable material as required, reshaping and recompacting by

sprinkling and rolling.

9. Should the base course, due to any reason or cause, lose the required stability, density or finish before the surfacing is complete; it shall be recompacted and refinished at the sole expense of the CONTRACTOR.
10. Where Iron Ore Topsoil material is used, the material shall be scarified, thoroughly wetted, mixed, manipulated, and bladed so as to secure a uniformly wetted material, and pulled in over the subgrade in courses and set under the action of blading and rolling. The work of mixing, blading, rolling, shaping and subsequent maintenance shall be performed by the continuous use of sufficient number of satisfactory rollers and power maintainers with adequate scarifier attachments.

3.03 PLACEMENT OF SUCCEEDING COURSES - ALL MATERIAL TYPES:

1. Construction methods shall be the same as prescribed for the first course.
2. Prior to placing the surfacing on the completed base, the base shall be “dry cured” to the extent directed by the ENGINEER.

3.04 DENSITY CONTROL:

1. When the “Density Control” method of compaction is indicated on the plans, each course of flexible base shall be compacted to the percent density shown on the plans.
2. The testing will be as outlined in Test Method Tex-113-E.
3. It is the intent of this specification to provide in that part of the base included in the top 8 inches immediately below the finished surface of the roadway not less than 100 percent of the density as determined by the compaction ratio method.
4. Field density determination shall be made in accordance with Test Method Tex-115-E.

3.07 TOLERANCES:

1. Flexible base will be measured by the square yard of surface area of completed and accepted work based on the width of flexible base as shown on the plans.
   a) The ENGINEER may accept the work providing not more than 25 percent of the density tests performed each day are outside the specified density by no more than three pounds per cubic foot and where no two consecutive tests on continuous work are outside the specified limits.

PART 4- MEASUREMENT AND PAYMENT

4.01 MEASUREMENT:

1. Flexible base will be measure by the square yard of surface area of completed and accepted work based on the width of flexible base as shown on the plans.
   a) The flexible base shall be measured for depth by the units of 2000 square yards, with one measurement taken at location selected by the ENGINEER.
   b) In that unit where flexible base is deficient by more than 2 inch in thickness, the deficiency shall be corrected by scarifying, adding material as required, reshaping and recompacting by sprinkling and rolling.
   c) No additional payment over the contract unit price will be made for any flexible base of a thickness exceeding that required by plans.
2. The CONTRACTOR shall schedule his operations in such a manner as to facilitate the measurement of the pay item.
3. The ENGINEER may accept the work provided no more than 2 out of 10 depth tests performed are deficient by not more 2 inch and where no two consecutive tests on continuous work are outside the specified depth.

4.02 PAYMENT:

1. The accepted quantities of flexible base of the type, grade, and compaction method specified will be paid at the contract unit bid price per square yard, complete in place.
2. Where “Ordinary Compaction” is used, all sprinkling, rolling, and manipulation required will not be paid for directly, but will be incidental to other bid items.
3. The unit prices bid shall each be full compensation for shaping and fine grading the roadbed; for securing and furnishing all materials, including all royalty and freight involved, for furnishing scales and labor involved in weighing the material when required; for loosening, blasting, excavating, screening, crushing and temporary stockpiling when required; for loading all materials for all hauling and delivering on the road; for spreading, mixing, blading, dragging, shaping and finishing and for all manipulation, labor, tools, and incidentals necessary to complete the work.

END OF SECTION 02601

SECTION 02602 FIBERGLASS MANHOLES AND WETWELLS

GENERAL

1.01 WORK INCLUDED

A. Furnish all materials, labor and equipment and install fiberglass reinforced polyester manholes and wetwells complete and in place as shown on the Drawings and as specified herein.

1.02 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

A. Excavation and backfill is specified in Section 02221.
B. Gravel bedding is specified in Plan Sheet Detail.
C. Cast-in-place concrete is specified in Division 3.
D. Manhole frames and covers are specified in Division 3.

1.03 STANDARDS

A. ASTM D-3753: Standard Specification for Glass-Fiber Reinforced Polyester Manholes and Wetwells.
B. ASTM C-581: Practice for Determining Chemical Resistance of Chemical Thermosetting Resins Used in Glass-Fiber Reinforced Structures Intended for Liquid Service.
C. ASTM D-2412: Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel Plate Loading.
D. ASTM D-695: Test Methods for Compressive Properties of Rigid Plastics.
E. ASTM D-2584: Test Method for Ignition Loss of Cured Reinforced Resins.
F. ASTM D-790: Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and electrical Insulating Materials.
G. ASTM D-2583: Test Method for Indentation Hardness of Rigid Plastics by means of a Barcol Impressor.
H. AASHTO H-20: Axial Loading.

1.04 QUALITY ASSURANCE

A. Experience Requirements: Manholes and wetwells shall be the product of one (1) manufacturer having at least 5 years successful experience manufacturing fiberglass manholes and wetwells of the types and sizes as specified herein.
B. Inspection:
   1. The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the Engineer, or other representative of the owner. Such inspections shall be made at the place of manufacture, or at site of delivery, and the sections shall be subject to rejection on account of failure to meet any of the specification requirements as specified herein. Sections rejected after delivery to the job site shall be marked for identification and shall be removed from the job at once. All sections which have been damaged after delivery will be rejected, and if already installed shall be acceptable if repaired or removed and replaced at the contractor's expense.
   2. At the time of inspection, the material will be examined for compliance with the requirements of this specification and the approved drawings. All sections shall be inspected for general appearance, dimension, "scratch-strength", blisters, cracks, roughness, soundness, etc. The surface shall be dense and close-textured.
   3. Imperfections may be repaired, subject to the approval of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval.
C. Markings: All manholes and wetwells shall be marked on the inside. These markings shall be permanent and include:
   1. Manufacturer Identification (Name)
   2. Manufacturing Serial Number
   3. ASTM Designation
   4. Diameter and Length
D. Certification: The manufacturer of the fiberglass wetwells and manholes shall certify that all physical and chemical requirements listed in this specification are met. The certification shall be submitted to the engineer in writing and shall consist of a copy of the manufacturer's test report, accompanied by a copy of the test results, that the manhole has been sampled, tested, and

inspected in accordance with the provisions of ASTM 3753 and this specification, and meets all requirements. An authorized agent of the manufacturer shall sign each certification.

E. Acceptable Manufacturers:
   1. Containment Solutions, Inc., Conroe, TX.
   2. L.F. Manufacturing, Inc., Giddings, TX.
   3. Or equivalent.

1.05 SUBMITTALS

A. Manufacturer's descriptive literature and recommended methods of installation.
B. Certificates: Manufacturer's certification in accordance with 1.04.D.
C. Warranties

1.06 GUARANTEE/WARRANTY

A. In addition to the one (1) year warranty provided by the Contractor, wetwells and manholes shall be warranted by the manufacturer for a period of twenty (20) years against internal or internal corrosion and against structural failure.
B. Contractor shall obtain any training from the manufacturer as required for conditions of the warranty to be met.
C. If any wetwell or manhole fails within the warranty period, the manufacturer shall either repair it, deliver a replacement unit to the point of original delivery, or refund the original purchase price.

1.07 DELIVERY, STORAGE AND HANDLING

A. FRP wetwells and manholes shall be lifted by the installation of lifting lugs as specified by the manufacturer on the outside surface near the top of the wetwell. Wetwells and manholes may also be lifted in the horizontal position with two slings on a spreader bar. Use of chains or cables in contact with the wetwell/manhole surface is prohibited.
B. FRP wetwells and manholes may be stored upright or horizontally, however, the wetwell vertical deflection shall not exceed 4% of the diameter. The wetwell shall not be dropped or impacted.
C. Additional handling and installation instructions shall be in accordance with the FRP manufacturer's instructions.
D. Each FRP section manufactured in accordance with the drawings shall be clearly marked to indicate the intended installation location. The contractor shall be responsible for the installation of the correct FRP sections in their designated locations.

1.08 PRODUCTS

1.09 GENERAL REQUIREMENTS

A. Fiberglass reinforced polyester wetwells and manholes shall be manufactured from commercial grade polyester resin having fiberglass reinforcements. The resin system shall be suitable for atmospheres containing hydrogen sulfide and dilute sulfuric acid as well as other gases associated with the wastewater collection systems. Wetwells and manholes shall be a one-piece unit.

1.10 MATERIALS

A. Resin: The resins used shall be a commercial grade unsaturated polyester resin. UV inhibitors shall be added directly to resins to prevent photo-degradation during storage.
B. Reinforcing Materials: The reinforcing materials shall be commercial Grade "E" type glass in the form of mat, continuous roving, chopped roving, roving fabric or a combination of the above, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.
C. Surfacing Materials: If reinforcing material is used on the surface exposed to wastewater and sewer gases, it shall be a commercial grade chemical-resistant glass that will provide a suitable bond with the resin and leave a resin rich surface.
D. Fillers and Additives: Fillers, when used, shall be inert to the environment and wetwell construction. Additives, such as thixotropic agents, catalysts, promoters, etc., may be added as required by the specific manufacturing process to be used. The resulting reinforced plastic material must meet the requirement of this specification.

1.11 FABRICATION

A. Exterior Surface: The exterior surface shall be relatively smooth with no sharp projections. Handwork finish is acceptable if enough resin is present to eliminate fiber show. The exterior surface shall be free of blisters larger than 1/2 inch in diameter, delamination and fiber show.

B. Interior Surface: The interior surface shall be resin rich with no exposed fibers. The surface shall be free of grazing, delamination, and blisters larger than 1/2 inch in diameter, and wrinkles of 1/8 inch or greater in depth. Surface pits shall be permitted up to 6 square feet if they are less than 3/4 inch in diameter and less than 1/16 inch deep.

C. Cylinder Section: Cylinders shall meet all requirements for pipe stiffness as required in ASTM D3753. All wetwells and manholes 6-foot diameter and larger shall be rib reinforced.

D. Fiberglass Reinforced Top/Cone: The fiberglass wetwell top or manhole cone shall be fabricated using fiberglass material as specified in Paragraph 2.02 and shall meet all requirements in 2.04 of this Section. Tops and cones to be attached to the cylinder at the factory with fiberglass layup in compliance with ASTM-D3299.
   1. Wetwell Tops and Hatch Openings:
      a. Wetwells shall be provided with glass reinforced tops as shown on the Drawings and shall be joined to the cylinder section at the factory with resin and glass fiber reinforcement forming a monolithic structure to prevent infiltration and exfiltration.
      b. Wetwell top shall be designed to withstand backfill and concrete slab. When reinforcement is necessary for strength, the reinforcement shall be fiberglass channel laminated to top per ASTM-D3299. Stiffeners shall be of non-corrosive materials encapsulated in fiberglass. FRP encapsulated wood or lumber is not permitted.
      c. Hatch opening dimensions and position to be as shown on the drawings and specified in Section 11322.
      d. Vapor barrier lip around hatch opening shall be constructed of fiberglass pultruded structural shapes. Vapor barrier lip shall extend to the hatch frame as shown on the Drawings so that no concrete of the top slab is exposed to the wetwell interior. Contractor to coordinate this dimensional requirement.
   2. Manhole Cones:
      a. The manway cone on manholes must provide a bearing surface on which a standard frame and cover may be supported and adjusted to grade.
      b. The cone shall be concentric and shall be joined to the cylinder section at the factory with resin and glass fiber reinforcement forming a monolithic structure to prevent infiltration and exfiltration.
      c. Manway cone shall have a raised collar around the manway opening over which HDPE manhole adjustment rings may be installed.

E. Bottom Flange: All wetwells shall have an integral bottom flange of minimum 3-inch width as shown on the drawings for embedment and anchoring of the cylinder in the concrete base slab. Where indicated on the drawings, manholes shall also have bottom flange.

F. Stubouts and Connections:
   1. Pipe connections 4” through 15” in diameter shall be made by means of “Inserta Tee” watertight compression connection. Connections may be factory installed.
   2. Pipe connections larger than 15” in diameter shall be factory installed and be of the following types:
      a. Rubber gasketed PVC sewer pipe stubouts installed with resin and glass fiber reinforced lay-up. Gaskets shall meet the same performance requirements of the sewer pipe to be installed.
      b. PVC or FRP pipe stubouts with resilient pipe-to-wetwell connectors (boots) conforming to the requirements of ASTM C-923.

G. Defects not Permitted:
   1. Exposed fibers: glass fibers not wet out with resin.
   2. Resin runs: runs of resin and sand on the surface.
   3. Dry areas: areas with glass not wet out with resin.
   4. Delamination: separation in the laminate.
   5. Blisters: light colored areas larger than 1/2 inch in diameter.
   6. Crazing: cracks caused by sharp objects.
   7. Pits or Voids: air pockets.
   8. Wrinkles: smooth irregularities in the surface.
   9. Sharp projection: fiber or resin projections necessitating gloves for handling.

1.12 DESIGN REQUIREMENTS

A. Wetwells and manholes shall be designed by the manufacturer to perform as underground structures at the depths required.

B. Complete manhole FRP structures shall be capable of supporting the top slab covers, frames, and soil overburdens plus a live load equivalent to AASHTO HS-20 loading. To establish this rating, the complete manhole shall not leak, crack, or suffer other damage when load tested to 40,000 ft-lbs and shall not deflect vertically downward more than 1/4 inch at the point of load application when loaded to 24,000 lbs.

C. Cylinders shall be resistant to buckling when empty and when the groundwater elevation is at grade.

D. The anchoring wall structure at the embankment within the reinforced concrete base zone shall be designed to resist external hydrostatic water forces of an empty or full cylinder with the groundwater at grade elevation.

E. All cutouts for pipe connections specified and shown on the Drawings shall be capable of maintaining the unit's structural integrity.

F. Stiffness: The cylinder shall be tested in accordance with ASTM Method D 2412. The wetwell cylinder shall have the minimum pipe-stiffness values shown in the following table when tested in accordance with ASTM 3753, Section 8.5, (note 1).

