SECTION 33 39 13 – MANHOLES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:

1. Precast Concrete Manholes.

B. Related Sections:

1. Section 31 23 16.13 – Excavation, Trenching, and Backfilling for Utilities
2. Section 33 31 00 – Gravity Sewer
3. Section 33 11 00 - Water Utility Distribution Piping
4. Section 33 34 00 – Force Mains

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Manholes:

1. Basis of Measurement: Price per manhole.
2. Basis of Payment: Includes excavating, concrete foundation slab, all concrete structure sections from bottom of manhole to Rim, brick masonry transition to cover frame, frame and cover, to indicated depth, finished bottom and forming and sealing of pipe inlets and outlets.

B. Manhole Lining:

1. Basis of Measurement: Price per manhole lined.
2. Basis of Payment: Includes surface preparation, repairs, application, materials, clean-up, and required application materials/equipment.

1.3 REFERENCE STANDARDS

A. All products, installation and testing of force mains and gravity sewers shall meet the requirements of Regulation 61-67, Standards for Wastewater Facility Construction or State Primary Drinking Water Regulations (R61-58).

B. All products, installation and testing of force mains and gravity sewers shall meet the requirements of "Recommended Standards for Wastewater Facilities" (Ten State Standards), latest edition.

C. Any reference to SCDOT standard specifications was obtained from "Standard Specifications for Highway Construction" published by the South Carolina Department of Transportation. Unless otherwise noted, the most current date published applies.

D. American Association of State Highway Transportation Officials:

1. AASHTO M91 - Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale).
2. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
3. AASHTO M306 - Standard Specification for Drainage, Sewer, Utility, and Related Castings.

E. American Concrete Institute:

1. ACI 350.1 - Tightness Testing of Environmental Engineering Concrete Containment Structures & Commentary

F. American Society for Testing Materials:

1. ASTM A48 - Standard Specification for Gray Iron Castings.
2. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
3. ASTM C33 - Standard Specification for Concrete Aggregates.
4. ASTM C150 - Standard Specification for Portland Cement.
5. ASTM C478 - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.
6. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
7. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
8. ASTM C923 - Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
9. ASTM D41 - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
10. Additional applicable ASTM standards which are not specifically stated.

1.4 SUBMITTALS

A. Product Data: Upon receiving Owner’s Notice to Proceed, submit manufacturer information for manhole covers, component construction, features, configuration, and dimensions.

B. Shop Drawings:

1. Indicate structure locations, nomenclature as shown on approved construction drawings, and elevations.
2. Indicate sizes and elevations of pipe connections.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

E. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

G. Submit qualifications statement for manufacturer.

1.5 COORDINATION

A. Coordinate Work of this Section with utility owners and local authorities.

B. Notify affected utilities at least 72 hours prior to construction.

C. Notify the appropriate Commission representative of any recommencement of work should there be any suspension of work for more than 72 hours.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Handling: Comply with precast concrete manufacturer instructions and ASTM C913 for unloading and moving precast manholes and drainage structures.

C. Stored Materials:

1. Store materials according to manufacturer instructions.
2. Store precast concrete manholes and drainage structures to prevent damage to Owner's property or other public or private property.
3. Repair property damaged from materials storage.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.7 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this Section with a minimum five years of experience.

B. Installer: Company specializing in performing Work of this Section with minimum five years of documented experience.

1.8 CLOSEOUT DOCUMENTS

A. Provide Record Drawings showing nomenclature as shown on approved construction drawings, actual locations of manholes and connections and record all invert elevations associated with each manhole.

B. Refer to Specification Section 33 31 00 – Gravity Sewer for full requirements of record drawings pertaining to sewer.

1.9 WARRANTY

A. Provide a two-year materials and workmanship warranty. The contractor shall be responsible for correcting defects in the Work during the warranty period, including defective material and workmanship.

B. Furnish 5-year manufacturer's warranty for concrete manholes.

1.10 GENERAL REQUIREMENTS

A. Manhole top elevations shall be greater than or equal to the fifty (50) year flood elevation. If lower than the 50-year flood elevation, watertight manhole covers shall be required.

