**SECTION 33 40 00**

**STORM DRAINAGE UTILITIES**

**BASED ON DFD MASTER SPECIFICATION DATED 11/23/2021**

This section has been written to cover most (but not all) situations that you will encounter. Depending on the requirements of your specific project, you may have to add material, delete items, or modify what is currently written. The Division of Facilities Development expects changes and comments from you.

Modify this document to account for project specific conditions.

***Note to the Designer: If project also includes plumbing coordinate this section with:***

* ***Section 22 14 00 – Facility Storm Drainage***

***and clearly define party responsible for testing of the respective utility on the Drawings.***

**PART 1 - GENERAL**

**SCOPE**

Confirm application limits for Storm Drainage Utilities specifications. Coordinate with Division 22 Plumbing.

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to provide for the storm drainage work required in these specifications and on the drawings. The limits of the work, including the responsible party for testing purposes, shall be clearly defined on the Drawings. Included are the following topics:

PART 1 - GENERAL

Scope

Related Work

Reference Documents

Reference Standards

Submittals

Provisions for Future Work

As-Built Drawings

PART 2 - MATERIALS

Reinforced Concrete Pipe

PVC Pipe

HDPE Solid Wall Pipe

HDPE Corrugated Wall Pipe

Polypropylene Pipe

Corrugated Metal Pipe

Ductile Iron Pipe

Connections for Dissimilar Pipe Materials

Manholes

Inlets

Round Catch Basins

Castings

Apron Endwalls

Board Insulation

Locator Tape

PART 3 - EXECUTION

General

Laying Pipe

Bedding/Utility Cover

Structures (Manholes, Inlets, Round Catch Basins)

Apron Endwalls

Casting Installation

Connections to Existing Structures

Drainage Laterals

Pipe Insulation

Locator Tape

Deflection Testing

Leakage Testing

Sewer Televising

Abandon Sewer

**RELATED WORK**

***Note to the designer: Determine if this work will impact other related work and revise these specifications accordingly to only include those Sections that apply to the project.***

Applicable provisions of Division1 govern work under this section.

Related work specified elsewhere:

Section 02 32 00 – Geo Technical Investigation

Section 22 11 00 – Facility Water Distribution

Section 22 13 00 – Facility Sanitary Sewerage

Section 22 14 00 – Facility Storm Drainage

Section 30 05 00 – Common Work Results for All Exterior Work

Section 31 23 16.13 – Trenching

Section 31 25 00 – Erosion Control

Section 32 91 13.50 – Stormwater Bioinfiltration

**REFERENCE DOCUMENTS**

Wherever WisDOT or SSHSC appears in this specification it shall be construed to mean the pertinent sections of the Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction (SSHSC), current edition, and all supplemental and interim supplemental specifications, as they may pertain, except this contract shall be a lump sum contract and measurement and basis of payment methods shall not apply.

Where these specifications do not cover portions of the work to be undertaken, the Standard Specifications for Sewer and Water Construction in Wisconsin, current edition, shall govern the work.

**REFERENCE STANDARDS**

American Society for Testing and Materials (ASTM):

C76 Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

C425 Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings

C443 Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

C507 Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe

C700 Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated

C877 Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections

D1784 Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

D2235 Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings

D2564 Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

D2680 Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping

D3034 Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

D3212 Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

D3350 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

D4673 Standard Classification System for Acrylonitrile-Butadiene-Styrene (ABS) Plastics and Alloys Molding and Extrusion Materials

F477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

F679 Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings

American Water Works Association (AWWA):

C104/ANSI A21.4 Standard For Cement-Mortar Lining for Ductile-Iron Pipe and Fittings

C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

C151/ANSIA21.53 Standard for Ductile Iron Pipe, Centrifugally Cast

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M252 Corrugated Polyethylene Drainage Pipe

AASHTO M294 Corrugated Polyethylene Pipe, 12- to 60-in Diameter

AASHTO M330 Corrugated Polypropylene Pipe, 12-to 60-in Diameter

**SUBMITTALS**

Provide manufacturer’s product information (cut sheets), shop drawings and O&M information for storm drainage materials including:

* Pipe
* Fittings
* Pre-Cast and Cast-in-Place Structures
* Outfalls
* Castings

Provide reports documenting all required testing and televising.