1. STIFFNESS REQUIREMENTS
2. Length (ft) F/AY (psi)
3. 3 to 6 0.72
4. 7 to 12 1.26
5. 10 to 20 2.01
6. 21 to 30 3.02
7. 31 to 40 5.24

G. Physical Properties:

	Hoop Direction	Axial	
1. Tensile Strength (psi)	18,000	5,000	
2. Tensile Modulus (psi)	0.8 x 106	0.7 x 106	
3. Flexural Strength (psi)	22,500	14,300	
4. Flexural Modulus (psi)			
a. (no ribs - 48", 60", 72")		1.4 x 106	0.7 x 106
b. (with ribs - 72", 96", 144")		0.7 x 106	0.7 x 106

H. Dimensional Requirements:

1. The wetwells and manholes shall be a circular cylinder, sized per the plans for the applicable locations. Wetwells shall be produced per the length indicated on the plans +/- ½". Manholes shall be produced in half-foot increments of length +/- 2 inches. Tolerance on the inside diameter shall be +/- 1%. Other diameters as agreed upon between purchaser and the manufacturer are covered by this specification.
2. The minimum wall thickness for all wetwells and manholes at any depth shall be 0.50 inches measured to the nearest percent (0.01 inches) with micrometer, caliper, gauge or other suitable instrument. A minimum of one thickness reading per 33.4 ft2 of laminated surface in area of constant thickness shall be made. Through regions of wall taper, sufficient checks must be made to establish actual thickness. The test shall be run at least once per ten manholes.

1.13 EXECUTION

1.14 EXCAVATION

A. The Contractor shall do all necessary excavation for the various wetwells and manholes. Such excavations shall be of sufficient size to permit the proper installation of the base and wall forms and allow room for the striping of forms. All excavation shall conform to the size and dimensions as shown on the drawings plus a maximum of four feet to permit working room.

B. Care shall be taken to insure that the excavation is not carried to a greater depth than required. If shoring the wall of the excavated area becomes necessary, shoring shall be of two-inch material. Shoring shall be braced to insure support of the walls and also permit the construction of the wetwell or manhole itself without necessitating the removal of any shoring until such time as the entire manhole is completed. No shoring shall be left or backfilled around, unless

authorized by the engineer. Shoring shall remain in place for at least twenty-four hours after the concrete work has been completed.

C. Contractor shall be responsible for handling groundwater to provide firm, dry subgrade for the structure, shall prevent water from rising on new poured-in-place concrete within 24 hours after placing, and shall guard against flotation or other damages resulting from groundwater or flooding. The Contractor shall be fully responsible and liable for all damages resulting from failure of the dewatering plan or system. Refer to Section 01563 GROUNDWATER HANDLING.

1.15 GENERAL CONSTRUCTION METHODS

A. All wetwell and manhole work shall be completed and finished in a careful and workmanlike manner, special care being given to cutting and installing wall penetrations in the wall of the cylinder.

B. Field-installed connections for sewer pipe 4" through 15" in diameter shall be made by means of watertight compression connection (e.g. "Inserta Tee", or approved equal) as shown on the plans and details. Cutouts and installation shall be in strict accordance with manufacturer's written instructions utilizing installation equipment (e.g. hole saw) approved for use by the manufacturer of the fitting. Use of equipment which does not meet this requirement is expressly prohibited. Jig saws, saber saws, or axes, hammers, chisels, and similar impact type tools shall not be used.

C. Field fabrication of stubouts using FRP lay-up reinforcement is prohibited unless approved in writing by the Engineer.

D. All connections shall be made on flat surfaces of cylinder or top away from structural ribs. Contractor shall coordinate location and elevations of all connections with the manufacturer before fabrication to ensure this requirement is met.

E. All cut edges where glass fiber is exposed (e.g. hole saw cuts in the cylinder section or top) shall be coated with resin to prevent wicking of moisture into fiberglass laminate. Contractor shall use resin of the same type and grade as used in the fabrication of the wetwell/manhole.

F. The bottom of manholes shall be completed by installing sufficient additional concrete/grout to shape or form the bench as shown on the drawings.

G. The cast-in-place concrete base slab shall be placed on a 6-inch minimum bed of gravel. Sub-base soil below gravel bed shall be thoroughly compacted to minimum 95% Standard Proctor Density.

H. The bottom of the fiberglass manhole or wetwell shall be cast-in-place a minimum of 4 inches and shall be adjusted in grade so that the top slab section is at the elevation specified in the drawings. Contractor shall be responsible for coordinating and verifying all dimensional requirements as specified and shown on the Drawings.

I. Contractor shall internally brace fiberglass wetwell tops during placement of top slab concrete to support and prevent deflection of the top while the slab cures.

1.16 BACKFILLING

A. Anti-flotation rings made from lean concrete mix shall be poured in place around manhole and wetwell in quantities as shown on the Drawings. Anti-flotation rings shall be poured only after the concrete base slab has been allowed to cure the required time and the forms and shoring have been removed.

B. The backfilling around the outside of manholes shall commence as soon as the anti-flotation ring has cured. Backfill shall be placed in layers of not more than 12 inches and shall be thoroughly tamped before the next layer is installed.

C. Backfill shall be either hand or mechanically tamped. Whichever method is used, care must be exercised to insure that the backfill is thoroughly compacted to 90% Standard Proctor Density (ASTM D-690).

D. Unless shown otherwise on the drawings, suitable material selected from the excavation shall be used for backfill. Material shall be subject to approval by the Engineer.

1.17 DROP MANHOLES

A. Drop manholes shall consist of a standard sanitary sewer manhole with one standard drop connection on one side only, as shown in the detail drawings. All materials used in the drop connection shall conform to the requirements of the pertinent specification.

1.18 CASTINGS AND CLEANING

A. Manhole frames and covers within the limits of bituminous concrete pavement shall be set at the elevation of the top of the wearing course.

B. All new manholes and wetwells shall be thoroughly cleaned by the removal of all accumulations of silt, debris and foreign matter of any kind, prior to final inspection.

1.19 MANHOLE TESTING

A. Refer to Section 02570 for manhole testing requirements.

1.20 WETWELL TESTING

A. Successful passage of a hydrostatic test shall be required for acceptance of all wetwells. Testing shall be conducted with all connections in place. If a wetwell fails a hydrostatic leakage test, it shall be made watertight and retested.

B. Test Procedure:

1. Pneumatic test plugs with a sealing length equal to or greater than the diameter of the connecting pipe to be sealed shall be used to plug all influent, effluent, and vent pipes.
2. Wetwell shall be filled with water (provided by the Contractor and as approved by the Engineer) to a pre-determined level at or immediately below the underside of the fiberglass top. Additional water may be added over a twenty-four (24) hour period to compensate for absorption and evaporation losses.
3. At the conclusion of the twenty-four (24) hour saturation period, the wetwell shall be filled to the original level and the water level observed by reference to gradations marked on a measuring rod or a pump guide rail.
4. The wetwell shall be considered to pass the hydrostatic test if the rate of leakage or water loss is equal to or less than 0.025 gallons per foot diameter per foot of wetwell depth per hour.

C. Testing and Certification:

1. Testing shall be done by the Contractor and witnessed by the Engineer or his representative. All wetwells shall be tested as finished and completed for final acceptance.
2. Any defective work or materials shall be corrected or replaced by the contractor and retested. This shall be repeated until all work and materials are acceptable.

END OF SECTION 02602

SECTION 02660 CONCRETE CURB AND GUTTER AND VALLEY GUTTER

PART 1 – GENERAL

1.01 GENERAL DESCRIPTION OF WORK:

A. This work shall consist of the construction of concrete curb, edge curb, concrete curb and gutter, concrete gutter or valley gutter, or combination thereof in compliance with these specifications, lines, grades, concrete strength and details shown on the plans, or as directed by the ENGINEER.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Concrete and manufactured curb and gutter materials shall be subject to inspection and tests at plants and construction sites for compliance with quality requirements.
B. Concrete curb and gutter or concrete valley gutter shall be constructed with concrete conforming to the provisions of Section 03300 - Cast-In-Place Concrete.
C. Preformed expansion Joint Filler shall conform to the requirements of AASHTO M-33 or M-153.
D. Linseed Oil shall conform to the requirements of AASHTO D-260.
E. Mineral Spirits shall conform to the requirements of AASHTO D-235.

2.02 FOUNDATION:

A. Concrete curb and gutter or concrete valley gutter shall be placed on an approved foundation conforming to the requirements of the following Specifications:
    1. TxDOT ITEM 247 - Flexible Base,

PART 3 - EXECUTION

3.01 EXCAVATION:

A. When required, excavation shall be made to the specified depth, and the base upon which the curb and gutter or valley gutter is to be placed shall be compacted to a firm, even surface conforming to the requirements of Subsection 2.02 above.
B. All soft and unacceptable material shall be removed and replaced with material approved by the ENGINEER in conformance with the requirements of Subsection 2.02 above.

3.02 FORMS:

A. Forms shall be of wood or metal, straight, free from warp, and of such construction that there will be no interference to the inspection of grade or alignment.
B. All forms shall extend for the entire depth of the curb and gutter and shall be braced and secured sufficiently so that no deflection from alignment or grade will occur during the placing of the concrete. Flexible forms shall be used in curved sections so that the top surface of the forms will form a smooth, continuous arc.

3.03 MIXING AND PLACING:

A. Concrete shall be proportioned, mixed, and placed in accordance with the requirements of Section 03300.
B. Compaction of the concrete placed in forms shall be by vibration or other acceptable methods.
C. Unless otherwise provided, the exposed surfaces of curbs and gutters shall be finished by belting or with wooden floats. Forms shall be left in place until the concrete has set sufficiently so that they can be removed without injury to the curb and gutter.

3.04 SECTIONS:

A. Curb and Gutter or Edge Curb shall be constructed in sections having a uniform length of 20 feet, unless otherwise directed by the ENGINEER. Sections shall be separated by open joints 1/8 inch wide except at expansion joints.

3.05 EXPANSION JOINTS:

A. Expansion joints shall be formed at the intervals shown on the plans using a preformed expansion joint filler having a thickness of 3/4 inch.
B. When the curb and gutter is constructed adjacent to or on concrete pavement, expansion joints shall be located opposite or at expansion joints in the pavement.

3.06 CURING

A. Immediately upon completion of the finishing, the curb and gutter shall be moistened and kept moist for 3 days, or the curb and gutter shall be cured by the use of membrane-forming material. The method and details of curing shall be subject to the approval of the ENGINEER.

3.07 SURFACE TREATMENT:

A. The surface of concrete curb and gutter or concrete valley gutter shall be treated with a solution of Linseed Oil and Mineral Spirits in accordance with the applicable requirements of Section 03300 - Cast-In-Place Concrete.

3.08 BACKFILLING:

A. After the concrete has set sufficiently, the spaces in front and back of the curb shall be refilled to the required elevation with material approved by the ENGINEER, and shall be thoroughly tamped in layers of not more than 6 inches.

3.09 SLIP-FORM CONCRETE CURB, CONCRETE CURB AND GUTTER OR CONCRETE VALLEY GUTTER:

A. Any concrete curb or concrete curb and gutter, except on structures, may be placed using a slip form machine provided that the finished concrete curb or concrete curb and gutter is true to line and grade and the concrete is dense and of the required surface texture.

B. The concrete shall be of a consistency that it will maintain the shape of the concrete curb or concrete curb and gutter section without support after slip forming.

C. The top and face of the finished concrete curb or concrete curb and gutter shall be true and straight and the top surface of the concrete curb or concrete curb and gutter shall be of uniform width and free from humps, sags, or other irregularities.

D. The forming portion of the slip form machine shall be readily adjustable vertically during the forward motion of the slip from machine to provide a variable height of concrete curb or concrete curb and gutter grade when necessary. A grade line gauge or pointer shall be attached to the slip form machine in such a manner that a continual comparison can be made between the concrete curb or concrete curb and gutter grade as indicated by the offset guidelines.

E. Concrete shall be fed to the slip form machine at a uniform rate. The slip form machine shall be operated under sufficient uniform restraint to forward motion to produce a well compacted mass of concrete free from surface pits larger than 3/16 inch in diameter and requiring no further finishing, other than light brushing with a wet brush. Finishing with a brush application of grout will not be permitted.

F. Transverse weakened plane and expansion joints shall be constructed at right angles to the line of the concrete curb, concrete curb and gutter, or concrete valley gutter.

G. Expansion joints may be constructed by sawing through the concrete curb or concrete curb and gutter section to its full depth. The width of the cut shall be such as to admit the joint filler with a snug fit.

H. The operations of sawing and inserting the joint filler shall be completed before curing the concrete. At the conclusion of the curing period the filler in each joint shall be checked for tightness of fit. The loose filler in any joint shall be mortared in place and cured.

I. Excavation shall be as per Subsection 2.02 above.

J. All remaining provisions of Subsection 2.02 above also apply, unless otherwise specified.

K. PART 4 - MEASUREMENT AND PAYMENT

3.10 MEASUREMENT:

A. Curb and gutter, curb, and valley gutter shall be measured by the linear foot.
   1. Curb shall be measured along the front face of the section at the finished grade elevation.
   2. Combination curb and gutter will be measured along the face of the curb at the flowline of the gutter.
   3. Valley gutter will be measured along the flowline of the gutter.

B. A deduction in length shall be made for drainage structures, such as catch basins or inlets, in the curb, gutter, or combination thereof.

C. There will be no direct measurement or payment of materials used to construct curb and gutter, curb or valley gutter.

D. Excavation or construction of embankment for foundation of curb, valley gutter, or combination curb and gutter will not be measured for payment.

3.11 PAYMENT: Payment will be subsidiary to the total project cost.

END OF SECTION 02660

SECTION 02957 SEWER MANHOLE REHABILITATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section includes requirements for repair and rehabilitation of sanitary sewer manholes.

1.2 QUALITY ASSURANCE

A. Follow national standards and as specified herein.

B. Personnel Involved in Installation of Manhole Rehabilitation Materials: Certified by manufacturer successfully completed training in handling, applying and finishing materials used.

C. Commercially Proven Product:

1. Successfully completed over period of at least 2 years, minimum of 1,000 vertical feet of manhole rehabilitation or 100 manholes.
    a. Document to satisfaction of the Commission.

