

# Municipality of Greenville

## Standard Specifications

Adopted October 14, 2019

Municipality of Greenville  
Outagamie County, WI

Summary of Revisions	
Revision Date	Comments



**REUSE OF DOCUMENTS**

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**END OF SECTION**

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**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. References
  - 2. Submittals

**1.02 REFERENCES**

- A. Definitions
  - 1. Basic Contract definitions and terminology are included in the General Conditions of the Contract and the Supplementary Conditions.
  - 2. The term “approved,” when used to convey Engineer’s action on Contractor’s submittals, applications, and requests, is limited to Engineer’s duties and responsibilities as stated in the General Conditions of the Contract.
  - 3. The term “regulations” includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- B. Reference Standards
  - 1. The following specifications shall be considered standard specifications for the Municipality of Greenville. If the reference standard specification conflicts with the Greenville standard specification, comply with the most stringent requirement.
    - a. WisDOT Standard Specifications (Most Current Edition).
    - b. WisDOT Standard Detail Drawings.
    - c. Wisconsin Sewer and Water Specifications Sixth Edition with Amendments.
    - d. Manual on Uniform Traffic Control Devices for Streets and Highways (Most Current Edition).

2. Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are a part of the Contract Documents by reference.
3. Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.
4. If compliance with two or more specified standards and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement.
5. The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements.
6. Each section of the specifications generally includes a list of reference standards normally referred to in that respective section. The purpose of this list is to furnish the Contractor with a list of standards normally used for outlining the quality control desired on the project. The lists are not intended to be complete or all-inclusive, but only a general reference of standards that are regularly referred to.
7. Each entity engaged in construction on the Project shall be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents. Where copies of standards are needed to perform a required construction activity, obtain copies directly from the publication source and make them available on request.

C. Specification Formats and Conventions

1. The Specifications are organized into Divisions and Sections using the 48-division format and The Construction Specifications Institute “MasterFormat” 2015 Edition Numbering and Titles.
2. The Specifications use section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.

## **1.02 SUBMITTALS**

- A. All submittals shall be sent to Municipality for review of compliance with specifications.

**PART 2 - PRODUCTS** (Not Used)

**PART 3 - EXECUTION** (Not Used)

**END OF SECTION**

**SECTION 02 41 13**  
**SELECTIVE SITE DEMOLITION AND UTILITIES ABANDONMENT**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Demolition of Pavements, Curb and Gutter, Sidewalks, and Driveways
  - 2. Demolition of Walls, Piers, Surface Drains, Foundations, and Concrete or Masonry Structures
  - 3. Demolition or Abandonment of Manholes, Inlets, and Catch Basins
  - 4. Removal of Culvert Pipe
  - 5. Removal or Abandonment of Sewer Utility Pipe
  - 6. Removal or Abandonment of Water Main, Hydrants, Valve Boxes, Curb Stops and Boxes

**1.02 ALLOWANCES**

- A. If so stated in the specification “Allowances”, installation testing will be paid as an allowance. All other testing will be incidental to the Work.
- B. If there is no reference in the specification section to “Allowances”, then testing costs will be incidental to other Work items.

**PART 2 - PRODUCTS**

**2.01 MATERIALS**

- A. Granular backfill material shall conform to Crushed Aggregate Base Course Gradation #2 stated in the appropriate Specification Section.
- B. Cellular Concrete for Abandonment
  - 1. Cellular Concrete consisting of 1 part cement, 1 part fly ash, 8 parts sand by volume with a target water / cement ratio of 0.65.
- C. Sand for Pipe Abandonment
  - 1. M50 Grade Silica Sand.