**PROVISIONS FOR FUTURE WORK**

***Note to the designer: Describe any specific provisions required to accommodate future storm drainage work.***

Construct storm drainage system in a manner that will facilitate future extension or connection.

**AS-Built drawings**

Show the actual locations of storm drainage facilities and service lines and structures on drawings. Show changes to proposed storm drainage facilities, alignment, or grades. Show the actual locations, sizes and types of underground utilities and other features encountered during construction.

**PART 2 - MATERIALS**

***Note to the designer: Edit material requirements to account for agency/institution and local utility requirements, or variations in material availability. Edit pipe requirements to account for depth of bury, traffic and other load conditions for this project.***

**reinforced concrete pipe**

Pipe and fittings shall conform to ASTM C-76 for circular pipe and ASTM C-507 for elliptical pipe. Unless otherwise specified, provide Class III for circular pipe and Class HE-III for elliptical pipe.

Joints for reinforced concrete pipe shall be bell and spigot or tongue and groove. Joints shall be provided with rubber gaskets conforming to ASTM C433. Joints for elliptical pipe shall be provided with trowelable impervious bituminous joint sealer that is manufactured for sealing reinforced concrete storm drainage pipe joints.

When required, external sealing bands shall meet the requirements of ASTM C877 (Type II), and shall be Mar Mac Mac Wrap, Cretex Wrap, Sealing Systems, Infi-Shield, or approved equal.

**PVC PIPE**

Conform to ASTM D-3034 with solvent weld or elastomeric joints. Pipe shall be SDR-35, unless otherwise noted. Pipe over 15 inches in diameter shall meet the requirements of ASTM F679-03. Do not mix different manufacturer's products, or fittings.

PVC fittings shall be same joint type and SDR as connecting PVC storm drainage pipe.

**HDPE SOLID WALL PIPE**

***Note to the designer: Verify the necessary Dimension Ratio (DR) based on site specific conditions including vehicle loads, pipe diameter, depth, and soil type. In diameters greater than 8 inches, this pipe is generally not acceptable for use under roadways, parking lots, loading docks or other vehicle traffic areas because the pipe’s strength and stability is dependent on bedding cover and backfill materials and proper compaction.***

Polyethylene Resin

Polyethylene resin used for manufacturing piping and fittings shall meet ASTM D1248 for Type III, Class C, Grade P34, Category 5, with a PPI recommended designation of PE3408 and a minimum cell classification of PE 345434C in accordance with ASTM D3350. The polyethylene compound shall be combined with carbon black to provide protection against degradation by ultraviolet light. Pipe shall be made from virgin material with no rework compound, except that obtained from the manufacturer’s own production of the same formulation.

Polyethylene Piping

High density polyethylene (HDPE) piping, shall meet the requirements of AWWA C906, current version. Pipe dimensions and workmanship shall be in accordance with ASTM F714 and ASTM D2122. Pipe shall be of diameter shown on the drawings, with dimension ratio (DR) of DR11, unless otherwise noted.

Pipe, fittings, and joints shall meet or exceed the following physical properties:

|  |  |  |
| --- | --- | --- |
| Property | ASTM Test method | Value |
| Density, gm/cc | D1505 | 0.955 |
| Melt Index, gm/10 min | d1238-e | 0.10 |
| High Load Melt Index, gm/10 min | D1238-F | 12.0 |
| Tensile Strength @ Break, psi | d638 | 4,500 |
| Tensile Strength @ Yield, psi | d638 | >3,200 |
| Elongation, % | d638 | >800 |
| Flexural Modulus, psi | d790 | 136,000 |
| Environmental Stress Cracking Resistance F20’ Hours (100°c) | d1693 (Cond. C) | >5,000 |
| Brittleness Temperature, °f | d746 | <-180 |
| Melting Point, °f | d789 | 261 |
| Vicat Softening Temperature, °f | d1525 | 255 |
| Hardness, Shore D | D2240 | 66 |
| Volume Resistivity, ohm-cm | D991 | 2.6 1016 |
| Recommended Hydrostatic Design Stress: |  | 1600 psi @ 73.4°F 800 psi @ 140°F |