1.3 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. C78, Standard Test Method for Flexural Strength of Concrete
2. C109, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
3. C157, Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
4. C307, Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings
5. C580, Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
6. C596, Standard Test method for Drying Shrinkage of Mortar containing Hydraulic Cement.
7. C882, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
8. D638, Standard Test Method for Tensile Properties of Plastics
9. D792, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
10. D4787, Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates
11. D4833, Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
12. F2414, Standard Practice for Sealing Sewer Manholes Using Chemical Grouting

B. Federal Specification HH-P-117 for Dry Oakum

1.4 SUBMITTALS

A. Submit following Section 01330.

1. Working drawings showing design calculations, materials selected, and manufacturer's installation requirements.
2. Catalog data showing manufacturer's clarifications and updates, ASTM references, material composition, specifications, physical and chemical properties.
3. Manufacturer's recommended procedures for handling, storing, repairing, and installing materials selected.
4. Method of construction (as appropriate):
    a. Access manholes and site locations.
    b. Work dimensions.
    c. Existing utilities.

d. Size of working area.
e. Impacted portions of existing sewer.
f. Site access points.
g. Bypass pumping plan: Follow Section 02960

5. Emergency plan detailing procedures followed in event of health and safety emergency, pump failures, overspray, chemical spills, sewer overflows, service backups, and sewage spillage. Maintain copy on site for duration of project
   a. Address dangers associated with sewer rehabilitation work (i.e. working with large boiler trucks).
   b. Identify health and safety officer (i.e. crew chief)
      1) Designated health and safety officer:
   a) Responsible for providing health and safety oversight of personnel participating on project team.
   b) Perform and document routine work area inspections, conduct safety meetings, and provide safety orientations for team members.
   c) Have the following contact information in easily accessible place; (1) Non emergency number. (2) Contractor's health and safety representative name and number. (3) Occupational health clinic number(s).
   c. Submit the following;
      1) List of critical rehabilitation equipment, including boiler truck equipment, to be inspected on daily basis.
      2) Recently completed (previous month) monthly maintenance log.
      3) Annual third-party certified inspection for boiler truck(s) to be used on project.
      4) Certification of training for boiler truck operator.
      5) Noise attenuation.
6. Epoxy and cured-in-place (CIP) manhole liner products.
   a. Infrared spectrograph chemical fingerprint and Certificate of Analysis for each lot of material:
      1) Lot number.
      2) Product name.
      3) Manufacturer.
      4) Brookfield Viscosity.
      5) Thix Index.
      6) Gel time at cure temperature.
      7) Peak temperature for failure.
      8) Percent of non-volatile solids.
      9) Specific Gravity.
      10) Catalyzed Stability time at optimum temperature.
      11) Catalyst to resin ratio.
      12) Analysis signature.
      13) Date tested.
      14) Batch ticket for each resin-catalyst-colorant batch made up and impregnated into felt liner material.
   b. Shipping manifest:
      1) Date shipped.
      2) Origination and delivery locations.
      3) Shipping method and carrier.
      4) Shipping order number.
      5) Purchase order number.
      6) Shipped item.
      7) Stock number.
      8) Lot number.
      9) Manufacturer.
      10) Any shipping, storage, or safety requirements.
      11) Received by, and date.

12) Signature of receiver.

7. Stock sheets, order forms, delivery forms, invoices, and Hazardous Material forms for material used.

B. Submit following Section 01450 and specified herein.
1. Certified statement from manufacturer approved installer of their system.
   a. Include certificates of training from manufacturer for each crewmember involved in installation process.
2. Documentation of Products and Installers: Engineer's approval required before installation of rehabilitation materials.
   a. Descriptions of projects completed in past 2 years where proposed rehabilitation material was used.
      1) Include vertical feet of manhole rehabilitated. Manhole identification number, work order number, Contract number, Contractor's name, operator's contact information, and date of readings.
3. Safety plan for steam curing of cured-in-place bag liners.
4. For manhole process involving materials that cure in field as component of their installation.
   a. Provide ASTM certified lab test results for field installations completed in United States over the past two years.
      1) In place properties for actual field installations for proposed materials.
      2) Test results must verify physical properties specified herein have been achieved in previous field applications.
5. Detailed description of field testing processes and procedures.
   a. Keep accurate record of work for each manhole rehabilitated under this contract.
      1) Show manhole identification number and location, quantities of rehabilitation material used, estimate of infiltration eliminated, and results of post-rehabilitation inspection.
   b. DVD-ROM with Color video inspection reports and all digital records (original inspection videos, photographic stills, etc.) made following manhole rehabilitation.
      1) Provide to Engineer within 10 days, following Section 02956.
   c. Curing logs: Show material curing readings per unit of time collected during material installation.
      1) Store electronically on data logger. Submit printed copy with Post video inspection DVD-ROM.
   d. For CIP liners, provide tabulation of time versus temperature by liner manufacturer with lengths of time exposed portions of liner will endure without self-initiated cure or other deterioration.
      1) Tabulate at 5 degrees F. increments, ranging from 70 degrees F. to 100 degrees F.
      2) Include analysis of progressive effects of such self-initiated cure on insertion and cured properties of liner.
   e. Third party material testing report complete with samples, tests done, results and Analyst signature.
      1) Third party is defined as ASTM or equivalent accredited materials testing firm with no financial or directorial link to manufacturer or Contractor.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect, store, and handle materials during transportation and delivery, while stored on-site, and during installation following approved submittals.
   1. Maintain temperature less than 120 degrees F. while in storage.
   2. Engineer may inspect and test materials at factory, before delivery to site or while in storage.

B. Material found to be defective or damaged due to manufacture or shipment:
   1. When Engineer deems repairable: Repair following manufacturer's

recommendations.
2. When Engineer deems not repairable: Rejected, removed from Contract site, and replaced under Engineer's direction.
3. Repair or replacement of defective or damaged material will be at no additional cost to Commission.

PART 2 PRODUCTS

2.1 MATERIALS

A. Acrylic or Acrylate Base Grout for non-structural infiltration control: Follow ASTM F2414 and as specified herein.
1. Two-part chemical grout mixed at point of injection.
2. Minimum 25 percent acrylic or acrylate base material by volume.
   a. To increase strength or offset dilution during injection period, use higher concentration of base material as directed by Engineer.
3. Controllable reaction time: 30 seconds to 1 hour.
4. Viscosity: 1.5 centipoises water.
   a. May be increased maximum of 2.5 centipoises water as directed by Engineer.
   b. Remain constant throughout injection period.
5. Tolerates dilution and reacts in moving water.
6. Final reaction:
   a. Produces chemically, continuous irreversible, non-biodegradable, flexible gel, impermeable to water at pressures up to 15 psi in pure form.
   b. Produces stabilized soil in ground that will not become brittle or rigid.
7. Gel does not bleed water under stress.
8. Dehydrated gel returns to 90 percent of its original volume and form after prolonged period of low ground water.
9. Do not use catalyst containing dimethyl amino propionitrile (DMAPM).
10. Use root inhibitor (50% active dichlobenil) when roots are present in manholes, connecting pipes or laterals.
    a. Change dye color to confirm root inhibited grout is being injected.
11. Use latex additive for increased tensile strength.
12. Tinted to allow detection of grout in drill holes or at leakage locations.
13. Approved Manufacturers.
    a. Grout.
       1) Avanti International, Acrylic Gel.
          a) Additives
             (1) AV-101 Catalyst T+
             (2) AV-103 Catalyst SP
             (3) AC50W – Root Inhibitor
             (4) AC-257 Icoset
       2) De Neef, Inc.,
          a) AC400 Acrylate Grout
             (1) Additives
                 (a) TE 300 Triethanolamine
                 (a) P200 Sodium Persulfate
       3) Or Equal.

B. Urethane Base Grout for non-structural infiltration control: Follow ASTM F2414 and as specified herein.
1. Ratio: One part urethane prepolymer to 10 parts water by volume (10 to 50 percent prepolymer).
2. Liquid prepolymer:
   a. Solids content: 77 to 83 percent.
   b. Specific Gravity: 1.04
   c. Flash Point: 20 degrees F.
   d. Viscosity: 200 to 1,200 centipoises water at 70 degrees F.

3. Water for reacting prepolymer: pH of 5 to 9.
4. Use manufacturer recommended gel control agent to control cure time as required.
5. Final Reaction:
   a. Produces chemically continuous irreversible, non-biodegradable, flexible gel, impermeable to water at pressures up to 15 psi in pure form.
   b. Produces stabilized soil in ground that will not become brittle or rigid.
6. Dehydrated gel returns to 90 percent of its original volume and form after prolonged period of low ground water.
7. Use root inhibitor (50% active dichlobenil) when roots are present in manholes, connecting pipes, or laterals.
8. Use latex additive for increased tensile strength.
9. Tinted to allow detection of grout in drill holes or at leakage locations.
10. Approved Manufacturers.
    a. Warren Environmental, Inc.
       1) SG-201 Grout.
    b. Avanti.
       1) Norosac AC 50W Root Inhibitor.
       2) AV-254 Gelseal.
          a) Additives
             (1) AV-257 Icoset.
             (2) AV-255G Grout Side Accelerator.
    c. De Neef, Inc.
       1) Hydro Active Multigel NF.
       a) Additives.
          (1) Flexgel Cat Water Side Accelerant.
          (2) Reinforcing Agent.
    d. Sauereisen.
       1) F370, Hydroactive Polyurethane Grout.
    e. Or Equal.

C. Cementitious Reconstruction for Manhole Restoration.
1. Quick setting (under 20 minutes), high strength, sulfide resistant, calcium aluminate-based or Portland cement material.
2. Suitable for troweling or rotary spray application to inside of manhole.
3. Use additives to increase corrosion resistance or bond strength at manufacturer's direction and with Engineer's approval.
4. Initial set time per manufacturer's recommendation and per project conditions.
5. Density when applied: 135 lb/cf +/- 5 lb/cf.
6. Compressive strength (ASTM C109) at 1 day.
   a. Per manufacturer's recommendation.
   b. Minimum acceptable: 2,000 psi.
7. Compressive strength (ASTM C109) at 28 days.
   a. Per manufacturer's recommendation.
   b. Minimum acceptable: 5,500 psi.
8. Bond Strength (ASTM C882) at 28 days.
   a. Per manufacturer's recommendation.
   b. Minimum acceptable: 1,640 psi.
9. Flexural Strength (ASTM C78) at 28 days.
   a. Per manufacturer's recommendation.
   b. Minimum acceptable: 1,500 psi.
10. Shrinkage (ASTM C596) at 28 days: 0 percent.
11. Approved Manufacturers.
    a. IPA systems, Inc.
       1) Octocrete (trowel).
       2) Drycon (brush or trowel) (Non-Structural Application only).

3) Drycon SM (spray gun).
4) Drycon SMF fiber reinforced.

b. The Strong Company, Inc.
1) Strong-Seal MS-2A.
2) Strong-Seal MS-2C (mild corrosion resistance).
3) Strong-Seal High Performance (high corrosion resistance).

c. AP/M Permaform.
1) Permacast MS-10,000 (corrosion resistant).
2) Permacast MS-10,000 with Con-Shield (anti-bacterial additive).
3) Permacast CR-9,000 (calcium aluminate cement) (trowel).

d. Sauereisen.
1) F-120 Underlayment (calcium aluminate cement) (trowel).
2) F-120 FC Fast Setting Underlayment.
3) F-121 Substrate Resurfacer.

e. QuadEx.
1) Aluminaliner (calcium aluminum cement).

f. WBE Dorcas, Inc.
1) Dinjer CMS 10K-A

g. Or Equal.

D. Hydraulic Water Plugs for non-structural infiltration control.
1. Rapid setting to plug active leaks prior to other rehabilitation work.
2. Initial Set Time at 70 degrees F: 60 to 90 seconds.
3. Final Set Time at 70 degrees F: One hour.
4. Compressive Strength (ASTM C109) at 28 days:
a. Per manufacturer's recommendation.
b. Minimum acceptable "or equal" products: 4,000 psi.
5. Length Change (ASTM C157): 0 percent.
6. Approved Manufacturers.
a. Sauereisen.
1) Instaplug F-180.
b. IPA Systems, Inc.
1) Octoplug Plus.
2) IPANEX Rapid.
c. The Strong Company, Inc.
1) Strong-Seal QSR (acid resistant)
2) Strong-Plug.
d. AP/M Permaform,
1) Permacast-Plug.
e. Quadex.
1) Quad-Plug.
f. WBE Dorcas, Inc., Colorado Springs, CO.
1) Dinjer Stop Leak Ultra – Rapid Setting Repair Material.
g. Or Equal.

E. Oil-free Oakum Water Plugs for non-structural infiltration control.
1. Rapid setting oil-free oakum and hydrophilic grout to plug active water leaks prior to other rehabilitation work.
2. Oil-free oakum meeting Federal Specification HH-P-117.
3. Two-part urethane resin.
4. Initial set time: 5 to 10 seconds.
a. Use accelerator to decrease initial set time.
5. Approved Manufacturers.
a. Avanti International
1) Oil-free Oakum (AV-219)
2) Multigrout (AV-202).
b. DeNeef, Inc.

1) Oil-free Oakum
2) Hydro Active Sealfoam
3) Hydro Active Flex LV grout. c. Or Equal.

F. Manhole Chimney Seals.
1. Cured in Place Chimney Liner.
a. Seamless tube liner formed in place within existing manhole, beginning just below cover seat extending downward maximum of 24 vertical inches.
1) Structurally independent of existing manhole structure.
b. Resin impregnation method: On site.
c. Resin-Catalyst-Colorant Additive Mixture:
1) Tested to certify design standards are met before impregnating felt material.
2) Quantity of resin used for tube impregnation: Sufficient to fill volume of air voids in felt tube with additional allowances for polymerization shrinkage and loss of resin through cracks and irregularities in manhole walls.
d. Seams in felt tube.
1) Stronger than non-seamed felt.
2) Overlapped layers of felt in vertical seams that cause lumps in final product shall not be utilized.
e. Cured Liner.
1) 50-year life span.
2) Chemically resistant to internal exposure to sewage containing small quantities of hydrogen sulfide, carbon dioxide, methane, mercaptans, kerosene, moisture and diluted sulfuric acid.
3) Chemically and physically resistant to external exposure of soil bacteria, moisture, roots and chemical attack, this may be due to material in surrounding ground.
2. Approved Manufacturers.
a. Cured In Place Liner
1) LMK
2) CIPMH Chimney.
3) Or Equal.