## **PART 3 - EXECUTION**

### **3.01 GENERAL**

- A. Remove existing structures, with attached parts and connections, within limits shown on the Engineered Plans or that interfere with new construction.
- B. Do not damage adjacent portions of existing structures not shown for removal.
  - 1. Complete operations necessary for the removal of any existing structure that might endanger the new construction, prior to the construction of the new Work.
  - 2. Do not use any equipment or devices that might damage structures, facilities, or property which are to be preserved and retained.
- C. Salvageable Material
  - 1. Remove salvageable material without damage designated to remain the property of the Owner or designated for relocation within the Project and place in location designated by the Owner.
  - 2. Safeguard and protect salvageable materials designated for relocation within the Project or until delivery to the Owner.

### **3.02 DEMOLITION OF PAVEMENTS, CURB AND GUTTER, SIDEWALKS AND DRIVEWAYS**

- A. Remove pavements, curb and gutter, sidewalks and driveways designated for removal on the Engineered Plans or elsewhere determined by the Engineer.
- B. Dispose of removed materials offsite at Contractor's selected disposal site.
- C. Remove to an existing joint or saw cut to a true line, with vertical face and full depth of the pavement.
  - 1. Location of saw cut to be approved by Municipal Engineer or Director of Public Works.
  - 2. Sludge from sawing shall be removed from pavement upon completion of each saw cut by methods that minimize amount of sludge flowing onto or being deposited on pavement of any live traffic lane. Sludge from sawing may not be disposed of on areas of the roadway or roadside. Sludge also must not enter waterways or storm sewer system.
- D. Provide removal of materials sufficient to provide for proper grades and connections to new work.

- E. Coordinate salvage or disposal of railing with property owner and Engineer. Disposal of railing shall be incidental.

### **3.03 DEMOLITION OF WALLS, PIERS, SURFACE DRAINS, FOUNDATIONS, AND CONCRETE OR MASONRY STRUCTURES**

- A. Remove as shown on the Engineered Plans entirely or to an elevation at least three (3) feet below the road earth subgrade or elsewhere to three (3) feet below the finished proposed slopes or natural ground.

### **3.04 DEMOLITION OR ABANDONMENT OF MANHOLES, INLETS, AND CATCH BASINS**

- A. Remove as shown on the Engineered Plans entirely or to an elevation at least three (3) feet below the road earth subgrade or elsewhere to three (3) feet below the finished proposed slopes or natural ground.
- B. Provide by-pass system where utility is in service.
- C. Salvage castings without damage and deliver to a location designated by the Owner.
- D. Provide pipe of same adjacent material replacing removed structure where utility is to remain in service as shown on the Engineered Plans.
- E. Where structure is to be abandoned, clean debris from interior of structure.
- F. If pipe connecting to the structure is to be abandoned, then provide concrete plug at pipe ends prior to backfilling abandoned structure.

### **3.05 REMOVAL OF CULVERT PIPE**

- A. Remove entirely all culverts designated to be removed, except as hereinafter provided for closing culverts.
- B. Remove sidewalls or substructure units in water to an elevation no higher than the elevation of the natural stream or lake bed.
  - 1. Where grading of the channel is required, remove such units to the proposed finished grade of the stream or lake bed.
  - 2. Remove all other sidewalls or substructure units down to at least 2 feet below natural or finished ground line, as the case may be.
- C. Where existing culverts are shown on Engineered Plans to be extended or otherwise incorporated into the new Work, remove only such part or parts of the existing culvert as necessary to provide a proper connection to the new Work.

- D. Remove pipe culverts designated for salvage in a manner that will preclude damage to the culverts.

### **3.06 REMOVAL OR ABANDONMENT OF SEWER UTILITY PIPE**

- A. Abandon pipe as designated on the Engineered Plans or by the Engineer by filling with blown sand or remove entirely.
- B. Remove pipe designated for removal on the Engineered Plans by excavating, removal, and disposal with the resulting trench backfilled and properly compacted using native excavated material or select backfill as required by these Specifications.
- C. Plug sewer pipe that is to be abandoned, or will not be reconnected, with concrete at each opening and at the entrance to manholes whether the manhole is to be abandoned or not.
- D. Sewer pipe plugs that are greater than twelve inches may be plugged using brick or concrete block masonry and concrete.