B. Manhole drops are required where the invert differential is 18 inches or greater.

C. Damaged manholes and appurtenances will be repaired or replaced at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

A. All precast concrete manhole sections shall be steel reinforced and conform to ASTM C478.

B. Cement shall conform to ASTM C150, Type II Portland Cement or approved equal.

C. All sections shall be designed for HS-20 traffic loading, be designed to resist earth loads, and resist uplift resulting from buoyant forces from ground water table.

D. Provide sections that bring the cover as close to elevation indicated on the Drawings as possible, limiting the height of the grade rings.

E. Maximize section heights to minimize the number of joints required to reach cover elevation.

F. Minimum section height is 16-in.

G. Knockout panels are not acceptable. All openings shall be precast with steel reinforcing. at locations and sizes indicated on Drawings. The minimum distance between pipe walls on any section shall not be less than 6-in.Precast concrete sections shall be properly cured prior to shipping. Precast concrete sections shall not be shipped before concrete has attained 4,000 psi compressive strength.

H. Mark date of manufacture, name, and trademark of manufacturer on the inside of each precast section.

2.2 PRECAST MANHOLES

A. Frame and Cover

1. Provide domestic manufactured gray cast iron frame and covers with 24” opening, conforming to ASTM A48.
2. Provide US Foundry, USF 668 Ring with KL-1 Cover, or approved equal.
3. Provide non-penetrating pick holes.
4. No vent holes are allowed.
5. Provide a minimum recycled material content of 75 percent consisting of post-consumer material.
6. Castings shall be of uniform quality and free of defects such as holes, gas holes, shrinkage, and cracks. Any defects shall be ground smooth and cleaned by shot blasting.
7. Bearing surface between cover and frame must be in close contact all around to prevent movement.
8. Maintain tolerances of +/- 1/16-in per foot.
9. Provide tracing information including: name of the producing foundry, country of manufacturer, ASTM material designation, recycle symbol, individual part number, cast or heat date.
10. Provide certification stating that samples representing each lot have been tested, inspected in accordance with AASHTO M306 and furnish results of these tests upon request.
11. Provide the words “Sanitary Sewer” in the center of all sanitary sewer covers and “Water” in the center of all water appurtenance covers.
12. Provide two (2) coats of bitumastic paint on frames and covers.

B. Lifting Lugs:

1. Size lifting lugs for a precision fit with common lift devices.
2. Provide no more than 2 lifting lugs or holes in each precast section for proper handling.
3. Holes shall not penetrate through section walls.

C. Grade Rings

1. Provide Precast Concrete Grade Rings conforming to ASTM 478 to adjust ring and covers to finished grade.
2. Maximum total ring height shall not exceed 6” at each manhole. Ring height shall not be less than 4-in. Where adjustment required is less than 4-in, provide brick or composite rings.
3. Cover frame flange and grade rings with 2” thick non-shrink grout and overlap cone section a minimum of 6-in and taper down.

D. Mortar

1. Materials: 1-part Portland cement, 2-parts sand, and add hydrated lime not to exceed 10 lbs to each bag of cement.
2. Portland cement shall be ASTM C150, Type II.
3. Sand shall be washed, cleaned, screened, and well graded with all particles passing a No. 4 sieve and conforming to ASTM C33.

E. Concrete (Poured in Place): Air entrained Portland Cement Concrete having a minimum of twenty-eight (28) day compressive strength of 3,000 psi.

F. Cone

1. Provide eccentric cones unless indicated otherwise on drawings.
2. When manhole is less than 4-ft deep, provide Flat Top Manhole.

G. Barrel

1. The wall thickness shall not be less than 5-in for 48-in diameter reinforced barrel sections, 6-in for 60-in diameter reinforced barrel sections and 7-in for 72-in diameter reinforced barrel sections.

H. Base

1. Cast base monolithically with walls unless indicated or detailed otherwise.
2. The base thickness shall not be less than 6-in for 48-in diameter reinforced barrel sections, 8-in for 60-in diameter reinforced barrel sections and 8-in for 72-in diameter reinforced barrel sections.

I. Flat Top

1. Provide flat top on manholes where indicated on drawings.
2. The top slab thickness shall not be less than 8-in.
3. Design to incorporate 24-in cast-in-place ring and cover.

J. Flexible Pipe Connections
1. Provide flexible pipe boots that result in a water-tight connection conforming to ASTM C923
2. Boot can be cast into manhole wall or installed into a cored opening using internal compression rings. Provide Trelleborg - Kor-N-Seal or approved equal.