G. Manhole Liners.
1. Cured-in-Place Bag Liners.
a. Seamless manhole formed in place, within existing manhole extending from channel to frame.
1) Structurally independent of existing manhole structure.
2) Liner thickness: Designed by manufacturer related to location, loads, water table and condition of manhole.
b. Multiple structural layers of fiberglass with non-porous membrane layer between fiberglass or Polyvinyl Chloride/Polyester (PVCP) liner
1) Fiberglass layer formed to manhole interior under pressure and cured with heat.
c. Liner fabricated to match manhole dimensions for custom fit.
1) Continuous length from bench to manhole frame, just below cover seat.
a) Pieced together length: Not acceptable.
b) Separate lining allowed for channel: Compatible with bag liner.
2) Stencil material type and name on liner: Viewable from inside.
d. Epoxy resin.
1) Polyamide Bisphenol “A” Epichlorodhydrin for use with fiberglass liner.
2) Modified epoxy resin for use with PVCP liner.
e. Approved Manufacturers.
1) Terre-Hill.
a) Multi-Plexx Liner System.
2) Poly-Triplex Technologies.

a) Poly Triplex Liner System.
3) Or Equal.

2. Spray on Epoxy Liners.
   a. Seamless manhole formed in place, within existing manhole extending from channel to frame.
   b. Two or three part epoxy coating.
   c. Existing wall preparation: Follow manufacturer's recommendations.
   d. Thickness:
      1) Structurally independent of existing manhole structure or sufficient to form protective barrier when used with Cementitious Manhole Restoration.
      2) Designed by manufacturer related to location, loads, water table and condition of manhole.
   e. Minimum Tensile Strength (ASTM C307): 2,500 psi.
   f. Minimum Flexural Strength (ASTM C580): 4,600 psi.
   g. Approved Manufacturers.
      1) Sauereisen.
         a) Sewer Gard No. 210 Sprayable.
         b) Sewer Gard No. 210 Rotary Spray.
         c) Sewer Gard No. 210G (Non-Structural Application Only)
         d) Sewer Gard No. 210 FS
         e) Hi-Build Filler Compound No. 209HB (Non Structural Application Only).
      2) Raven.
         a) Raven 400S (Non Structural Application Only).
      3) Terre Hill.
         a) Hydropoxxy (Non Structural Application Only).
      4) AP/M Permaform.
         a) Cor+Gard (Non Structural Application Only)
      5) SprayRoq, Inc.
         a) SR6100 (Non Structural Application Only). .
      6) Warren Environmental, Inc.
         a) S-301-14 Epoxy Spray System.
         b) M-301-18 Epoxy Trowel-On Mastic System.
         c) S-301-20 Thermaflex (Non Structural Application Only).
         d) SG-201 Injection Grout (Non Structural Application Only).
      7) WBE Dorcas, Inc., Colorado Springs, CO
         a) Dinjer SG Mastic – Two Part Epoxy.
      8) Or Equal.
3. Panel Liners.
   a. Seamless manhole formed in place within existing manhole, extending from channel to frame
      1) Structurally independent of existing manhole structure.
   b. High density Polyethylene (HDPE) Panels.
      1) Integrally extruded sheets with anchoring studs, minimum 39 studs per square foot.
      2) Minimum thickness of panel sheet with anchoring studs: 2 mm.
      3) Minimum thickness of flat liner sheet at joint overlaps: 3 mm.
      4) Joints between panels sealed using thermal welding.
      5) Density (ASTM D792): 0.945 gm/cm3.
      6) Elongation at break (ASTM D638): Greater than 400 percent.
      7) Minimum abrasion resistance (ASTM D4833): 160 pounds.
      8) Steel frames for mounting liner.
         a) Maintain minimum 2.5 inch annular space when filling with flowable concrete. Required thickness dependent on condition of manhole, location of manhole, loads applied to manhole and water table.
         b) Maintain minimum 1 inch annular space when filling with grout.
         c) Anchor bolts: Minimum penetration of concrete on manhole wall: 1.5

inches.
d) Countersink screws to mount liner to frames.
9) Cement in annular space.
a) Wall preparation: Determined by Engineer prior to placement of forms.
b) Minimum Compressive Strength: 4,000 psi at 28 days.
c) Minimum aggregate size: 8 mm.
d) Maximum aggregate size: 32 mm.
10) Grout in annular space.
a) Minimum Compressive Strength: 6,000 psi at 28 days.
b) Low viscosity, high flowability to fill annular space without voids.
c) Bonds to manhole wall.
11) Approved Manufacturer.
a) AGRU
(1) Sure Grip Concrete Protective Liner.
b) Or Equal.
c. Polyvinyl Chloride (PVC) Panels.
1) Resin: Minimum 99 percent PVC by weight.
2) Do not use copolymer resins or recycled materials.
3) Minimum thickness: 1.65 mm, with integrally extruded anchoring extensions on maximum 2 inch center and minimum ¼ inch deep.
4) Joints between panels sealed using thermal welding.
5) Minimum Tensile Strength (ASTM C307): 2,200 psi
6) Maximum Elongation at Break (ASTM D638): 200 percent of original.
7) Mastic primer and two-part mastic to bond panels to manhole walls.
8) Approved Manufacturers.
a) Ameron
(1) Arrow-Lock.
b) Or Equal.

4. Cast in Place Panel Liners.
a. Seamless manhole formed in place within existing manhole, extending from channel to frame.
1) Structurally independent of existing manhole structure.
2) Existing wall preparation as recommended by manufacturer.
b. Concrete.
1) Type I/II Portland cement concrete.
2) Non-Shrink.
3) Corrosive resistant.
4) Maximum Aggregate Size: 5/8 inch.
5) Fiber reinforcement and plasticizers to produce minimum compressive strength of 4,000 psi at 28 days.
c. Formwork.
1) Segmented forms in cylindrical and conical sections.
2) Provide adequate annular space for concrete.
3) Result in minimum finished manhole opening of 20 inches.
4) Sealed at bench and pipe openings to form water stop.
5) Removable from within newly cast in place manhole.
d. As specified, provide PVC or polyethylene panels for cast in place wall surface.
1) Minimum thickness: 0.065 inch.
2) Ribbed or studded for embedment into concrete.
a) Minimum pull out strength: 100 pounds per linear inch.
3) Fit securely to exterior of concrete forms.
4) Joints between panels sealed using Heat fusion or thermal welding.
e. Approved Manufacturers.
1) AP/M Permaform.
a) Permaform Liner.

b) Permaform with Con-Shield (anti-bacterial additive).
2) Or Equal.

5. Spray on Polyurethane Liners.
   a. Seamless manhole formed in place, within existing manhole extending from channel to frame.
   b. Two part 100% WOC-free self-priming polyurethane lining.
   c. Thickness:
      1) Dependent to manhole location, loads, water table and condition of manhole.
      2) Structurally independent of existing manhole structure, minimum 1/10 of an inch (100mils)
   d. Minimum Tensile Strength (ASTM D638): 7,450 psi.
   e. Minimum Compressive Strength (ASTM D695): 18,000 psi.
   f. Approved Manufacturers.
      1) SprayRoq Inc.
         a) Spray Wall
      b) Spray Shield Green II
      2) Or Equal.

H. Precast Concrete Manholes: See Section 02530 and Section 03400. I.
Manhole Frames and Covers: See Section 02530.

PART 3 EXECUTION

3.1 MAINTENANCE OF SERVICE

A. Maintain service usage throughout duration of project.
   1. Maximum time without service: 8 hours for property served by sewer.
      a. Without service longer than 8 hours will require bypass to sanitary sewer following Section 02530 at no cost to the Commission.

3.2 PUBLIC NOTIFICATION PROGRAM A. See Section 01110.

3.3 PREPARATION

A. Manhole Preparation: Following approved submittals for rehabilitation products used.
   1. Divert flow from channel.
   2. Prevent extraneous material from entering sewer lines during cleaning and rehab work.
      a. Filter solids-laden water through an approved de-silting device. No material shall be allowed to go downstream.
   3. Clean interior surface of manhole of debris, dirt, oil, grease, remains of old coating materials, and any other extraneous materials.
   4. Pressure wash interior of manholes to remove loose mortar, concrete and debris.
   5. Repair irregularities and missing material in manhole forming smooth surface.
   6. Stop leakage into manhole.

B. Chemical Grouting for Leakage Control.
   1. Provide 48 hour notice to Engineer prior to start of work for equipment inspection and testing.
      a. Allow measurements to be taken.
      b. Demonstrate acceptable grout volumetric measuring technique.
   2. Adjust chemical mixing ratios required for specific application.
      a. Minimum gel time 30 seconds or as directed by Engineer.
   3. Do not block pipes entering/exiting manhole with grout.
      a. Use mirror or camera to confirm pipes are not blocked.
   4. Do not damage manhole structure during operations.
      a. Repair damage as directed by Engineer.
   5. Protect area of manhole below repair work.

a. Do not allow solid material to enter sewage flow.
b. Remove protective devices as soon as practical.

6. Manhole Sealing: Follow ASTM F2414 and as specified herein.
   a. Brick manholes.
      1) Drill only the amount of holes necessary to stop leakage following industry standards and chemical grout manufacturer's recommendations.
         a) Do not use curtain of grout sealing method.
      2) Proceed with manhole reconstruction using reconstruction processes specified herein.
   b. Precast manholes.
      1) Seal pipe connections as specified by drilling between pipe and manhole opening and injecting grout.
      2) When specified, seal precast manhole base by drilling holes at leakage points along bench to wall, and in channel.
      3) At precast joints inject grout through holes drilled at leaking joint.
7. Hydraulic Water Plugs: Following approved submittals.
   a. Provide mechanical key by undercutting or square cutting opening and removing loose materials.
   b. Mix, handle, place and cure material.
   c. Finish surface as required for other rehabilitation work.
8. Oil-Free Oakum Water Plugs: Following approved submittals.
   a. Saturate oakum with resin.
      1) Use additives as required.
   b. Place, pack and cure material.

3.4 MANHOLE REHABILITATION

A. Locate Existing Manhole.
   1. Using available records, drawings, land surveying, GPS, metal detectors or other technology and techniques, locate, excavate and expose existing manhole.

B. Reset/Replace and Adjust manhole frame and cover: Following Section 02530 and Standard Details.

C. Chemical Grouting: As specified herein, following ASTM F2414 and specified herein.

D. Manhole Chimney Seals: Following approved submittals.
   1. Provide smooth circular surface following manufacturer's requirements.
      a. Install following Standard Details.
      b. Realign manhole frame and cover if required following Section 02530, Standard Details, and specified herein.
   2. Mix, handle, and apply material.

E. Cementitious Reconstruction: Following approved submittals and as specified herein.
   1. Mix and handle materials.
   2. Apply materials using rotary spray equipment or spray gun.
   3. Apply beginning at bottom of brickwork and work up to bottom of frame.
   a. Seal around pipe connections and steps.
   4. Do not allow material to enter sewage flow.
   5. Apply.
      a. Maximum applied thickness: 300 mils.
      b. Minimum applied thickness: 150 mils.
      c. Confirm with pictures and gauge.
   6. Trowel and brush for smooth finish.
   7. Cure using curing compound when recommended by manufacturer.
      a. Do not allow flow in manhole or traffic over manhole, until manufacturer's minimum cure times have been achieved.

F. MANHOLE LINERS: Following approved submittals.
   1. Cured in Place Liners.
      a. Custom fabricate liner to individual manhole dimensions.
      b. Line bench and channel area with compatible epoxy or resin material

placed in bottom of manhole. Extend minimum 6 inches up manhole wall.
c. Remove manhole steps.
d. Saturate liner with resin, place in manhole, pressurize with air or water and cure with hot water, steam or hot air.
e. Finish liner.
f. Finished liner: Forms monolithic structure from manhole frame to bench.

2. Epoxy Liners.
a. Mix and apply material.
1) Sagging of material is not permitted.
b. Seal around pipe connections and steps.
c. Cure.
d. Finished liner: Forms monolithic structure from manhole frame to channel.

3. Panel Liners.
a. Remove manhole steps.
b. Place pipe extensions in manhole at main line and pipes entering manhole as required.
c. Insert liner and attach to wall using supports.
1) Apply bonding agent compatible with grout or concrete to manhole wall before placing liner.
2) Provide adequate annular space between liner sheet and manhole wall to allow placement of concrete or grout.
3) Secure liner supports to manhole walls.
4) Secure liner to supports.
5) Form liner seams.
6) Place concrete or grout with no wrinkling of liner.
a) Vibrate to prevent voids.
7) After curing remove internal forms or supports.
8) Finish seams.
d. Liner Attached to Wall Using Mastic.
1) Apply mastic primer to manhole wall and cure.
2) Apply mastic to primed manhole wall.
3) Apply liner to mastic.
a) Embed anchoring extensions in mastic.
b) Wrinkling of liner not permitted.
4) Finish liner seams.
5) Finished liner: Forms monolithic structure from manhole frame to channel.

4. Cast in Place Panel Liner.
a. Remove manhole steps.
b. Erect internal forms.
1) Place PVC or PE liner with forms when specified.
2) Seal forms at bench to prevent concrete leakage.
c. Place concrete to prevent segregation of aggregate and cement.
d. Consolidate concrete to fill pockets, seams and cracks in existing manhole wall.
e. Remove formwork when concrete is cured.
f. Finish liner seams.
g. Seal concrete liner at frame and pipe penetrations.
h. Cured liner: Forms monolithic structure from manhole frame to channel.

G. Trim and seal incoming laterals and pipes.
H. Remove all construction and cleaning debris from site and dispose of properly at certified waste disposal facility.

3.5 REPLACE OR INSTALL MANHOLE
A. Follow Section 02530 and Standard Details.
1. Brick Manhole: Remove and install new precast manhole.

a. Replace existing exterior drops with inside drop c connections following Section 02530, Standard Details, and specified herein.

3.6 FIELD TESTING

A. Follow Section 01450 and specified herein.
   1. Monitor, record, and report to Engineer defects or damage to materials during installation.
   2. Collect, label, and store representative product samples.
      a. Submit product samples specified herein.
      b. Additional product samples maybe required, as directed by Engineer.
      c. Store and maintain products samples until contract maintenance bond has expired.
   3. Verify required testing is performed by approved laboratory.
   4. Engineer may inspect pre-rehabilitation work, rehabilitation operations, and post- rehabilitation work.