### **3.07 REMOVAL OR ABANDONMENT OF WATER MAIN, HYDRANTS, VALVE BOXES, CURB STOPS AND BOXES**

- A. Abandoning Water Mains and Hydrant Leads
  - 1. Abandon all intersecting mains within the street right-of-way as shown on the Engineered Plans and as directed by Engineer. Abandon mains to an existing tee or cross in live mains or as shown on the Engineered Plans.
  - 2. Abandoned mains may be left in place except that abandoned mains within new water main trenches shall be removed and properly disposed of.
    - a. All abandoned mains left in place shall be filled with blown sand.
    - b. Backfill and compact all excavations using materials and methods in accordance with the appropriate Specification Section and as shown on the Engineered Plans.
  - 3. Live tees, crosses, and mains shall be secured with restrained mechanical joint plugs and buttresses.
- B. Abandoning Valves and Valve Boxes
  - 1. The procedure for abandoning valves, including hydrant valves and curb stops, and valve boxes shall be as specified below:

- a. Abandoned valves shall be open and left in place unless it is stated within the Engineered Plans to remove and salvage valve(s) for the Owner.
- b. Abandon valve boxes by removing the cover and top section(s) to a depth of three (3) feet below the roadway / finish grade, whichever is greater. Backfill remaining valve box sections and the excavation with 3/8 inch crushed stone chips in accordance to the appropriate Specification Sections thoroughly compacted in 12-inch maximum lifts.
- c. Valves, valve boxes, and valve manholes within new water main trenches shall be removed and disposed of except for items designated to be salvaged.

C. Abandoning and Relocating Hydrants

1. Remove and salvage all hydrants shown on the Engineered Plans to be abandoned, removed, relocated, or replaced. Salvaged hydrants shall be delivered to a location designated by the Owner.
2. Allow the Owner to inspect and repair, if necessary, salvaged hydrants prior to their being installed at the new hydrant locations. The Owner will furnish new hydrants to be installed if repair of the existing hydrants will unduly interfere with the Contractor's Work operations.
3. Provide hydrant barrel extensions on salvaged hydrants where shown on the Engineered Plans or in the Bid Form.

D. Abandoning Water Services

1. Abandoned water service piping located in the new water service trench and abandoned curb valves and valve boxes shall be removed and properly disposed of except that salvageable curb valves and valve boxes shall remain the property of the Owner.
2. Deliver salvaged service materials to a location designated by the Owner.

**3.08 DISPOSAL OF REMOVED MATERIALS**

- A. Deliver materials designated for salvage to Owner's designated location.
- B. Haul and dispose of all other materials to a site provided by the Contractor in conformance with all governing authorities.
- C. All materials, not designated in the Contract to be salvaged, shall be removed from right-of-way and project site within 7 days after material has been deposited.

### **3.09 BACKFILLING**

- A. Fill all trenches, holes, and pits resulting from the removal of structures with satisfactory soil or with granular backfill.
- B. Place materials in layers not more than 12 inches in thickness.
- C. Thoroughly compact each layer by means of tampers, rollers, or vibrators.
- D. Do not use water to expedite settlement of backfill except with the approval of the Owner's Representative.
- E. Unless otherwise provided, backfill all trenches, holes, and pits to the elevation of the natural ground, the proposed finished earth subgrade, or finished slopes, as may be necessary due to the location of the removed structure.