3. Attach boots to pipe with dual stainless-steel straps and hardware.
4. Material: EPDM rubber.

K. Joints

1. Comply with ASTM C913 and C923.
2. Base, barrel, cone, and flat top sections shall have tongue and groove joints with vulcanized butyl rubber sealant or o-ring rubber gasketed joints.
3. Provide non-shrink grout on inside of joint, 2” wide and thick, taper to walls.

L. Steps

1. Provide Non-Skid Polypropylene Steps cast in section spaced at 16-in maximum.
2. Referenced manufacturer: M.A. Industries Inc., model PS1 Item # - 004-500.
3. Minimum embedment 3-in.
4. Maximum distance to first step 24-in.
5. Minimum width 10-in.
6. Minimum projection from section 5-in.
7. Load Test: comply with ASTM C478 and ASTM C497.
8. Materials:
    a. Steel Reinforcing shall be deformed 1/2-in, grade 60, steel bar complying with ASTM A615.
    b. Polypropylene conforming to ASTM D41.

M. Exterior Joint Collar

1. Install joint collar consisting of a polyethylene outer layer, rubberized mastic reinforcement, and woven polypropylene fabric on all below grade joints.
2. Provide SealWrap by MarMac Construction Products Company or approved equal.
3. Provide 12-in wide band with 6-in overlap on each side of section joints.

N. Precast Inverts

1. Channels with full benches to be monolithically poured with base at factory.
2. Form inverts to match inverts indicated on the Drawings with a minimum fall of 1.2-in.
3. Provide precast inverts with a minimum of 4-in from lowest point on invert to base section bottom slab.
4. Provide clearance pocket for pipe to project a minimum of 2-in inside the manhole to butt up against the channel.
5. The crown of the smaller inlet pipe shall be no lower than the crown of the outlet pipe.
6. When the fall between the inlet and the outlet is greater than 4-in, the inlet of the channel shall be below the inlet pipe invert and aligned horizontally within 1-in.
7. Form and finish channel to provide a consistent slope from the pipe outlet up to the inlets.
8. Maximum of 12-in fall between inlet and outlet. Minimum of 1.2-in fall between inlet and outlet.
9. Channel height to match largest pipe I.D.
10. Minimum bending radius of the invert centerline 1.5 times the pipe I.D.

11. Provide a 1/2-in radius at the intersection of 2 or more channels. Provide a 1/4-in radius at the edge of the bench and channel.
12. Slope bench from top of channel to base section wall at 1:12 and provide broom finish to create a non-skid surface for maintenance.

O. Fill any depressions, high spots, voids, chips, or fractures over 1/4-in in diameter or 1/4-in in depth with a sand cement paste and finish to a texture reasonably consistent with the formed surface.

2.3 DROP MANHOLES

A. Install Drop Manholes as detailed and at locations indicated on Drawings. Drop manholes are required at locations where the inlet invert of a manhole is 18 inches or greater above the outlet invert.

2.4 DOGHOUSE MANHOLES

A. Install Doghouse Manholes as detailed and at locations indicated on Drawings. Doghouse manholes are required for any locations where a manhole will be connected to an existing sewer line.

B. AIR RELEASE MANHOLES
1. All air released valves along the length of a force main or water line shall be housed in a manhole.
2. Manhole height shall be designed to accommodate the height of the air release valve assembly installed on the water or sewer line. Refer to plans and details for air release valves housed inside of a manhole.
3. Manhole access shall be positioned to allow full access inside of the manhole and space above the air release valve for servicing.
4. Provide manhole for each air release per Sections 2.1 GENERAL and 2.2 PRECAST MANHOLES.

2.5 WATERTIGHT MANHOLE COVERS

A. Install Watertight Manhole Covers as detailed and at locations indicated on Drawings. Watertight manhole covers will be required for any manhole elevation less than the 50-year flood elevation.

2.6 MANHOLE LINING

A. For any manhole receiving direct flow from a force main, a lining shall be provided on the interior.

B. Manhole lining shall be leak-resistant, consisting of a properly prepared substrate and approved repair materials (as required).