Pipe Marking

Each length of straight and special HDPE pipe and each HDPE fitting shall be plainly marked on the outside to identify the design pressure or class of pipe, proper location of the pipe or fitting in the pipeline, and the date of manufacture.

**HDPE corrugated WALL PIPE**

***Note to the designer: This pipe is not acceptable for use under roadways, parking lots, loading docks or other vehicle traffic areas because the pipe’s strength and stability is dependent on bedding cover and backfill materials and proper compaction.***

Corrugated HDPE pipe with an integrally formed smooth liner. Pipes that are between 4 inch diameter and 60 inch diameter shall meet the requirements of AASHTO M252 and M294, Type S. Corrugated HDPE pipes per AASHTO M294 shall only be used for storm drainage applications outside of the pavement and areas with low utility density.

Extruded pipe and blow molded fittings per AASHTO M252 and M294 shall be manufactured from PE compounds conforming to the requirements of ASTM D3350, cell class 424420C and 435400C, respectively.

Rotational molded fittings and couplings per AASHTO M252 and AASHTO M294 shall meet the requirements of ASTM D3350, cell class 213320C.

Injection molded fittings and couplings per AASHTO M252 and AASHTO M294 shall meet the requirements of ASTM D3350, cell class 314420C.

Joints for fittings and pipe shall be soil-tight bell and spigot, provided with rubber gasket. Rubber gasket shall be installed by the pipe manufacturer.

**POLYPROPYLENE PIPE**

***Note to the designer: This pipe is acceptable for use under roadways, parking lots, loading docks or other vehicle traffic areas.***

Polypropylene pipe meeting the requirements of AASHTO M330, Type S or Type D.

Polypropylene pipe shall be joined with a gasket integral bell & spigot joint meeting the requirements of AASHTO M330. Joints shall be watertight according to the requirements of ASTM D3212. Spigot shall have two gaskets meeting the requirements of ASTM F477.

Fittings shall conform to AASHTO M330 for their respective diameter sizes and types. Gasketed fittings and joints shall meet the watertight joint performance requirements of ASTM D3212.

**corrugated metal pipe**

***Note to the designer: Galvanized corrugated metal pipe shall only be used for culvert applications. If soil conditions exhibit corrosive environments, it is not advisable to use metal pipe.***

Galvanized pipe meeting the requirements of AASHTO M36. Minimum wall thickness shall be 16 Ga. for 12”-24” diameter pipe, 14 Ga. for 30” and 36” pipe, and 12 Ga. for 42”-54” diameter pipe.

Provide galvanized corrugated coupling bands with angle connectors having a minimum of 2 bolts. Coupling bands shall provide a joint that is soil tight.

**DUCTILE IRON PIPE**

Ductile watermain shall be Class 52, ANSI/AWWA C151/A21.51centrifugally cast, cement mortar lined meeting the requirements of ANSI/AWWA C104/A21.4.

Ductile iron watermain joints shall be rubber gasket push-on joint or mechanical joint meeting the requirements of ANSI/AWWA C111/A21.11.

Pipe shall be provided with conductive bonding straps to provide electrical continuity.

Pipe shall be manufactured in the United States.

**CONNECTIONS FOR DISSIMILAR PIPE MATERIALS**

Where new storm drainage pipe connects to and existing dissimilar pipe, the connection shall be made with either a no hub type couplings meeting the requirements of CISPI 310, or a rubberized mastic laminated to a strong reinforcing mesh, tightened with sheathed and protected steel straps.