**END OF SECTION**

**SECTION 02 41 13.23  
PAVEMENT REMOVAL**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Saw Cutting and Pavement Butt Joints
  - 2. Asphalt and Concrete Pavement Removal
  - 3. Asphaltic Pavement Milling
  - 4. Asphaltic Pavement Pulverizing
  - 5. Removing Brick Pavers
  - 6. Salvaging and Disposal of Materials

**1.02 ALLOWANCES**

- A. If so stated in the specification “Allowances”, installation testing will be paid as an allowance. All other testing will be incidental to the Work.
- B. If there is no reference in the specification section to “Allowances”, then testing costs will be incidental to other Work items.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION**

**3.01 PROTECTION OF PAVEMENTS TO REMAIN**

- A. If retaining a portion of the existing pavements, avoid damaging that portion during construction operations.
- B. Protect pavements to remain and do not use any equipment or devices that might damage pavements or property to be preserved.
- C. Pavements designated to remain and damaged by construction operations shall be removed and replaced to limits designated by the Engineer at no cost to Owner.

**3.02 SALVAGING OR DISPOSING OF MATERIALS**

- A. Carefully remove materials designated for salvage to avoid damage.

- B. Place salvaged materials in neat piles outside construction limits but within the right-of-way.
- C. Stockpile salvaged pavement materials designated for salvage and reuse on the project at locations within the construction limits designated by the Engineered Plans or a mutually agreed upon place between Contractor and the Owner.
- D. If the area of construction limits does not support adequate room for stockpiles and construction operations, secure a temporary offsite location for hauling and stockpiling of the salvaged material and reuse on the project.
- E. Stockpile salvaged pavement materials without contaminating the material with dirt or foreign matter.
- F. Properly dispose of pavement materials not designated for salvage and reuse on the project.

### **3.03 SAWCUTTING AND PAVEMENT BUTT JOINTS**

- A. All concrete and asphalt pavements (including butt joints), shoulders and driveways shall be saw-cut full depth prior to being shattered and removed.
- B. Where concrete pavements are covered with an asphalt overly, both the asphalt and concrete shall be saw-cut.
- C. Pavements shall be saw-cut in neat straight lines, at right angles to the street or driveway, to produce a clean joint for adjoining pavement installation.
  - 1. Saw cut location to be approved by Municipal Engineer or Director of Public Works.
- D. Protect saw-cut edges during construction operations. If a saw-cut edge is damaged during construction, saw-cut the pavement again immediately prior to paving at no additional cost to Owner.
- E. Milled butt joints are not required to be saw-cut if the milled edge is neat and straight.
- F. Sludge from sawing shall be removed from pavement upon completion of each saw cut by methods that minimize amount of sludge flowing onto or being deposited on pavement of any live traffic lane. Sludge from sawing may not be disposed of on areas of the roadway or roadside. Sludge also must not enter waterways or storm sewer system.

### **3.04 ASPHALT AND CONCRETE PAVEMENT REMOVAL**

- A. Remove pavements to the removal limits shown on the Engineered Plans.
  - 1. Prior to removals, saw-cut pavement in accordance to the removal limits shown on the Engineered Plans or marked on site by the Engineer.
  - 2. Perform removal operations in a manner not to damage saw-cuts, remaining pavement, and structures such as curb and gutter.
- B. Load and haul pavement off-site as removed.
- C. Identify the locations and protect all structures/structure access castings from damage during the removal process.
- D. Provide proper traffic safety devices at all locations of structures/casting protruding above the grade.
- E. Provide and maintain temporary ramping at all locations at the limits of the removed pavement that provide vehicle access to roadways and driveways.

### **3.05 ASPHALTIC PAVEMENT MILLING**

- A. Remove asphaltic pavement by milling at the location(s) and to the thickness(es) shown on the Engineered Plans and disposing, hauling, salvaging, stockpiling or reusing of the milled materials on the Project Site.
- B. Mill the existing asphaltic pavement until 100 percent of the millings pass the 1 ½ inch sieve.
- C. Windrow or load material as construction operations dictate.
- D. Milling materials shall be:
  - 1. Hauled to a location(s) designated by the Owner.
  - 2. Properly disposed of off-site at a location obtained by the Contractor.
  - 3. Relayed on site establishing pavement base
    - a. Immediately after milling, relay the material with a paver, grader, or both a paver and grader.
    - b. Match the lines, grades, and cross slopes shown on the Engineered Plans eliminating localized bumps, depressions, and ruts.
    - c. Immediately after relaying, compact the re-laid material either first with a rubber-tired roller or vibratory pad foot roller and second with a vibratory steel roller.