B. Video Inspections of post-rehabilitation condition of manhole.
   1. See Section 02956 for video inspection requirements.
   2. Submit to Engineer within 10 days following Section 02956.

C. Visual Inspection: Determine integrity of rehabilitation materials and water-tightness.
   1. Verify no inflow or infiltration.
   2. Verify services are reinstated and unobstructed.

D. Defects.
   1. When Engineer Deems Repairable: Repair defect, replace liner, install new manhole at no additional cost to the Commission.
   2. Document with CCTV recording following Section 02956

E. Manhole Lining: Test for continuity following ASTM D4787 and approved submittals.
   1. Conduct holiday test and gauge depth test on spray-on liners.
   2. Perform CCTV inspection of liner following Section 02956.
   3. Conduct pull test with embedded bolt or tab.
   4. Repair holes and discontinuities following manufacturer's recommendations.

F. Grout and Concrete: Test for compressive strength following ASTM C109.

3.7 WARRANTY INSPECTIONS

A. Conduct visual inspection prior to expiration of warranty to determine integrity of rehabilitation materials and water-tightness.
   1. Complete post inspection during first high groundwater period (spring or fall) following acceptance of work.
   2. Contractor will accompany Engineer on inspections.
   3. Inspect 25 percent of manholes rehabilitated at locations selected by Engineer.
      a. Infiltration and Inflow: None
      b. Structural Repair: Sound
      c. If more than one manhole fails warranty inspection, inspect all manholes with similar characteristics.
      d. Repair defects in accordance with Warranty.

PART 4 MEASUREMENT AND PAYMENT

4.1 MANHOLE REHABILITATION

A. Measurement: By each manhole located in various areas.
B. Payment: At unit price for each listed in Bid Schedule.

END SECTION 02957

SECTION 03300 CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Miscellaneous concrete elements, including equipment pads, light pole bases, flagpole bases, thrust blocks, and manholes.

B. Concrete curing.

1.02 RELATED REQUIREMENTS

A. Section 03100 - Concrete Forming and Accessories: Forms and accessories for formwork.

B. Section 03200 - Concrete Reinforcing.

C. Section 03313 - Concrete Paving: Sidewalks, curbs and gutters.

D. Section 03313 – Concrete Paving

1.03 PRICE AND PAYMENT PROCEDURES

1.04 REFERENCE STANDARDS

A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; American Concrete Institute International; 2010.

B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2002).

C. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2012.

D. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures; 2012.

1.05 SUBMITTALS

A. See Administrative Requirements, for submittal procedures.

B. Submit Concrete Mix Design for engineers' approval

PART 2 PRODUCTS

2.01 FORMWORK

A. Comply with requirements of Section 03100.

2.02 REINFORCEMENT

A. Comply with the requirements of Section 03200.

2.03 CONCRETE MATERIALS

A. Fly Ash: ASTM C618, Class C or F.

B. Calcined Pozzolan: ASTM C618, Class N.

C. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1.

END OF SECTION 03300

SECTION 03330 REINFORCING STEEL

PART 1 - GENERAL

1.01 This work shall consist of the furnishing and placing of reinforcing steel, deformed and smooth, of the size and quantity indicated and in accordance with these specifications.

PART 2 - PRODUCTS

2.01 BARS

A. Bar reinforcement shall be deformed and shall conform to ASTM A 615, A 616, Grades 40, 60 or 75 and shall be open-hearth, basic oxygen or electric furnace new billet steel, unless otherwise indicated. Large diameter new billet steel (Nos. 14 and 18), Grade 75, will be permitted for straight bars only.

B. Where bending of bar sizes No. 14 or No. 18 of Grades 40 or 60 is required, bend testing shall be performed on representative specimens as described for smaller bars in the applicable ASTM specification. The required bend shall be 90 degrees at a minimum temperature of 60 F around a pin having a diameter of 10 times the nominal diameter of the bar and shall be free of cracking.

C. Spiral reinforcement shall be either smooth or deformed bars or wire of the minimum diameter indicated. Bars for spiral reinforcement shall comply with ASTM A 675, A 615 or A 617. Wire shall comply with ASTM A 82. The minimum yield strength for spiral reinforcement shall be 40,000 psi.

D. In cases where the provisions of this item are in conflict with the provisions of the ASTM Designation to which reference is made, the provisions of this item shall govern.

E. Report of chemical analysis showing the percentages of carbon, manganese, phosphorus and sulfur will be required for all reinforcing steel when it is to be welded, except for drill shafts. No tack welding will be allowed. All welding shall conform to the requirements of AWS D-1-72.

F. The nominal size and area and the theoretical weight (lbs) of reinforcing steel bars covered by these specifications are as follows:

BAR SIZE NUMBER	NOMINAL DIAMETER INCHES	NOMINAL AREA SQUARE INCHES	WEIGHT PER LINEAR FOOT
2	0.250	0.05	0.167
3	0.375	0.11	0.376
4	0.500	0.20	0.668
5	0.625	0.31	1.043
6	0.750	0.44	1.502
7	0.875	0.60	2.044
8	1.000	0.79	2.670
9	1.128	1.00	3.400
10	1.270	1.27	4.303
11	1.410	1.56	5.313
14	1.693	2.25	7.65
18	2.257	4.00	13.60

G. Smooth bars, larger than No. 4, may be steel conforming to the above or may be furnished in any steel that meets the physical requirements of ASTM A36.

H. Smooth, round bars shall be designated by size number through No. 4. Smooth bars above No. 4 shall be designated by diameter in inches.

2.03 WELDED WIRE FABRIC

A. Wire for fabric reinforcement shall be cold-drawn from rods hot-rolled from open-hearth, basic oxygen or electric furnace billet. Wire shall conform to the requirements of the standard Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement, ASTM A82 or A 496. Wire fabric, when used as reinforcement, shall conform to ASTM A 185 or A 497.

B. When wire is ordered by size numbers, the following relations between size number, diameter in inches and area shall apply unless otherwise indicated:

SIZE W NUMBER	NOMINAL DIAMETER (INCH)	NOMINAL AREA SQUARE INCHES
31	0.628	0.310
30	0.618	0.300
28	0.597	0.280
26	0.575	0.260
24	0.553	0.240
22	0.529	0.220
20	0.505	0.200
18	0.479	0.180
16	0.451	0.160
14	0.391	0.140
12	0.391	0.120
10	0.357	0.100
8	0.319	0.080
7	0.299	0.070
6	0.276	0.060
5.5	0.265	0.055
5	0.252	0.050
4.5	0.239	0.045
4	0.226	0.040
3.5	0.211	0.035
3	0.195	0.030
2.5	0.178	0.025
2	0.160	0.020
1.5	0.138	0.015
1.2	0.124	0.012
1	0.113	0.010
0.5	0.080	0.005

C. When deformed wire is required, the size number shall be preceded by D and for smooth wire the prefix W shall be shown.

2.04 CHAIRS AND SUPPORTS

A. Chairs and Supports shall be steel, precast mortar or concrete block cast in molds meeting the approval of the ENGINEER of sufficient strength to position the reinforcement as indicated when supporting the dead load of the reinforcement, the weight of the workers placing concrete and the weight of the concrete bearing on the steel.

B. Chairs shall be plastic coated when indicated.

C. Chair types and uses shall be as follows:

Structural or Architectural Elements (columns, beams, walls, slabs) subjected to sand blasting, water blasting or grinding.	Galvanized steel or steel chairs with plastic coated exposed to weather, not feet.
Structural or Architectural Elements exposed to weather and subject to sand blasting, water blasting or grinding.	Stainless steel chairs.
Structural or Architectural Elements exposed to weather or corrosive conditions.	Uncoated steel chairs.

Slabs and grade beams cast on grade. Steel chairs with a base with 9 inch^2 minimum area or sufficient area to prevent the chair from sinking into fill or subgrade. Precast mortar or concrete blocks meeting the requirements of this item may be used.

2.05 BENDING

A. The reinforcement shall be bent cold, true to the shapes indicated. Bending shall preferably be done in the shop.

B. Irregularities in bending shall be cause for rejection.

C. Unless otherwise indicated, the inside diameter of bar bends, in terms of the nominal bar diameter (d), shall be as follows:

1. Bends of 90 degrees and greater in stirrups, ties and other secondary bars that enclose another bar in the bend:

Bar Number	Grade 40	Grade 50
3, 4, 5	3d	4d
6, 7, 8	4d	5d

2. All bends in main bars and in secondary bars not covered above:

Bar Number	Grade 40	Grade 60	Grade 75
3 - 8	6d	6d	--
9, 10	8d	8d	--
11	8d	8d	8d
14, 18	10d	10d	--

2.06 STORAGE

A. Steel reinforcement shall be stored above the surface of the ground upon platforms, skids or other supports and shall be protected as far as practicable from mechanical injury and surface deterioration caused by exposure to conditions producing rust.

B. When placed in the work, reinforcement shall be free from dirt, paint, grease, oil or other foreign materials. Reinforcement shall be free from injurious defects such as cracks and laminations.

C. Rust, surface seams, surface irregularities or mill scale will not be cause for rejection, provided the minimum dimensions, cross sectional area and tensile properties of a hand wire brushed specimen meets the physical requirements for the size and grade of steel indicated.

2.07 SPLICES

A. No splicing of bars, except when indicated or specified herein, will be permitted without written approval of the ENGINEER.

B. No substitution of bars will be allowed without the approval of the ENGINEER. Any splicing of substituted bars shall conform to Table 03330-1.

C. Splices not indicted will be permitted in slabs no more than 15 inches in thickness, columns, walls and parapets, but not included for measurement, subject to the following:

1. Splices will not be permitted in bars 30 feet or less in plan length.

2. For bars exceeding 30 feet in plan length, the distance center to center of splices shall not be less than 30 feet minus 1 splice length, with no more than 1 individual bar length less than 10 feet.

3. Splices not indicated, but permitted hereby, shall conform to Table 03330-1. The specified concrete cover shall be maintained at such splices and the bars placed in contact and securely tied together.

Table 03330-1
Minimum Lap Requirements

Bar Number		**Grade 40**		**Grade 60**	
No.	3	1 foot	0 inches	1 foot	4 inches
No.	4	1 foot	2 inches	1 foot	10 inches
No.	5	1 foot	5 inches	2 feet	3 inches
No.	6	1 foot	9 inches	3 feet	0 inches
No.	7	2 feet	4 inches	4 feet	0 inches
No.	8	3 feet	0 inches	5 feet	3 inches
No.	9	3 feet	10 inches	6 feet	8 inches
No.	10	4 feet	10 inches	8 feet	5 inches
No.	11	5 feet	11 inches	10 feet	5 inches

D. Spiral steel shall be lapped a minimum of 1 turn. Bar No. 14 and No. 18 may not be lapped.

E. Welding of reinforcing bars may be used only where indicated or as permitted herein. all welding operations, processes, equipment, materials, workmanship and inspection shall conform to the requirements indicated. All splices shall be of such dimension and character as to develop the full strength of the bar being spliced.

F. End preparation for butt welding reinforcing bars shall be done in the field, except Bar No. 6 and larger shall be done in the shop. Delivered bars shall be of sufficient length to permit this practice.

G. For box culvert extensions with less than 1 foot of fill, the existing longitudinal bars shall have a lap with the new bars as shown in Table 03330-1.

H. For box extensions with more than 1 foot of fill, a minimum lap of 6 inches will be required.

I. Unless otherwise indicated, dowel bars transferring tensile stress shall have a minimum embedment equal to the minimum lap requirements shown in Table 03330-1.

J. Shear transfer dowels shall have a minimum embedment of 12 inches.

PART 3 - EXECUTION

3.01 PLACING

A. Reinforcement shall be placed as near as possible in the position indicated. Unless otherwise indicated, dimensions shown for reinforcement are to the center of the bars.

B. In the plane of the steel parallel to the nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of the spacing between bars. In the plane of the steel perpendicular to the nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch.

C. Cover of concrete to the nearest surface of steel shall be as follows:

	Item	Minimum Cover Inches
1.	Concrete cast against and permanently exposed to earth.	3
2.	Concrete exposed to earth or weather:	
	Bar No. 6 through 18 bars	2
	Bar No. 5, W31 or D31 wire and smaller	1 1/2
3.	Concrete not exposed to weather or in contact with ground:	
	(slabs, walls, joists)	
	Bar No. 14 and 18	1 1/2
	Bar No. 11 and smaller	1
	(Beams, columns)	
	Primary reinforcement, ties, stirrups, spirals	1 1/2
	(Shells, folded plate members)	
	Bar No. 6 and larger	1
	Bar No. 5, W31 or D31 wire, and smaller	1

D. Vertical stirrups shall always pass around the main tension members and be attached securely thereto. The reinforcing steel shall be spaced its required distance from the form surface by means of approved galvanized metal spacers, metal spacers with plastic coated tips, stainless steel spacers, plastic spacers or approved precast mortar or concrete blocks. For approval of plastic spacers on a project, representative samples of the plastic shall show no visible indications of deterioration after immersion in a 5 percent solution of sodium hydroxide for 120 hours.

E. All reinforcing steel shall be tied at all intersections, except that where spacing is less than 1 foot in each direction, alternate intersections only need be tied. For reinforcing steel cages

for other structural members, the steel shall be tied at enough intersections to provide a rigid cage of steel. Mats of wire fabric shall overlap each other 1 full space as a minimum to maintain a uniform strength and shall be tied at the ends and edges.

F. Where prefabricated deformed wire mats are specified or if the CONTRACTOR requests, welded wire fabric may be substituted for a comparable area of steel reinforcing bar plan, subject to the approval of the ENGINEER.

G. A suitable tie wire shall be provided in each block, to be used for anchoring to the steel. Except in unusual cases and when specifically authorized by the ENGINEER, the size of the surface to be placed adjacent to the forms shall not exceed 2 1/2 inches square or the equivalent thereof in cases where circular or rectangular areas are provided. Blocks shall be cast accurately the thickness required and the surface to be placed adjacent to the forms shall be a true plan, free of surface imperfections.