Hub type couplings shall have neoprene gaskets with stainless steel shield, and multiple stainless steel clamps with worm gear tightening device. The rubberized mastic coupler shall be double wide, and clamped with four ratcheted steel straps protected by sheathing and a heavy cross-laminated polyethylene backing. The couplers shall be made specifically for the type and size of pipe materials being connected.

Couplings shall be Fernco, Husky, Charlotte, Mar Mac or approved equal.

**MANHOLES**

Note to the designer: Determine the need for cast-in-place manholes based on consideration of depth/configuration. Determine if sump manholes are required by facility stormwater policy or local stormwater regulations.

General

Provide precast concrete manholes unless otherwise shown or required. Cast-in-place manholes may only be used after receiving written approval by the DFD Project Representative and the A/E for customized manhole sizes and shapes.

Submit manufacturer's preproduction (shop) drawings for approval prior to the start of manufacturing.

Contractor shall carefully locate all pipe locations, sizes, orientation and elevation prior to ordering new manholes.

Precast Manhole Sections

Note to the designer: Determine manhole sizes based on pipe size, location, orientation and other project specific requirements.

Precast concrete manhole sections, including bottom and top shall meet the requirements of ASTM C478.

If conditions require a larger structure than shown on drawings, contact the DFD Project Representative and the A/E.

Provide eccentric cone top sections with a minimum clear opening of 24”. Flat top slabs may be used on manholes greater than 6-foot inside diameter.

Manhole wall thickness shall be a minimum of 5” for 4-foot inside diameter manholes, 6” for 5-foot inside diameter manholes, and 7” for 6-foot and 7-foot inside diameter manholes.

Provide pre-cast manhole base. Manhole bottom section may be pre-cast with integral base.

Joints

Provide manhole riser and barrel sections, cones, and flat tops, with standard pipe section tongue and groove joints.

Seal joints watertight with prefabricated rubber or plastic gaskets or formed in place butyl rubber seal.

Joint sealers: Hamilton Kent, ConSeal, MultiSeal Butyl-Tite, or approved equal.

Connections

Note to the designer: Determine connection type (ie cut-out or cored opening). Confirm that pipe size and knockout location geometry can be constructed and delivered in precast structure diameter specified.

Openings for connections in pre-cast structures shall be knock-outs or cut-outs. Cut-outs shall not extend into the joint of the bottom manhole section. Provide a minimum of 12” of separation between the edge of adjacent cut-outs or knock-outs.

Manhole Steps

Provide steps at 16” O.C. and project approximately 6” from wall.

Manhole steps shall be located in a straight, vertical line from the top of the manhole to the bottom. If the orientation of pipe openings prohibits this, locate manhole steps over the downstream pipe opening.

Manhole steps shall be steel reinforced polypropylene with ½-inch diameter deformed reinforcing bar. Steps shall be permanently secured in the manhole wall.

Manhole steps shall be American Step Company, M.A. Industries, or approved equal.

Bench and Flowline

Provide precast or cast-in-place bench and flowline.

Unless otherwise indicated on the drawings, bench height shall be ¾ the diameter of the downstream pipe. Slope bench towards flowlines at a minimum ½” per foot. Provide light broom finish on bench.

Flowlines shall be formed with gradual, uniform sweeps directed towards the downstream pipe. Provide smooth, troweled finish for flowlines.

When cast-in-place benches and flowline are used, lay the storm sewer pipe through the manhole.

Adjusting Rings

Fiber-reinforced pre-cast concrete adjusting rings meeting the requirements of ASTM C-478. Provide rings of 2” or 4” thickness.

Precompressed butyl gasket, 3/8” x 3½” shall be used between the top of the manhole and first adjustment ring, and between all subsequent rings. Butyl material shall be E-Z Stick, or equal.