- (1) Add water, as required, both before and during compaction to readily attain the required compaction.
  - (2) Compact each layer until there is no appreciable displacement, either laterally or longitudinally, under the compaction equipment.
  - (3) Route hauling equipment uniformly over previously placed base.
  - (4) Compact each layer before placing a subsequent layer.
- d. Excess milling material shall:
- (1) Be properly disposed of off-site at a location secured by the Contractor, unless Owner has a preferred site.

### **3.06 ASPHALTIC PAVEMENT PULVERIZING**

- A. Pulverize the full depth of existing asphaltic pavement until 97 percent or more of the material will pass the 2-inch sieve.
  1. Also pulverize the existing base to the depth shown on the Engineered Plans and mix with the pulverized asphaltic pavement.
  2. Windrow material as construction operations dictate.
- B. Immediately after pulverizing, relay the material with a paver, grader, or both a paver and grader.
- C. Match the lines, grades, and cross slopes shown on the Engineered Plans eliminating localized bumps, depressions, and ruts.
- D. Immediately after relaying, compact the re-laid material either first with a rubber-tired roller or vibratory pad foot roller and second with a vibratory steel roller.
  1. Add water, as required, both before and during compaction to readily attain the required compaction.
  2. Compact each layer until there is no appreciable displacement, either laterally or longitudinally, under the compaction equipment.
  3. Route hauling equipment uniformly over previously placed base.
  4. Compact each layer before placing a subsequent layer.

- E. Excess pulverized material shall:
  - 1. Be properly disposed of off-site at a location secured by the Contractor, unless Owner has a preferred site.

### **3.07 REMOVING BRICK PAVERS**

- A. Prior to removing brick pavers, document (i.e. photograph) the pattern in which the pavers are laid for reference during reinstallation.
- B. Remove and salvage existing brick pavers within areas shown on the Engineered Plans and as directed by the Engineer.
- C. Remove all bricks in a manner as not to damage the bricks.
  - 1. Any bricks damaged during removal shall be replaced at no cost to the Owner.
  - 2. Replacement brick shall conform to size, color, and composition of existing brick.
- D. Temporarily stockpile bricks at a protected location to prevent damage.

**END OF SECTION**

**SECTION 02 42 00**  
**REMOVAL AND SALVAGE OF CONSTRUCTION MATERIALS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Removal of Salvage Items
  - 2. Materials Salvaged for the Owner
  - 3. Protection of Salvaged Items
  - 4. Clean-up

**1.02 ALLOWANCES**

- A. If so stated in the specification “Allowances”, installation testing will be paid as an allowance. All other testing will be incidental to the Work.
- B. If there is no reference in the specification section to “Allowances”, then testing costs will be incidental to other Work items.

**1.03 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination
  - 1. Prior to starting the removal and salvage Work, coordinate the delivery destination of the various salvage items with the Owner.

**1.04 SUBMITTALS**

- A. Informational Submittals
  - 1. Provide one (1) copy of inventory list related to salvage items delivered to the Owner to include delivered items, date delivered, condition, and receipt signature by Owner.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION**

**3.01 SALVAGED ITEMS**

- A. Salvage all items, materials or equipment identified by the Owner to be dismantled or left intact, removed, protected, stored and/or delivered to the Owner remaining as property of the Owner.