H. Reinforcement shall be supported and tied in such a manner that sufficiently rigid cage of steel is provided. If the cage is not adequately supported to resist settlement or floating upward of the steel, overturning of truss bars or movement in any direction during concrete placement, permission to continue concrete placement will be withheld until corrective measures are taken. Sufficient measurements shall be made during concrete placement to insure compliance with the above.

I. No concrete shall be deposited until the ENGINEER has reviewed the placement of the reinforcing steel and all mortar, mud, dirt, etc., shall be cleaned from the reinforcement, forms, workers' boots and tools.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. The measurement of quantities of reinforcement furnished and placed will be based on the calculated weight of the steel actually placed as indicated, with no allowance made for added bar lengths for splices requested by the CONTRACTOR nor for extra steel used when bars larger than those indicated or with a higher grade of steel are substituted with the permission of the ENGINEER.

B. Tie wires and supporting devices will not be included in the calculated weights.

C. The calculated weight of bar reinforcement will be determined using the theoretical bar weight set forth in this item.

D. Measurement required by a change in design will be computed as described above for the actual steel required to complete the work.

4.02 PAYMENT

A. Reinforcing steel shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provided in the proposal contract.

B. Compensation, whether by contract pay item or incidental work, will be for furnishing, bending, fabricating, welding and placing reinforcement, for all clips, blocks, metal spacers, ties, chairs, wire or other materials used for fastening reinforcement in place and for all tools, labor, equipment and incidentals necessary to complete the work.

END OF SECTION 03330

SECTION 11322
SUBMERSIBLE LIFT STATION

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish, install and test the complete submersible lift station systems including but not limited to submersible pumps, guide rail assemblies, level switches, control panels, and all appurtenances necessary to make a complete and operable system as indicated in the Specifications and as shown on the Drawings.

1.02 QUALITY ASSURANCE

A. Qualifications of the Pump Manufacturer/Supplier:

1. The submersible pumps complete with related appurtenances including instrumentation and controls as specified herein forms an integrated system, and as such shall be furnished and coordinated by a single pump Supplier who shall provide all pumping equipment and appurtenances, regardless of manufacturer. The Supplier shall be responsible for the satisfactory operation of the entire system.
2. The Specifications and Drawings direct attention to certain required features of the equipment but do not purport to cover all details entering into its design and construction. Nevertheless, the Contractor shall furnish the equipment complete in all details and ready for operation for the intended purpose.
3. Manufacturer shall have a minimum of 5 years experience in the design and manufacture of submersible stations. Supplier shall have minimum of 5 years experience in coordination responsibility and supply of integrated pump station systems as described above.
4. Supplier shall have a full-service repair center located within a 150-mile radius of the Port of Brownsville - City of Brownsville, Texas.
5. Lift station installations that have proven reliable to the Port of Brownsville in similar applications over the last 5 years.
6. Equipment designed, constructed, installed and tested in accordance with the best practice and methods and the standards of the Hydraulic Institute.
7. Only pumping units having wire-to-water efficiencies within a reputable manufacturer’s equipment range of efficiencies will be accepted.
8. Contractor will perform pump tests in the Engineer’s presence to indicate that pump efficiency, capacity, and discharge head conform to the pump performance specifications as identified under “Conditions of Service” below. Refer to Paragraph 3.02 at the end of this Section.
9. Lift stations will include all of the alarms and other features required by the Texas Commission on Environmental Quality (TCEQ).

B. Acceptable Manufacturers:
   1. Xylem Water Solutions USA, Inc.- Flygt Products
   2. Engineer approved pump manufacturer

1.03 SUBMITTALS

A. The Contractor shall submit the following in an integrated submittal package for Engineer’s review:
   1. Complete layout drawings illustrating all construction details, dimensions, shop painting details, and materials by generic name. Submittal shall include any manufacturer instructions on installation, storage, and handling.
   2. Manufacturer’s literature, shop drawings, illustrations, maintenance instructions, and a list

of maintenance materials, list of special tools, and parts list.

3. Complete operating manuals.
4. Pump manufacturer's performance curves showing total dynamic head, pump input horsepower and pump efficiency throughout the range of each pump.
5. Manufacturer's certification that equipment, accessories and shop pointing meet or exceed the Specification requirements. Submit equipment performance testing results as required by these specifications. Should the proposed equipment not comply with all the specification requirements, all deviations from the specification requirements shall be listed.
6. Submit all requirements for interface with controls and/or equipment furnished in Division 16. Submit wiring diagrams as required to accurately depict all such interface requirements to ensure proper operations of each system or item of equipment.
7. Contractor shall provide a letter from each individual equipment manufacturer certifying that the equipment manufacturer or supplier has:
   a. Reviewed the Construction Documents, the intended installation by the Contractor, and the intended functional and operational conditions;
   b. Determined all conditions to be acceptable; and
   c. Found no conditions which would cause the warranty to be void or the equipment to function improperly.
   d. The submittals will not be reviewed without the inclusion of these noted certifications.
8. Warranty.
9. Complete Bill of Materials.

B. Prior to shipment, the completed pump and motor assemblies shall be shop tested for performance in accordance with the Hydraulic Institute Standards, and certified copies of the pump and motor performance data shall be furnished. For all pumps, the manufacturer shall:
   1. Test motor and cable insulation for moisture or insulation defects per UL criteria.
   2. Run pumps shall while completely submerged to establish that the design points listed under the "Conditions of Service" below.
   3. Submit certification that pumps meet the design points and Hydraulic Institute Standards.

C. Attention is directed to the fact that the Drawings are based upon a particular piece of equipment. If the equipment to be provided requires an arrangement differing from that indicated on the Drawings, the Contractor shall prepare and submit for review, detailed mechanical drawings showing all necessary changes. Such changes shall be at no additional cost to the Owner.

1.04 GUARANTEE

A. The Contractor shall obtain a 5 year prorated warranty from the pump manufacturer as follows from the date of startup, in the name of the Owner, against defects in workmanship and materials, covering parts and labor. The minimum terms of the warranty shall be as follows:

0-18 months	100%
19-39 months	50%
40-60 months	25%
Provide 12 month clog free guarantee	

The terms of the warranty shall be from the date of substantial completion as determined by the Engineer.

B. The Contractor shall obtain a 5 year warranty from the access hatch manufacturer, in the name of the Owner, against defects in workmanship and materials, covering parts and labor.

C. Fiberglass wet well guarantee shall be as specified.

1.05 CONDITIONS OF SERVICE

A. The pumping units specified in this section will be used to lift and transfer domestic

wastewater using the following design flow criteria:

Number of pumps:	2
Size of Pumps:	2” Minimum
Minimum Horsepower:	20
RPM:	3290 Maximum
Voltage:	460 V
Phase:	3-phase

Firm Flow with two Pumps On: **120 gpm (.173MGD) Minimum Efficiency 31.56% at required Head**

The Pumps should be able to pump 60 gpm (.086 MGD) with 1 Pump off.

Pumps shall be capable of operating throughout the pump curve without overload or cavitation.

B. Minimum allowable velocity in the lift station force main with one pump operating shall be 2 fps. Maximum velocity with all lag pumps operating shall be limited to 8 fps.

2.00 PRODUCTS

2.01 GENERAL

A. Pumping units shall pump sewage from a wet well and discharge into a force main against a total dynamic head as specified under Conditions of Service.

B. The pumps shall be controlled automatically by mercury float control system. All equipment for the station shall perform automatically. Manual operation of pumps shall also be possible.

2.02 PUMPS

A. General:
1. All pumps and guide rail system parts shall be designed and proportioned to have liberal strength, stability, and stiffness to perform required functions for the pumps specified.
2. All hardware, such as anchor bolts, plates, nuts and washers, etc., shall 316 stainless steel of ample size and strength for purpose intended, furnished and installed by Contractor in accordance with manufacturer’s instructions.
3. Provide ample room and fittings for inspection, repairs and adjustments.
4. Slide-away coupling guide rail system and removal mechanism shall be designed so that when pump is idle, it may be removed for service or inspection and then returned to service without entering the wet well to unbolt or unlock the connection between the pump and piping.
5. Pump base elbow accurately aligned, sized, and rigidly anchored in position in accordance with the manufacturer’s requirements and recommendations and allow for complete removal of each pump.
6. No portion of the pump shall bear directly on the floor.
7. The pumps shall have a wide suction and shall easily pass 2-inch solids or stringy matter.
8. All major pump components shall be of gray cast iron, ASTM A-48, Class 35 minimum standard, with smooth surfaces devoid of blow holes or other irregularities.
9. All metal surfaces coming into contact with the pumpage, other than stainless steel, shall be protected by a factory applied spray coating of alkyd primer with a chlorinated rubber paint finish on the exterior of the pump.
10. Critical mating surfaces where watertight sealing is required shall be machined and fitted with nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.
11. Rectangular cross sectioned gaskets requiring specific torque limits to achieve

compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

12. Provide cable holders and anchor bolts of 316 stainless steel construction as shown on the Drawings. All cable holder hooks shall be ½-inch diameter minimum. Anchor bolts shall have minimum 6-inch embedment in concrete and be cast in place. Anchor bolt installation after slab placement is unacceptable.
    a. Provide one holder for holding in place and supporting all the level control float cables. The level control float cable holder shall have one hook for each float installed plus one spare. Pump cable support Kellems grips shall not be hung on float cable holder.
    b. Provide one combination upper guide rail bracket/cable holder for each pump and lifting cable/chain and serve as the upper guide rail bracket. Combination bracket/cable holder shall have two hooks and be as manufactured by Halliday Products, Inc., Orlando FL, or equal. Contractor to coordinate requirements with pump manufacturer.

B. Guide Rail:
    1. Pump shall be mounted on a guide rail system, with slide away coupling base/discharge elbow.
    2. The lower guide holders shall be integral with the discharge connection and shall be anchored to the wet well floor by means of stainless steel anchors.
    3. There shall be two guide rails per pump constructed of stainless steel pipe of explosion-proof (non-sparking) design. Rails shall be 316 SS 2-inch minimum diameter or larger as recommended by the manufacturer.
    4. Support guide rails with brackets at the top of the wet well in the hatch opening. Intermediate guide brackets shall be supplied for rail lengths in excess of 15 feet. Maximum spacing of guide brackets shall be no more than 10 feet. Intermediate guide brackets shall be secured to the discharge pipes. Attachment of guide rail brackets to the fiberglass wet well is prohibited. Upper bracket shall have two integral cable holder hooks (½-inch diameter) for power cable and lifting chain support, and shall be secured by anchor bolts cast into the top slab a minimum of 6 inches.
    5. Guide bar brackets shall be 316 stainless steel.
    6. Lower guide bar supports shall be integrally cast boss on the discharge connection and arranged such that the guide bar is held in place by sliding over the boss.
    7. Guide rails are part of the pump package and shall be supplied by the pump manufacturer.

C. Pump Casing:
    1. Constructed of gray cast iron, ASTM A48, Class 35 minimum, of ample thickness, capable of prolonged resistance to the abrasive action of solids or foreign matter contained in the liquid passing through the pump.

D. Discharge Connection:
    1. Minimum size and type indicated on the Drawings.
    2. Sealing of pump to discharge connection shall be by means of metal to metal contact.
    3. Discharge connection and guide rail sliding brackets shall be non-proprietary in design allowing compatibility with any pump brand listed under “Acceptable Manufacturers”.

E. IMPELLER - Hard-Iron

The impeller shall be of Hard-Iron ® (ASTM A-532 (Alloy III A) 25% chrome cast iron), dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The leading edges of the impeller shall be hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means

of a single trim screw. The impeller shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.

F. VOLUTE / SUCTION COVER

The pump volute shall be a single piece grey cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide trash release pathways and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The insert ring shall be cast of Hard-Iron ® (ASTM A-532 (Alloy III A) 25% chrome cast iron) and provide effective sealing between the multi-vane semi-open impeller and the volute housing.

G. Shaft:
1. Pump and motor shaft shall be the same unit. Couplings shall not be acceptable. The pump-motor shaft shall be ASTM A572 431 stainless steel, accurately machined.
2. Maximum deflection shall not exceed 0.002 inches at the lower seal.
3. All shafts shall be dynamically balanced and shall be amply sized to minimize shaft deflection. Shaft overhang shall not exceed 2.5 times the shaft diameter.

H. Seal:
1. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in an oil reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate.
2. The lower, primary seal unit, located between the pump and the oil chamber shall contain one stationary and one positively driven rotating tungsten carbide ring.
3. The upper, secondary seal unit, located between the oil chamber and the motor housing, shall contain one stationary tungsten carbide ring and one positively driven rotating tungsten carbide seal ring.
4. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The following seal types shall not be considered acceptable nor equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces.
5. Cartridge type systems will not be acceptable. No system requiring pressure differential to offset pressure and to affect sealing shall be used.
6. Each pump shall be provided with an oil chamber for the shaft sealing system. The oil chamber shall be designed to prevent overfilling and to provide oil expansion capacity. Oil shall be white paraffin food grade.
7. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load.

I. Motor:
1. Submersible pump motors shall be of nationally known manufacture and conform to NEMA standards and specifications. The motor and pump shall be designed and assembled by the same manufacturer.
2. Squirrel-cage, induction, shell type design housed in an air filled, water tight chamber, NEMA Design B.
3. The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of $\pm$10%. The motor shall be designed for operation in ambient conditions of 40°C (104°F) and with a temperature rise not to exceed 80°C. A performance chart shall be provided showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.
4. The stator windings and stator leads shall be insulated by trickle impregnation method

using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95% with moisture resistant Class H insulation rated for 180°C.