**INLETS & CATCH BASINS**

***Note to the designer: Determine the need for cast-in-place inlets and catch basins based on depth and configuration of inflow and outflow pipes.***

***Provide details in drawings showing inlet sizes needed for project specific hydrology, pipe size, location and orientation as well as wall thickness and bottom thickness needed for external loads including depth, soils and vehicular traffic.***

General

Inlets and catch basins shall be round or rectangular precast concrete unless otherwise shown or required. Cast-in-place inlets may only be used after receiving written approval by the DFD Project Representative and the A/E for customized sizes and shapes.

Submit manufacturer's preproduction (shop) drawings for approval prior to the start of manufacturing.

Contractor shall verify pipe locations, sizes, orientation and elevation prior to ordering new inlets.

Precast Inlets & Catch Basins

Precast inlets, shall meet the requirements of ASTM C478.

If field conditions require a larger structure than shown on drawings contact the DFD Project Representative and the A/E.

Joints

Inlets requiring separate base and riser sections must be provided with standard pipe tongue and groove joints.

Seal joints watertight with prefabricated rubber or plastic gaskets or formed in place butyl rubber seal.

Joint sealers: Kent Seal, ConSeal, MultiSeal Butyl-Tite or approved equal.

Pipe Connections

Note to the designer: Determine pipe connection type (ie cut-out or cored opening). Confirm that pipe size and knockout location geometry can be constructed and delivered in precast structure diameter specified.

Provide custom knock-outs/cut-outs based on project and location specific conditions.

A minimum of 2” of the precast structure is required between the top of a knock-out/cut-out and the top of the structure. A minimum of 2” of precast structure is required between the side of a knock-out/cut-out and the inside face of an adjacent sidewall.

Inlet Flowline

Provide either pre-cast or cast-in-place flowline that provides positive flow through the structure. Provide bench that directs water towards the flowline.

Flowlines and benches shall be formed with gradual, uniform sweeps directed towards the downstream pipe. Provide smooth, troweled finish for flowlines.

Catch Basin Sump

Outlet pipe invert shall be located above the bottom of the catch basin as shown in the detail drawings. Sump shall be watertight.

Adjusting Rings

Fiber-reinforced pre-cast concrete adjusting rings meeting the requirements of ASTM C-478. Provide rings of 2” or 4” thickness.

Precompressed butyl gasket, 3/8” x 3½” shall be used between the top of the inlet and first adjustment ring, and between all subsequent rings. Butyl material shall be E-Z Stick, or equal.

**CASTINGS**

Note to the designer: Determine casting type, size and load rating. Consult with the Owner Agency to address and specific casting requirements. Determine if any existing castings are able to be salvaged.

General

All castings shall be heavy duty iron conforming to ASTM A48, Class 20 and rated for AASHTO H-20 loading. Provide non-rocking or machined castings with concealed pickhole.

Standard Manhole Frame and Casting (Solid Lid)

Neenah Foundry R-1550, with Type B lid; or approved equal.

Low Profile Manhole Frame and Casting (Solid Lid)

Neenah Foundry R-1689, with Type B lid; or approved equal.

Standard Manhole Frame and Casting (Open Grate)

Neenah Foundry R-2050, with Type D grate; or approved equal.

Low Profile Manhole/Round Catch Basin Frame and Casting (Open Grate)

Neenah Foundry R-2464, with Type D grate; or approved equal.

Standard Security Manhole Frame and Casting (Solid Lid)

Neenah Foundry Company R-1916-C with bolt down type B lid; or approved equal.

Standard Security Manhole/Round Catch Basin Frame and Casting (Open Grate)

Neenah Foundry Company R-2050 with Type D grate having 4 Type “E” countersunk flathead pent socket screws; or approved equal.

Low Profile Security Manhole Frame and Casting (Solid Lid)

Neenah Foundry R-1689, with Type B lid having 4 Type “E” countersunk flathead pent socket screws; or approved equal.

Low Profile Security Manhole/Catch Basin Frame and Casting (Open Grate)

Neenah Foundry R-2464, with Type D grate having 4 Type “E” countersunk flathead pent socket screws; or approved equal.