C. Provide a calcium aluminate cementitious coating.
   1. Base shall be made with calcium aluminate cement and 100% calcium aluminate aggregate. The materials shall form a structurally enhanced monolithic liner covering all interior manhole surfaces.
   2. After 28 days, lining shall meet the minimum requirements:
      a. Tensile Strength (ASTM C496): > 700 psi
      b. Compressive Strength (ASTM C109): > 7,000 psi
      c. Flexural Strength (ASTM C348): > 1,300 psi
      d. 90% Relative Humidity Shrinkage (ASTM C157): < 0.07%
      e. Bond (ASTM C882): > 2,500 psi
      f. Freeze/Thaw (ASTM C666): No damage @ 100 cycles

D. Provide SewperCoat PG, SewperCoat 2000 HS or approved equal.

E. Cementitious coating shall be applied using specially designed machines consisting of a 3-stage progressive cavity rotor-stator style pump capable of producing a minimum of 250 psi pumping pressure, vertical shaft mixer with twin horizontal mixing paddles, and a minimum 12 cfm/90 psi air system for spray application of the mortar for applying cementitious materials. Use equipment that includes a water storage system, and water metering device. Use a Material hydraulically powered mixer and pump.

2.7 MISCELLANEOUS MATERIALS

A. As required, provide all other materials for a complete and proper installation for products and installation as described here within.

PART 3 - WORK EXECUTION

3.1 LAY OUT OF WORK

A. Provide all required materials, labor, instruments, etc. required to properly lay out work.

B. Prepare "cut sheets" for approval by Engineer and Owner.

C. Exercise proper precaution to verify requirements on the Drawings prior to laying out Work. Any errors that otherwise might have been avoided shall be corrected at no additional cost to the owner.

D. Provide proper notification of errors or discrepancies found to Engineer in a timely manner to ensure corrective actions are made.

E. Refer to Specification Section 33 31 00 – Gravity Sewer.

3.2 LOCATING

A. Refer to specification Section 33 31 00 – Gravity Sewer for locating procedures.

B. Manholes are to be located strictly in accordance per the plans and details. Notify Engineer of any discrepancies associated with existing utilities and manhole placement.

C. Manholes shall not be located further than 400 linear feet.

3.3 EXAMINATION

A. Verify that items are properly sized and located.

B. Verify that excavation base is ready to receive Work and excavations, and that dimensions and elevations are as indicated on Drawings.

3.4 PREPARATION

A. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers as indicated on Drawings to indicate its intended use.

B. Coordinate placement of inlet and outlet pipe or duct sleeves as required by other Sections.

C. Do not install manholes and structures where Site conditions induce loads exceeding structural capacity of manholes or structures.

D. Inspect precast concrete manholes and structures immediately prior to placement in excavation to verify that they are internally clean and free from damage; remove and replace damaged units.

3.5 INSTALLATION

A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface structures or utilities in immediate or adjacent areas.

B. Correct over-excavation with coarse aggregate.

C. Remove large stones or other hard matter impeding consistent backfilling or compaction.

D. Protect manhole from damage or displacement while backfilling operation is in progress.

E. Excavating:

1. As specified in Section 31 23 16.13 – Excavation, Trenching, and Backfilling for Utilities and to indicated locations and depths.

2. If ground water is encountered, prevent accumulation of water in excavations, place manhole or structure in dry trench.
3. Where possibility exists of watertight manhole or structure becoming buoyant in flooded excavation, anchor manhole or structure to avoid flotation as approved by Engineer.

F. Base and Alignment:

1. Install manholes supported at proper grade and alignment on stone bedding.
2. Excavation for manhole base shall be carried to a depth such as to provide a minimum lift of stone bedding as shown on details. Stone shall reach beyond perimeter of base for a minimum distance of 8".
3. Form and place manhole sections plumb and level to correct dimensions and elevations.

G. Backfilling: As specified in Section 31 23 16.13 - Excavation, Trenching, & Backfilling.

H. Precast Concrete Manholes:

1. Lift precast components at lifting points designated by manufacturer.
2. When lowering manholes into excavations and joining pipe to units, take precautions to ensure that interior of pipeline and structure remains clean. Clean joints prior to assembling.
3. Assembly:

    a. Assemble multi-section manholes and structures by lowering each section into excavation.
    b. Install rubber gasket joints between precast sections according to manufacturer recommendations.
    c. Lower, set level, and firmly position base section before placing additional sections.