- B. Salvage items to the maximum extent possible.
- C. Prior to any demolition work, remove items to be salvaged from the structure or Work site.
- D. Remove of salvageable items by hand labor to the maximum extent possible.
- E. Care shall be taken not to damage portions of the structure to remain or items identified for salvage.
- F. Remove furnishings, equipment, and materials not scheduled for salvage or recycling prior to salvaging procedures.
- G. Keep a complete recording of all salvaged materials including the condition of such materials before, and after salvage operations.

### **3.02 SITE WORK**

- A. The following site items shall be removed intact and salvaged:
  - 1. Fences, railings, and gates
  - 2. Site lighting fixtures and poles
  - 3. Signs (Road Signs and Street Name Plates)
  - 4. Benches, Bikes Racks, and Arbors
  - 5. All other items as shown in the Engineering Plans

### **3.03 CONCRETE**

- A. The following concrete items shall be removed intact and salvaged:
  - 1. Precast Structures
  - 2. All other items as shown in the Engineering Plans

### **3.04 MECHANICAL EQUIPMENT**

- A. The following mechanical equipment shall be removed intact and salvaged:
  - 1. Pumps
  - 2. Shafts
  - 3. Pipe fittings
  - 4. Ventilation system

5. All other items as shown in the Engineering Plans

### **3.05 ELECTRICAL EQUIPMENT**

- A. The following electrical fixtures and equipment shall be removed intact and salvaged:
  1. Controls: Cabinets and contents
  2. Light fixtures
  3. SCADA System
  4. Electrical panels / load centers
  5. Telecommunications equipment
  6. All other items as shown in the Engineering Plans

### **3.06 UTILITIES**

- A. The following utility items shall be removed intact and salvaged:
  1. Water Utility:
    - a. Hydrants
    - b. Valves
    - c. Fittings
    - d. Valve boxes
    - e. Curb Boxes
    - f. Structure castings
  2. Sewer Utilities:
    - a. Structure castings
    - b. Casting lids and grates
    - c. Culverts, apron end walls, trash racks
    - d. Valves
    - e. Valve boxes

### **3.07 PROTECTION OF ITEMS**

- A. Protect all salvage items during the time of removal through to the delivery to the Owner's designated storage location.
- B. Protect from damage during removal and transport.
- C. If the salvaged items are to be reinstalled under this contract, properly store the items protecting them from other operation, weather conditions and theft.

### **3.08 CLEAN-UP**

- A. Upon completion of the Work, clean all areas affected by the Work of dust, dirt and debris caused by the removal and salvage operations.
- B. Debris and rubbish shall be removed and transported in a manner that prevents spillage on streets or adjacent areas.
- C. Comply with all local regulations regarding hauling and disposal.

**END OF SECTION**

**SECTION 31 11 00  
CLEARING AND GRUBBING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Clearing
  - 2. Grubbing
  - 3. Replacement and Charges for Damaged Trees and Shrubs
  - 4. Disposal

**1.02 ALLOWANCES**

- A. If so stated in the specification “Allowances”, installation testing will be paid as an allowance. All other testing will be incidental to the Work.
- B. If there is no reference in the specification section to “Allowances”, then testing costs will be incidental to other Work items.

**1.03 QUALITY ASSURANCE**

- A. Regulatory requirements:
  - 1. Conform to applicable local code for disposal of debris
  - 2. Coordinate Work with utility companies

**PART 2 - PRODUCTS**

**2.01 REFERENCES**

- A. The Council of Tree and Landscape Appraisers (CTLA):  
CTLA Guide for Plant Appraisal (8<sup>th</sup> Edition)

**PART 3 - EXECUTION**

**3.01 PREPARATION**

- A. Protect utilities, benchmarks, property monuments, and adjacent property.
- B. Provide temporary fences, barricades, coverings, and other protections to preserve existing trees and shrubs to remain.