Standard Curb Inlet Casting

Neenah Foundry Company R-3067, with Type A grate; or approved equal.

Gutter Inlet Casting

Neenah Foundry Company R-3290-A; or approved equal.

Flat Inlet Casting

Neenah Foundry Company R-1878-B7G; or approved equal.

**APRON ENDWALLS**

General

Provide apron endwalls where shown on the drawings and at the following locations:

* Where storm sewers outfall into ditches, swales or other surface water body
* On both ends of a culvert pipe (pipe that crosses under a road, sidewalk, trail or other surface feature)

Unless otherwise indicated, apron endwalls shall be constructed of the same material, same sidewall thickness and to the same design standards as the pipe they are connected to. Apron endwalls shall be the same diameter as the pipe that they are connected to.

**Note to designer: Corrugated HDPE Wall Pipe and Polypropylene Pipe can be connected to metal apron endwalls utilizing a Type 2 connection, as utilized for annular corrugated metal pipe. Additionally, connection to a reinforced concrete apron endwall shall be constructed utilizing a Mar Mac Dissimilar Pipe Coupler or approved equal.**

Pipe ties shall be constructed using galvanized ¾” diameter steel rod and hardware, or other approved materials.

Pipe Gates

Apron endwalls for pipe greater than 18” in diameter shall be provide with pipe gates. Pipe gates shall be constructed of 1” diameter standard steel pipe members with welded connections and spaced no greater than 12” O.C.E.W. Pipe gate shall be attached to endwall at a minimum of 4 locations using 4”x4”x3/16” thick steel angles and 3/8” galvanized machine bolts. Pipe gates shall be provided with a galvanized finish, unless noted.

**BOARD INSULATION**

Insulation shall be rigid, closed-cell extruded polystyrene insulation suitable for buried insulation. Individual boards shall have dimensions of 8’x4’x2”.

Owens Corning, Dow Styrofoam, or approved equal.

**LOCATOR TAPE**

Detectable metallic locator tape, specifically manufactured for marking utilities.

Tape shall be a minimum of 6” wide and shall be marked “STORM”.

**PART 3 - EXECUTION**

**General**

Complete exploratory excavations at utility crossings as shown on the drawings and as necessary to complete the work.

Maintain clearances between existing or proposed storm drainage lines and watermains as follows:

* 8’ horizontal separation (measured center to center) between existing or proposed sanitary or storm drainage lines and watermains.
* 12” vertical separation (measured from outsides of pipes) where watermains cross over sanitary or storm drainage lines.
* 18” vertical separation (measured from outsides of pipes) where watermains cross under sanitary or storm drainage lines.

Notify the A/E and DFD Project Representative of utility conflicts as soon as they are encountered.

Store and handle pipe in accordance with manufacturers’ recommendations. Keep pipes clean of soil, debris and animals.

**LAYING PIPE**

Install pipe in accordance with the SSSWC and ASTM specifications that pertain to the specified type of pipe material and the installation situation.

Do not use any pipe or fittings cracked in cutting or handling or otherwise not free from defects.

Clean all pipe of any dirt and/or debris both inside and outside prior to placing in the trench.

Make joints in accordance with manufacturer's directions with due care to avoid damaging pipe and/or disturbing previously laid pipe.

Cut pipe only according to manufacturer's directions.

Lay all drainage pipes to horizontal alignment and grade shown on the drawings with bell ends up hill. Establish and maintain horizontal alignment using total station, transit or theodolite. Discrepancies from the required horizontal alignment or grade at any location shall not be greater than 0.10’ or 0.05’, respectively.

**Bedding/Utility Cover**

***Note to the designer: Determine the materials to be used for bedding and utility cover based on the project specifics. Coordinate the materials to be used with those defined in Part 2 of Section 31 23 16.13 – Trenching.***

Provide bedding and utility cover in accordance with the applicable requirements of Section 31 23 16.13 – Trenching.