4. Remove foreign materials from joint surfaces and verify that sealing materials are placed properly.
5. Maintain alignment between sections by using guide devices affixed to lower section.
6. Joint sealing materials may be installed on Site or at manufacturer's plant.
7. Verify that installed manholes meet required alignment and grade.
8. All penetrations in manhole that are not precast shall be cored.
9. Pipe shall project into the manhole 2-inches.
10. Install exterior joint collars per manufacturer's recommendations.

I. Doghouse Manholes and Structures:

1. Stake out location and burial depth of existing sewer line in area of proposed manhole or structure.
2. Carefully excavate around existing sewer line to adequate depth for foundation slab installation.
3. Protect existing pipe from damage.
4. Cut out soft spots and replace with granular fill compacted to 95 percent maximum density.
5. Bear firmly and fully on compacted crushed stone bedding as indicated on Drawings.

6. Install precast concrete manhole over existing pipe according to applicable Paragraphs in this Section.
7. Grout pipe entrances as indicated on the Drawings.
8. Perform final connection to existing pipe at approved time.
9. Block upstream flow at existing manhole or structure with expandable plug.
10. Use hydraulic saw to cut existing pipe at manhole or structure entrance and exit and along pipe length at a point halfway up OD on each side of pipe.
11. Bottom half of pipe is to remain as manhole flow channel.
12. Saw cut to smooth finish with top half of pipe flush with interior of manhole or structure.
13. Grout invert of manhole to achieve slope to manhole and trowel smooth.

3.6 LINING OF MANHOLES

1. Surface Preparation:
    a. New Concrete Structures:
        1) Concrete must be cured fully.
        2) Surfaces that have been cured with conventional curing compounds or contaminated with oils/greases must be chemically cleaned to remove contaminates before any blasting/hydroblasting may occur.
        3) Concrete shall have a uniform surface texture, exposing fine aggregate. Finished product shall resemble coarse sandpaper. If surface is not uniform in appearance, blasting/hydroblasting shall be repeated until desired surface is obtained.
        4) Provide any additional surface preparation steps identified/required by manufacturer.
    b. Existing Concrete Structures:
        1) All existing liners shall be thoroughly removed.
        2) All existing concrete structures shall be abrasively blasted or hydroblasted to achieve hard firm surface. Hydroblast shall have a minimum pressure of 5,000 psi at 5 gpm.
        3) Any voids, cracks, defects, exposed rebar, etc. shall be repaired with an acceptable product compactible the with concrete surface and the lining to be applied.
        4) All surfaces shall be cleaned with a detergent to remove all old, grease, and other contaminates. Surface shall be cleaned before and after blasting activities.
        5) Before coating all surfaces shall be free of dust, loose particles, oils, greases, existing coatings, and contaminates.
        6) All surfaces must be fully dried after completion of surface preparation.
        7) Provide any additional surface preparation steps identified/required by manufacturer for existing concrete surfaces.
2. Application of Liner:
    a. New Concrete Structures:
        1) Mix all products in strict accordance with manufacturer's instructions.
        2) Coating shall be applied by a spray application and have a minimum thickness of 120 mils.

b. Existing Concrete:
    1) Mix all products in strict accordance with manufacturer's instructions.
    2) Spray-apply the calcium aluminate base at a minimum of 1/2" thickness.
        a) Trowel and brush finish material immediately following the spray application.
    3) Finish coating shall be applied by a spray application over calcium aluminate base and have a minimum thickness of 120 mils.

3. Clean-up
    a. All waste shall be properly disposed of and use standard procedures for waste disposal. Removal shall be in strict accordance with the Manufacturer's recommendations.
    b. All work areas shall be cleaned properly and completely. Owner reserves right to withhold payments to contractor until area is cleaned adequately.

3.7 INSPECTIONS AND TESTING

A. Testing:

1. Perform testing on Precast Concrete Manholes in accordance with ACI 350.

B. Equipment Acceptance:

1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests at no additional cost to the Owner.

C. Construction Observation:
1. Clean and prepare each manhole for observation upon completion. Manholes shall be free of cracks, standing water, debris, and be located at grade per plans and details.

END OF SECTION 33 39 13