### **3.02 CLEARING**

- A. Clear trees and shrubs within construction limits indicated for removal on the Engineered Plans.
  - 1. Do not remove trees and shrubs unless specifically stated for removal on the Engineered Plans.
  - 2. Unless shown on the Engineered Plans, do not remove trees without Engineer's approval.
  - 3. Complete clearing in a manner that prevents obstruction to traffic.
- B. Clearing consists of the felling, trimming, and cutting of trees into sections and satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas cleared.
- C. Cut trees, stumps, roots, brush, and other vegetation in areas cleared flush with or below the original ground surface, except such trees and vegetation as indicated to be left standing.

### **3.03 GRUBBING**

- A. Grubbing consists of the removal and disposal of stumps, roots larger than 2 inches diameter, and matted roots from the areas designated for clearing.
- B. Remove grubbed material together with logs and other organic or metallic debris to a depth of not less than 18 inches below original ground surface level.
- C. Fill depressions made by grubbing with suitable material conforming to the adjacent material and compact to level of original ground.

### **3.04 REPLACEMENT AND CHARGES FOR DAMAGED TREES AND SHRUBS**

- A. Replace damaged trees and shrubs designated to remain in place with like kind or species determined by Owner.
- B. Replace damaged trees with minimum 3" diameter.
- C. Additional tree liability charges to Contractor will be based on estimated tree value lost determined in accordance with "The Council of Tree and Landscape Appraisers (CTLA) Guide for Plant Appraisal (8th Edition)."

### **3.05 DISPOSAL**

- A. Dispose of all cleared and grubbed material in a safe manner in accordance with local, state, and federal laws and requirements.

- B. Obtain any necessary permits and approvals required to properly dispose off-site, burn, bury, or dump cleared and grubbed material.
- C. Conform to all requirements for disposal of diseased trees.
- D. Remove debris, rock, and extracted plant life from Site.

**END OF SECTION**

**SECTION 31 23 00  
EXCAVATION AND FILL**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Site Preparation
  - 2. Excavation
  - 3. Stockpiling
  - 4. Filling
  - 5. Placing Layers
  - 6. Grading
  - 7. Compaction and Moisture Requirements
  - 8. Borrow

**1.02 REFERENCES**

- A. American Society for Testing and Materials (ASTM)
  - ASTM D1556 Test for Density of Soil in Place by the Sand-Cone Method
  - ASTM D1557 Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Lb (4.54 kg) Rammer and 18 in. (457 mm) Drop
  - ASTM D2216 Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
  - ASTM D2487 Standard Test Method for Classification of Soils for Engineering Purposes
  - ASTM D6938-07 Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
  
- B. American Association of State Highway and Transportation Officials (AASHTO)
  - AASHTO T99 Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305mm (12-in.) Drop
  - AASHTO T191 Standard Method of Test for Density of Soil In-Place by the Sand-Cone Method

AASHTO T310 Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

C. Wisconsin Department of Natural Resources (WDNR)

WDNR Wetland General/Individual Permit Conditions

### **1.03 ALLOWANCES**

- A. If so stated in the specification “Allowances”, installation testing will be paid as an allowance. All other testing will be incidental to the Work.
- B. If there is no reference in the specification section to “Allowances”, then testing costs will be incidental to other Work items.

### **1.04 SUBMITTALS**

- A. Informational Submittals
  - 1. Location map of borrow site if not indicated on Engineered Plans.
  - 2. Field or Site Quality Control Submittals –Submit two (2) copies of the results of quality control testing (include location where tests were performed).
  - 3. Borrow haul vehicle identification, determined capacity and daily haul log.

### **1.05 QUALITY ASSURANCE**

- A. Obtain an independent testing laboratory approved by the Owner to provide quality control testing.
- B. Material Testing Requirements
  - 1. Source Testing of Soils and Aggregate:
    - a. Test all select soils and aggregates for acceptance as required by other Sections within these Specifications.
  - 2. Installation Testing
    - a. Determine maximum density and optimum moisture content for compaction in accordance with ASTM D1557 (one test for each type of material for each source).
    - b. Conduct field density tests in accordance with ASTM D1556 and/or D6938.