5. Motors shall have normal starting torque and low starting current.
6. Motors shall maintain sufficient capacity to operate pump throughout entire pump performance curve from shut-off through run-out without exceeding name-plate rating for current and power.
7. The motor shall be designed for continuous duty handling of pumped media at 40°C (104°F) and be capable of up to 15 evenly spaced starts per hour.
8. Pump motors shall be furnished with ball bearings, permanently grease lubricated. Ball bearings shall be designed for a minimum B-10 rating of 70,000 hours.
9. Vertical motors shall be provided with radial keyways to absorb thrust caused by the shaft.
10. The junction chamber containing the terminal board shall be hermetically sealed from the motor by an elastomer compression seal.
11. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board. Wire nuts or crimping type connection devices are not acceptable.
12. Leads shall be terminated in a cast connection box and shall be clearly identified.
13. The motor shall be fitted with heavy lifting eyes, each capable of supporting the entire weight of the pump and motor.
14. A heat sensor thermostat shall protect motor against excess heat in compliance with its U.L. Class I, Group D rating. Sensor shall reset automatically at the motor when motor cools with manual reset at the control panel.
15. An electric sensing probe shall be mounted in the seal chamber to detect any water leakage past the outer seal. Moisture detection shall send a signal to the control panel to shut pump down and stay activated until the pump is repaired and the alarm is reset.
16. Pumps handling sewage shall be rated explosion-proof, NEMA Design B, Class I, Group D, Division 1.

J. Power Cable:
1. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices.
2. The outer jacket of the cable shall be oil resistant chloroprene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.
3. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall isolate the interior from foreign material gaining access through the pump top.
4. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

K. Lifting Cable and Retrieval Mechanism:
1. Furnish with one complete Flygt Pump Lift system or approved equal. The system shall include Nylon rope connected to high tensile strength proof-tested chain and forged steel Grip-Eye for use with a mechanical lifting device. System shall be appropriately sized for the weight of pump to be lifted.
2. Chain/cable length shall be equal to the height between the pump lifting handle and a point five feet above the top slab.
3. Chain/cable shall attach to the pump lifting eye or lifting bail with a stainless steel shackle.

L. Spare Parts:
1. Spare parts shall be delivered at the same time as the equipment to which they pertain.
2. The contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.

3. Parts shall be packaged in individual suitable containers labeled with the part number, name and quantity.
4. Spare parts shall include:
   a. Two (2) complete sets of pump seals, gaskets, bearings, and o-rings per each pump size.
   b. Any special tools required to service the equipment.
   c. One (1) set of bearings for each size pump.
   d. One (1) impeller wear ring for each pump size.

2.03 CONTROL SYSTEM

A. Functional Description
   1. Pump Control: Pumps shall be automatically turned on and off at wet well levels identified on the Drawings. Under normal operating conditions with all pumps operational, one pump shall serve as standby. The lead pump shall start when the wet well level reaches the “LEAD PUMP ON” elevation, and lag pumps, excluding one standby pump, shall turn on at the lag elevations indicated. When the wet well is pumped down to the “ALL PUMPS OFF” level, all pumps shall shut off and the pump start status (i.e. standby, lead, lag, lag 2, etc.) shall automatically alternate according to a prescribed sequence. However, automatic alternation shall not occur if the lead pump selection switch in the control panel is set for a fixed status. The pump alternator shall select as the lead pump the next pump in sequence having been idle for the longest period of time (i.e. First On, First Off). With all pumps operational, the standby pump shall not start.
   2. Alarm Control: Pump over temperature, overload, or seal failure shall signal an alarm condition and cause the pump to be locked out and removed from the alternation sequence. Manual reset of the alarm condition shall unlock the pump and restore its position in the pump alternation sequence.
   3. Alarm Level Control: If the liquid level drops below the “LOW LEVEL ALARM” float elevation, all pumps shall be locked out. If the liquid level reaches the “HIGH LEVEL ALARM” float elevation, an alarm shall be indicated, the running pumps shall continue to run, and the standby pump shall start.

B. Automatic Controls
   1. The control of pump operation and wet well level alarms shall be by means of mercury float switch system.
   2. Mercury float switches shall be suspended from the cable holder hooks. Provide one mercury float switch at each of the following levels indicated on the Drawings:
      a. HIGH LEVEL ALARM
      b. ALL PUMPS OFF
      c. LEAD PUMP ON
      d. LAG PUMP ON
      e. HIGH LEVEL ALARM
   3. The low level switch shall be interlocked to cut-off pump in the automatic mode.

C. Alarm System
   1. The alarm system shall activate indicator lights located in the control panel for each of the following alarm conditions:
      a. Power outage
      b. High water level
      c. Low water level
      d. Pump seal failure (one light per pump)
      e. Pump over temperature (one light per pump)
      f. Pump overload (one light per pump)
   2. Each alarm point shall be provided with auxiliary dry contacts and all contacts shall be wired to a teledialer.
   3. A manual alarm reset shall be furnished for the alarm lights, as well as a lamp test push button.

D. Control Panels shall be as specified in Division 16.

E. Wiring
1. The pump station control panel shall be completely wired at the factory in accordance with the latest edition of National Electrical Code.
2. All wiring in the pump station control panel shall be color coded and numbered and indicated on the wiring diagram by the manufacturer.
3. Sufficient flexible cable shall be provided on the motor to allow the motor to be removed without detaching the power leads.
4. A one-line schematic diagram on the Drawings indicates the electrical service of the pump station.

2.04 WETWELL AND APPURTENANCES

A. Wet well
1. The wet well shall be constructed of fiberglass reinforced polyester resin as indicated on the Drawings and as specified in Section 02572.
2. The entrance hatches, vent fittings and electrical conduits shall be cast into the wet well top slab as shown on the Drawings.
3. All Lift Station Wet Well pipe connections shall be factory installed. If required, and pre-approved by the Owner, field-cut pipe penetrations in the barrel of the wet well and receiving manhole shall be cut by means of a hole-saw and completed using “Inserta Tee” type stub out connections. All other means for field-cutting wall penetrations are prohibited. Stub outs larger than 15-inch shall be factory installed.

B. Access Hatches:
1. Cover doors and frames shall be of all-aluminum construction. Covers shall open to 90° and lock automatically in the open position. A grip handle shall be provided to release the cover for closing. Covers shall be constructed to withstand a minimum 300 psf live load with a maximum allowable deflection of 1/150 of the span.
2. Contractor shall coordinate hatch dimensions and submit shop drawings from the hatch manufacturer demonstrating hatches are adequately sized for pump to be provided.
3. Door leaf(s) shall be ¼-inch aluminum diamond pattern plate reinforced with structural aluminum channels.
4. Angle frame shall be ¼-inch aluminum with continuous anchor flange.
5. Doors shall incorporate a 90° return flange around the perimeter.
6. Door leafs having any dimension in excess of 48 inches shall be equipped with spring operators for easy opening such that the force required to completely open the door does not exceed nine (9) pounds at the edge of the plate.
7. Doors shall close flush with the frame and rest on a built-in neoprene cushion/gasket.
8. Cover door shall be equipped with a padlock bar for securing the hatch with a padlock and a recessed lifting handle.
9. All hardware including but not limited to hinges, pins, nuts, bolts, locking devices, etc., shall be 316 stainless steel.
10. The cover frame shall be cast in the top slab.
11. A “safety hatch” type accessory shall be included to provide fall-through and confined space access protection as required by OSHA standard 126.502 (c) (4) (I) drop test. All metal hardware shall be 316 stainless steel.
12. Access hatches shall carry a lifetime guarantee against defects in material and/or workmanship.
13. Aluminum embedded or in contact with concrete must be painted with one shop coat of zinc chromate followed by one heavy coat of aluminum pigmented asphalt paint.
14. Field cutting of finished surfaces is not allowed unless specifically approved by the Engineer.
15. Weldments:
    a. Welding of parts shall be in compliance with the latest edition of AWS D1.2. Welding shall be done by welders certified to perform welding in accordance with the

requirements of the AWS Code.
   b. Weld aluminum work on the unexposed side when possible in order to prevent pitting or discoloration.
   c. Welded joints shall be rigid and continuously welded or spot welded as specified or shown. Dress the face of welds flush and smooth. Exposed joints shall be close fitting and located where least conspicuous.
16. Acceptable Manufacturers:
   a. Halliday Products, Orlando, FL.
   b. Or equivalent.

C. Pump Winch Base and Embedded Sockets
Contractor shall provide and cast in place a portable hoist and embedded hoist socket and debris cap where indicated on the Drawings. 316 SS Adjustable Hoist for a lifting capacity of 1330 lbs (Halliday Products). Embedded 316 SS lined hoist socket for each pump required.

D. Vent(s): Install FRP Fiberglass vent line(s) and fittings of the quantity and size specified and connected to the wet well cylinder at the location shown on the drawings. Vent piping shall be installed according to the details contained in the plans.

2.05 PIPING AND VALVES

1. Piping carrying sewage within the lift station below and above grade shall be flanged Class 53 ductile iron pipe and fittings unless otherwise specified in the plans.
2. Make flanged joints with bolt and nut. Nuts and bolts inside the wet well shall be 316 stainless steel. Outside the wet well, bolts and nuts shall be Grade B meeting the requirements of ASTM A307.
3. Provide wall castings conforming to ANSI A21.10 except where otherwise indicated on the drawings. Casting shall have central fin not less than ½-inch thick and of the same diameter as the flange to form a water stop/thrust collar at the center of the slab.
4. Check valves and Gate valves in the sewage discharge pipes shall be 125 pound class and conform to the requirements of Section 15100. Check and gate valve size shall be as shown on the Drawings. Valves shall be installed in a manner that will provide for proper clearances and ease of operation.
5. All buried pipe connections to lift station shall have a sleeve type flexible connection 4 feet from the pump station or as shown on the Drawings.
6. Pipe Supports and Hangars:
   a. All pipes shall be adequately supported as shown on the Drawings. Pipe saddle supports shall be adjustable type with pipe and floor flanges as manufactured by Anvil International Inc. (Fig.264), Carpenter & Paterson Inc., or equal. Pipe Supports shall be adjustable, and zinc plated. The floor flanges shall be secured to concrete piers or concrete slab as shown on the Drawings using 316 stainless steel anchor bolts cast in place.
   b. Concrete inserts for hangers and supports shall be furnished and installed in the concrete as it is placed. The inserts shall in accordance with the requirements of the piping layout and jointing method and their locations shall be verified from approved piping layout drawings and the structural drawings. Pipe hangers and supports are specified in Section 15094.
   c. Layouts for hanger and supports shall be submitted to the Engineer for approval.

3.00 EXECUTION

3.01 INSTALLATION

A. Contractor shall install equipment in accordance with manufacturer's requirements.

B. Do not install equipment until all defects or inadequacies in receiving structure have been corrected to meet Specifications.

C. Erect and lubricate equipment in strict accordance with the manufacturer's instructions.

D. All equipment mechanisms shall withstand all stresses that may occur during fabrication, erection, and intermittent or continuous operation.

E. Contractor to furnish and install supports as indicated on the Drawings, and as required by the equipment manufacturer.

F. Thoroughly clean all equipment and appurtenant piping to remove all dirt, grease, mill scale, and other foreign matter and touch up factory finish to the satisfaction of the Engineer.

3.02 START-UP AND TESTING

A. After all pumps have been completely installed, the Contractor shall conduct in the presence of the engineer, such tests as are necessary to insure that the pumps perform satisfactorily. Field tests shall include all pumps included under this section. The contractor shall supply the water necessary to complete the field tests.

B. If the pump performance does not meet the Specifications, corrective measures shall be taken by the Contractor, or pumps shall be removed and replaced with pumps that satisfy the conditions specified.

C. All piping shall be pressure tested for water tightness in accordance with Section 02556 of these Specifications.

END OF SECTION

SECTION 15100 VALVES AND APPURTENANCES

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish all labor, materials, equipment and incidentals required and install complete and ready for operation all valves and appurtenances as shown on the Drawings and as specified herein.

B. All valves and appurtenances shall be of the size shown on the Drawings and as far as possible all equipment of the same type shall be from one manufacturer.

C. All valves and appurtenances shall have the name of the maker and the working pressure for which they are designed cast in raised letters upon some appropriate part of the body.

D. All exposed valves, where applicable, shall have “open-closed” position indicators. The position indicators shall be conveniently located for easy visibility.

E. The equipment shall include, but not be limited to, the following:

1. Resilient Seat Gate Valves
2. Valve Stem Extensions
3. Valve Boxes
4. Check Valves
5. Combination Valves for Sanitary Sewer Service
6. Sleeve type Couplings

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Piping is specified Division 15.

1.03 DESCRIPTION OF SYSTEMS

All of the equipment and materials specified herein are intended to be standard for use in controlling the flow of potable water and domestic wastewater.

1.04 QUALITY ASSURANCE

All of the types of valves and appurtenances shall be products of well established reputable firms who are fully experienced and qualified in the manufacture of the particular equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these specifications as applicable.

1.05 SUBMITTALS

A. Submit to the Engineer within 15 days after execution of the contract a list of materials to be furnished, the names of the suppliers and the date of delivery of materials to the site.

B. Complete shop drawings of all valves and appurtenances shall be submitted to the Engineer for approval in accordance with the requirements of the General Conditions.

1.06 TOOLS

Special tools, if required for normal operation and maintenance, shall be supplied with the equipment.

2.00 PRODUCTS

2.01 RESILIENT SEATED GATE VALVES

A. Gate valves shall be resilient seated, manufactured to meet or exceed the requirements of AWWA C509 (valves 12-inch and smaller) or AWWA C515 (valves larger than 12-inch) or latest revision and be UL listed and FM approved. All valves shall be rated for 250 psi working pressure and be tested in strict accordance with AWWA C509/C515. The valves shall be tested and certified to ANSI/NSF 61. Valve shall have an unobstructed waterway equal to or greater than the full nominal diameter of the valve.

B. The valve body, bonnet, stuffing box and disc shall be ASTM A-126, Class B grey iron or ASTM A395 or A536 ductile iron. Flanges shall conform to ANSI B16.1 Class 125.

C. All ferrous surfaces inside and outside shall have a fusion-bonded epoxy coating, 10 mils minimum.

D. The valves are to be non-rising stem (NRS) with the stem made of cast, forged, or rolled bronze per AWWA C509/C515. The stem shall have at least one “anti-friction” thrust washer above and below the stem collar to reduce operating torque. The design of the NRS valve stem shall be such that if excessive input torque is applied, stem failure shall occur above the stuffing box at such a point as to enable the operation of the valve with a pipe wrench or other readily available tool. Valves with two-piece stem collars do not meet the requirements of AWWA C509/C515 and are unacceptable.