Where excavation extends below the bottom of the structure's base or the trench, bring the excavation to the required elevation by the use of compacted *[Crushed Stone Bedding]*.

A minimum of 12” of compacted *[Crushed Stone Bedding]* shall be placed below the structure base.

A minimum of 8” of compacted *[Crushed Stone Bedding]* shall be placed below the bottom of the apron endwall.

A minimum of *[6”]* of compacted *[Crushed Stone Bedding]* shall be placed below the storm drainage pipe and *[12”]* of cover material shall be placed over the storm drainage pipe (both measured at the bell of the pipe).

**STRUCTURES (MANHOLES, INLETS, CATCH BASINS)**

Structures having improper location and/or orientation of the pipe connections will be rejected. Field repairs or adjustments of connection points are not permitted.

Do not connect abandoned pipes to new structures.

Limit the excavation for structures so as to provide only the necessary amount of space to sufficiently prepare the subgrade, set the base, set the structure, and lay pipe. Provide adequate clearance for compaction equipment and operator between structure and trench soil retention for adequate backfilling and compaction.

Set structure base in accordance with elevation and location as indicated on the drawings. Install base plumb and level. Install subsequent pre-cast sections in accordance with shop drawing layout. Provide watertight gaskets between each section.

Inlets and Manholes

Pour inverts with smooth surface draining to downstream pipe. Where two or more lines meet at an angle, provide curved channel. Slope bench or floor at 2 inches/ft towards flow channel.

Catch Basins

Verify sump is clean and watertight after connecting pipes to catch basin.

Structures shall be provided with between 4” and 8” of adjusting rings, with the top adjusting ring being 2” thick. Provide butyl sealant material between rings. Once rings are in place, tuck point the exterior joint and provide the entire exterior surface of the adjusting ring riser with a coating of mortar.

**APRON ENDWALLS**

Limit the excavation for apron endwalls so as to provide only the necessary amount of space to sufficiently prepare the subgrade, set the apron endwall, and lay pipe. Provide adequate clearance for compaction equipment and operator between apron endwall and trench soil retention for adequate backfilling and compaction.

Where excavation occurs below the bottom elevation of the apron endwall bottom, bring the excavation to the required elevation by the use of compacted crushed stone bedding.

Set apron endwall in accordance with elevation and location as indicated on the drawings. Install base plumb and level.

Apron endwalls for pipe greater than 18” in diameter shall be restrained using a minimum of two pipe ties per section. Pipe ties shall also be used to restrain the first two pipes located immediately upstream of the apron endwall. Pipe ties shall be bolted through the sidewall of the pipe.

Provide riprap downstream of apron endwalls at all storm drainage outfalls and at other locations as indicated on the drawings.

**CASTING INSTALLATION**

***Note to the designer:* *Correctional and mental health facilities shall be provided with Security Castings. Verify casting models and locking or fastening features to be incorporated into manhole covers. If welded covers are required specify whether contractor or institution staff will weld manhole covers.***

Install casting type as indicated on the drawings or in the specifications. *[Correctional and mental health facilities shall be provided with Security Castings.]*

Provide butyl sealant material between last adjusting ring and casting base. Adjust casting elevation and slope to match adjacent proposed grades.

**CONNECTIONS TO EXISTING STRUCTURES**

Make all necessary openings into existing structures or drainage pipes including the reconstruction of existing inverts or benches, as necessary. Patch all openings permanently watertight with concrete brick and mortar, hydraulic cement, or flexible watertight boots.

**DRAINAGE LATERALS**

***Note to the designer: If connecting lateral to storm drainage main owned by municipality or drainage district, verify connection requirements and modify this specification accordingly. A manhole may be required at the connection of a lateral greater than 6-inches in diameter to the storm drainage main.***

Connect existing storm drainage laterals in accordance with all of the requirements of the storm drainage mains, including bedding, backfill, compaction, and jointing of the pipe. Connect drainage laterals to the storm drainage main by means of an approved "wye" fitting. Connect the new pipe to the existing lateral material using a no-hub coupling or approved transition fitting. Coupling/fitting shall be selected for the specific pipe material being connected.

**PIPE INSULATION**

Provide insulation where indicated on the drawings.

Install insulation on compacted utility cover material, 6” above the top of the pipe. Stagger joints where more than one layer of insulation is required. Provide insulation with a minimum of 1’ of utility cover material. Place cover and backfill material in manner that does not damage insulation; replace any damaged insulation.

**LOCATOR TAPE**

Install locator tape directly above new non-metallic storm sewer pipe approximately 15 inches below finished grade. Bring tape to surface and terminate in a drainage structure.

**DEFLECTION TESTING**

Test all PVC and HDPE drainage pipe in the presence of the DFD Project Representative by a "go-no-go" deflection test mandrel furnished by the Contractor. Do not perform deflection testing any sooner than 30 days following the installation of the pipe. Pull the mandrel by hand, or hand operated winch so as to avoid any damages to the pipe that may be caused by mechanized pulling equipment.

Size the mandrel to test the pipeline for a maximum allowable internal deflection of the pipe (in any direction) of not to exceed five (5) percent of the original internal diameter for the pipelines tested, regardless of how long after installation the testing takes place.

***Note to the designer: If televising is not required for the storm drainage pipes on this project remove the paragraph below.***

*[Deflection testing may be done concurrently with any necessary televising of the pipes. When done concurrently with televising, the mandrel may be pulled by mechanized equipment, provided the mandrel is visible in the television picture during the testing and the operation of the mandrel can be**quickly halted before damage to the pipe occurs.]*

Where poor trench soils conditions require the pipe excavation to be undercut and/or over excavated, the Construction Representative reserves the right to require an additional deflection test prior to the expiration of the Contractor's one year performance guarantee.

Remove and replace all pipe that fails to pass the five (5) percent vertical deflection testing until the pipe passes the deflection test.

**LEAKAGE TESTING**

Storm sewers shall be visually inspected for excessive water infiltration and soil leakage into sewers or structures. Contractor shall repair/correct any infiltration or soil leakage that is considered excessive by the DFD Project Representative.

**SEWER TELEVISING**

Note to the designer: If televising is not required for the storm drainage pipes on this project remove or edit the paragraph below.

*[Upon completion of the sewer construction all new sewers shall be televised to provide a record of the actual conditions inside the newly constructed sewers via closed circuit televising equipment. The DFD Project Representative may or may not be present during sewer inspections via this method.*

*Utilize televising equipment with a color camera specially designed and equipped for the conditions of the sewers to be televised, and with a monitor screen.*

*Transport the camera equipment through the sewers by means of mechanical or hand operated winches, coordinated to provide speed and directional control necessary to fully observe the sewer interior. Provide a light source for the necessary illumination.*

*Provide televising equipment equipped with an on-screen distance meter, capable of registering distances in the sewer from the starting manhole, and accurate to the nearest 0.5’ station, so as to facilitate in the locating of sewer features and/or defects from the ground surface.*

*Provide televising equipment with an on-screen date and time clock, so as to permit the verification of the date and time of the television inspection.*

*All video files of the sewer inspection shall contain audio notes describing the sewer location, direction of inspection, and a description of any pertinent features observed during the televised inspection (service locations, leaking or faulty joints, debris in the line, offset joints, etc.). In addition, record this information on a written log or record, in a format of the Contractor's choosing.*

*The Contractor shall provide to the DFD Project Representative with 2 DVD copies of the CCTV inspection videos and all inspection forms.]*

**ABANDON SEWER**

Where indicated on the drawings, existing sewer to be left in place shall be abandoned in accordance with Section 3.2.24 of the SSSWC. Sewer shall not be abandoned until existing laterals have been reconnected to the replacement sewer. Abandoning sewers is considered incidental to the construction.

**END OF SECTION**