E. The valves shall have bolts and nuts for the stuffing box and bonnet fabricated of ASTM A-307, Grade B zinc plated steel or type 316 stainless steel. Refer to Paragraph 3.01.

F. The NRS valves shall have a stuffing box that is o-ring sealed. Two o-rings shall be placed above and one o-ring below the stem thrust collar. The thrust collar shall be factory lubricated. The thrust collar and its lubrication shall be isolated by the o-rings from the waterway and from outside contamination providing permanent lubrication for long term ease of operation. Valves without a stuffing box are unacceptable. Valves without at least three stem o-rings are also unacceptable.

G. The sealing mechanism shall consist of disc and guide lugs completely encapsulated in SBR ASTM D2000 rubber material. The peel strength shall not be less than 75 pounds per inch. Guide caps of an Acetal bearing material shall be placed over solid guide lugs to prevent abrasion and to reduce the operating torque. Guide lugs placed over bare metal are not acceptable. The resilient sealing mechanism shall provide zero leakage at the water working pressure when installed with the line flow in either direction.

H. Non-buried valves shall have an arrow cast on the handwheel showing opening direction. Buried valves shall be provided with a 2” square operating nut, and the bolt that attaches the operating nut to the stem shall be recessed into the operating nut so as not to interfere with valve wrench operation. All valves shall turn counter-clockwise to open, and clockwise to close.

I. Tapping valves where indicated on the drawings shall have an inlet flange conforming to ANSI B16.1 Class 125 for attachment to a tapping sleeve or cross. In addition, the valve inlet flange shall have a machined projection or raised face complying with MSS SP-60 for accurate alignment to the mating recess in the tapping sleeve flange. The seat opening of the tapping valves shall be at least .30” larger than the nominal pipe size to permit full size shell cutters.

J. The valves shall be warranted by the manufacturer against defects in materials or workmanship for a period of ten (10) years from the date of manufacture.

K. Valves shall be Mueller A2360 or A2361 Series or approved equal.

2.02 VALVE STEM EXTENSIONS

A. Extension stems shall be provided as necessary to situate the operating nut no greater than 18 inches below the valve cover.

B. Extension stems shall be equipped with stem guides affixed to the valve box at intervals not to exceed ten feet.

C. Stem guides shall be considered a part of the extension. Extension stems and stem guide shall be manufactured items or approved equal.

2.03 VALVE BOXES

A. All buried valves shall have cast-iron three piece valve boxes as shown on the Draw.

B. Valve boxes shall be provided with suitable heavy bonnets and be set to finished grade.

C. The barrel shall be two-piece, sliding type, having 5-inch shaft. The upper section shall have a flange at the bottom having sufficient bearing area to prevent settling and shall be complete with cast iron covers.

D. Covers shall have “WATER” cast into the top for all water mains and “SEWER” cast into the top of all wastewater lines.

E. All valves shall have actuating nuts extended to top of valve boxes.

F. Valve boxes shall be provided with concrete base.

2.04 CHECK VALVES

A. Check valves for PVC and ductile iron pipelines shall be resilient disc swing type suitable for cold working pressures of 250 psig in water and wastewater and shall conform to ANSI/AWWA C508 standards. Valve shall be hydrostatically tested at 1.5 times the rated cold working pressure.

B. The valves shall be ductile iron body conforming to ASTM A536 Grade 65-45-12. Body shall have full flow area equal to the nominal pipe diameter. The seating surface shall be on a 45 degree angle to minimize disc travel. Valves shall be so constructed that disc and body seat may easily be removed and replaced without removing the valve from the line.

C. Top access shall be full size, allowing removal of the disc without removing the valve from the line. The cover shall be domed in shape to provide flushing action over the disc for operation in lines containing high solids content.

D. Resilient disc shall be one-piece construction of precision molded Buna-N (NBR), conforming to ASTM D2000-BG, with an integral o-ring type sealing surface. Disc shall have steel and nylon reinforcement in the hinge. Non-slam closing characteristics shall be provided through a short 35 degree disc stroke and a disc accelerator. The flex portion of the disc shall be warranted for twenty-five (25) years.

E. Disc accelerator shall be one-piece, stainless steel construction and provide rapid closure of the valve in high head applications. The disc accelerator shall be enclosed within the valve and shall be field adjustable and replaceable without removal of the valve from the line. The disc accelerator shall be securely held in place by being captured between the cover and disc. It shall be formed with a large radius to allow smooth movement over the disc surface.

F. Valve shall be cycle tested 1,000,000 times with no signs of wear, cracking, or distortion to the valve disc or seat and shall remain drop tight at both high and low pressures. Manufacturer shall have 5 years minimum experience in the manufacture of resilient disc check valves.

G. Ends shall have Class 125 ANSI B16.1 flanges.

H. Valve shall have mechanical disc position indicator remaining in continuous contact with the disc under all operating conditions.

I. Provide screw-type backflow actuator of rising-stem design with a stainless steel T-handle to allow opening of valve during no-flow conditions. Buna-N seals shall be used to seal the stainless steel stem in a bronze bushing.

J. Exterior and interior of the valve shall be coated with an NSF 61 approved fusion bonded epoxy shop coating.

K. Valve shall be Surgebuster™ Series #7200 as manufactured by Val-Matic Valve & Manufacturing Corporation, Elmhurst, IL, or approved equal.

2.05 COMBINATION AIR/VACUUM VALVES FOR SANITARY SEWER SERVICE

A. The air-vacuum release valves for use in sanitary sewer force mains shall be installed as shown on the Drawings.

B. Valve shall release air and gases at a flow equal to or greater than the pumping capacity during filling of the system and admit air under vacuum conditions. Valve shall maintain an air pocket separation between the pumped liquid and the working mechanism.

C. The operating mechanism shall be non-metallic and corrosion resistant. The valve body, floats, float guide, and stem shall be of stainless steel Type 316. The resilient seat shall be of Buna N.

D. The valve shall be suitable for 230 PSIG working pressure. Valve shall have standard NPT inlets and outlet ports. Provisions shall be made for back-flushing the valve with clean water via cam lock attachment.

E. Provide valve with 316 stainless steel ball valve of equal size to the air valve inlet to permit removal of the valve while maintaining the pumping system in service.

F. The air release valve for sanitary sewer service shall come with a five year warranty.

G. Valve shall be as manufactured by ARI Flow Control, Model D-020 or approved equal.

2.06 SLEEVE TYPE COUPLINGS

A. Coupling shall have stainless steel middle ring without pipe stops. Provide epoxy coated steel follower rings with ribbed construction and two wedge-section gaskets of material suitable for wastewater service.

B. Nuts and bolts shall conform to AWWA C-111 and be provided in sufficient quantity to compress the gaskets.

C. Couplings shall be Dresser Style 38 or equal.

2.07 SHOP PAINTING

Ferrous surfaces of valves and appurtenances shall receive a coating of rust inhibitive primer. All pipe connection openings shall be capped to prevent the entry of foreign matter prior to installation.

3.00 EXECUTION

3.01 INSTALLATION

A. All valves and appurtenances shall be installed in the locations shown, true to alignment and rigidly supported. Any damage to the above items shall be repaired to the satisfaction of the Engineer before they are installed.

B. Pipe for use with flexible couplings shall have plain ends.

C. Flanged joints shall be made with 316 stainless steel bolts, nuts and washers. Mechanical joints shall be made with mild corrosion resistant alloy steel bolts and nuts. All exposed bolts

shall be painted the same color as the pipe. All buried bolts and nuts shall be heavily coated with two (2) coats of bituminous paint comparable to Inertol No. 66 Special Heavy.

D. Prior to assembly of split couplings, the grooves as well as other parts shall be thoroughly cleaned. The ends of the pipes and out-side of the gaskets shall be moderately coated with petroleum jelly, cup grease, soft soap or graphite paste, and the gasket shall be slipped over one pipe end. After the other pipe has been brought to the correct position, the gasket shall be centered properly over the pipe ends with the lips against the pipes. The housing sections then shall be placed. After the bolts have been inserted, the nuts shall be tightened until the housing sections are firmly in contact, metal-to-metal, without excessive bolt tension.

E. Prior to the installation of sleeve-type couplings, the pipe ends shall be cleaned thoroughly for a distance of 8 inches. Soapy water may be used as a gasket lubricant. A follower and gasket, in that order, shall be slipped over each pipe to a distance of about 6 inches from the end, and the middle ring shall be placed on the already laid pipe end until it is properly centered over the joint. The other pipe end shall be inserted into the middle ring and brought to proper position in relation to the pipe already laid. The gaskets and followers shall then be pressed evenly and firmly into the middle ring flares. After the bolts have been inserted and all nuts have been made up finger tight, diametrically opposite nuts shall be progressively and uniformly tightened all around the joint, preferably by use of a torque wrench of the appropriate size and torque for the bolts.

F. Air Valve Locations: After the mains have been installed the Contractor shall install the air release valves. The connection to the main shall be by a stainless steel tapping saddle, or as shown on the Drawings. These connections to the main shall be at high points and other locations as determined by the Engineer. In order for the Engineer to determine these locations, the Contractor shall submit the as-built elevations of the top of the pipe to the Engineer as soon as possible after the pipe has been installed. Elevations shall be determined at intervals not to exceed 100 feet and at defined breaks in the pipe profile grade. Should re-excavation of the main be necessary to install the air release valve connection, cost for this work and subsequent backfill/restoration work cost shall be included in the appropriate lump sum price bid for air release valves.

G. Valve boxes with concrete bases shall be installed as shown on the Drawings. Mechanical joints shall be made in the standard manner. Valve stems shall be vertical in all cases. Place cast iron box over each stem with base bearing on compacted fill and top flush with final grade. Boxes shall have sufficient bracing to maintain alignment during backfilling. Knobs on cover shall be parallel to pipe. Remove any sand or undesirable fill from valve box.

END OF SECTION 15100

SECTION 15117 AIR RELEASE AND AIR AND VACUUM VALVES

1.00 GENERAL

1.01 WORK INCLUDED
Furnish labor, materials, equipment and incidentals necessary to install air release and air and vacuum valves of the sizes and types indicated. Furnish the necessary isolating valves and piping.

1.02 QUALITY ASSURANCE [Not Used]

1.03 SUBMITTALS
Submittals shall be in accordance with Section 01300, SUBMITTALS and shall include:

1.00 Shop drawings

1.04 STANDARDS [Not Used]

1.05 DELIVERY AND STORAGE [Not Used]

1.06 JOB CONDITIONS [Not Used]

1.07 OPTIONS [Not Used]

1.08 GUARANTEES [Not Used]

2.00 PRODUCTS

2.01 MATERIALS [Not Used]

2.02 MIXES [Not Used]

2.03 FABRICATIONS [Not Used]

2.04 MANUFACTURED PRODUCTS
A. GENERAL
1. Each air valve shall have a cast iron body, bronze, or stainless steel trim and stainless steel float. Float shall be baffled to prevent air from blowing valve C closed until air is exhausted.
2. Valve body, float, etc., shall be designed for a working pressure and shall seat at a minimum pressure shown in the valve schedule, Paragraph 3.05.
3. Air valves shall be manufactured by the Valve and Primer Corporation (APCO), Val-Matic Manufacturing Corp., or Multiplex Manufacturing Company (Crispin).
4. Top of valve assembly shall be fitted to attach discharge pipe as indicated. Valve inlet shall be N.P.T. for 2" and smaller valves. Valve inlet shall be ANSI flange for 3" and larger valves. Flange rating shall equal or exceed the maximum working pressure.

B. AIR RELEASE VALVES (AR): Air release valves shall be designed to automatically release accumulated air pockets within the pipeline while in operation and under pressure. Air release valves shall be APCO Model 200, Val-Matic Model 38, or Crispin Model P.

C. AIR AND VACUUM VALVES (AV): Air and vacuum valves shall be designed to allow large volumes of air to escape through the valve orifice when filling a pipeline and to close water tight once the air has been expelled. Air and vacuum valves shall also permit large volumes of air to enter through the valve orifice when the pipeline is being drained to break the vacuum. Air and vacuum valves

shall be APCO Model 140, Val-Matic Model 100, or Crispin Model AL.

D. COMBINATION AIR VALVES (CAV)
1. Combination air valves shall be heavy duty air and vacuum valves with air release.
2. Combination air valves shall be designed to release accumulations of air at high points within a pipeline by exhausting large volumes of air as the pipeline is being filled and by releasing accumulated pockets of air while the pipeline is in operation and under pressure. Combination air valves shall also be designed to permit large volumes of air to enter the pipeline during pipeline drainage.
3. Combination air valves shall be APCO Model 140C, Val-Matic Model 200, or Crispin Model C.

E. AIR AND VACUUM VALVES FOR VERTICAL TURBINE PUMPS (PAV)
1. Air and vacuum valves for vertical turbine pumps shall be designed to allow large volumes of air to escape out the valve orifice when the pump is started and close water tight when the liquid enters the valve. The air valve shall also permit large volumes of air to re-enter through the valve orifice when the pump is stopped to prevent a vacuum in the pump column.
2. The baffle shall be designed to protect the float from direct contact of the rushing air and water to reduce premature float closures in the valve.
3. The entire float and baffle assembly must be shrouded with a perforated water diffuser to reduce slamming of the float.
4. The discharge orifice shall be fitted with an adjustable throttling device to regulate the flow of air escaping to establish a pressure loading on the rising column of water to minimize shock to the pump and check valve.
5. Air and vacuum valves for vertical turbine pumps shall be APCO Series 140 WDT, Val-Matic Model 100 DWS-T, or Crispin Model DL.

3.00 EXECUTION

3.01 PREPARATION [Not Used]

3.02 INSTALLATION

Carefully handle and install valves vertically in such a manner as to prevent damage to any part of the valves. Installation shall be in accordance with the Manufacturer's instructions. Provide nuts, bolts, and gaskets where applicable.

3.03 FIELD QUALITY CONTROL [Not Used]

3.04 CLEAN AND ADJUST [Not Used]

3.05 SCHEDULES

Location	Size	Type	Pressure WP./Min.P.	No. Required
All P.L. High Points	3"	CAV	150# / 40#	10
Cooling Water	1/2"	AR	50# / 5#	2
Pump Discharge	2"	PAV	200# / 100#	2

END OF SECTION 15117