- c. Minimum frequency for field density testing shall be two (2) acceptable tests per layer per project or as follows, whichever number is greater:

Fill utilized for:	Number of Acceptable Tests for each Compacted Fill Layer:
Embankments, dikes or berms	1 test per 100 Linear Feet
Structural or controlled fills	1 test per 500 Linear Feet
Non-structural fills	1 test per 2,000 cubic yards

- 3. Provide Additional Density and Gradation Testing:
  - a. Change in method of compaction.
  - b. Change in source or quality of soil or aggregate.
  - c. Disturbed cut areas.

- C. When the testing results show that the Work is of an acceptable nature, the acceptance of the work shall not relieve the Contractor from making corrections to the tested work during the warranty period.

**PART 2 - PRODUCTS**

**2.01 MATERIALS**

- A. Topsoil
  - 1. Natural on-site upper layer of soil consisting of loam, sandy loam, silt loam, silty clay loam, or clay loam humus-bearing soils able to sustain plant life.
- B. Wetland Topsoil
  - 1. Material consisting of moist organic soil, including any existing wetland vegetation and seeds.
- C. Fill and Borrow
  - 1. Material consisting of satisfactory soil or a mixture of satisfactory soil, stone, gravel or other acceptable materials, of a character and quality satisfactory for the purpose intended. Material shall be free from sod, stumps, logs, and other perishable and deleterious matter.
  - 2. As a minimum, all soil shall meet the requirements of Soil Class G-1 in accordance to the appropriate Specification Section.

D. Embankments

1. For embankments that will function as temporary or permanent water impoundments for ponds or small dams, the following shall apply:
  - a) Satisfactory soil materials are those complying with ASTM D2487 soil classification groups GC, GM, SC, SM, CL, ML, CH, and MH; or as determined by Engineer.
  - b) Unsatisfactory soil materials are those complying with ASTM D2487 soil classification groups GW, GP, SW, SP, OL, OH, and PT; or as determined by Engineer.

**PART 3 - EXECUTION**

**3.01 SITE PREPARATION**

- A. Provide erosion and sediment control prior to excavation in accordance to the appropriate Specification Sections and Engineered Plans.
- B. Clear and grub as in accordance to the appropriate Specification Sections and shown on the Engineered Plans.
- C. Remove and dispose of site debris.
  1. All debris materials removed from the project site shall be disposed of at a legally approved site.
  2. Do not burn materials onsite.
- D. Excavate wetland topsoil material from areas shown on the Engineered Plans, stockpile and protect from contamination of other soils. Handle material in compliance with associated permits / permitting authorities / regulatory agencies.
- E. Remove structures, pavement and debris (such as vehicles, equipment, appliances, building materials or remains thereof, tires, and containers) from the site to an off-site disposal area selected by the Contractor in accordance with appropriate Specification Sections.

**3.02 EXCAVATION AND FILL**

- A. Topsoil Stripping
  1. Segregate and stockpile stripped and/or excavated soils for use on the site as intended and stated on the Engineered Plans.
  2. Excavate/strip and stockpile topsoil within the project limits shown on the Engineered Plans prior to beginning excavating, fill or hauling operation.

3. Provide excavating/stripping of topsoil in a manner that will minimize sediment runoff and not obstruct natural or intended drainage.
4. Do not strip topsoil when wet.
5. Do not mix topsoil with subsoils.

B. Stockpiling

1. Stockpiles shall exceed ten (10) feet in height.
2. Protect stockpiles from sediment transport by surface roughening, watering, and perimeter silt fencing and in accordance with appropriate Specification Sections.
3. Provide temporary seeding of stockpiles remaining longer than 30 days in accordance to appropriate Specifications Sections.
4. Upon completion of the Project or as approved by the Owner, remove surplus soil material from site or to a location designated by the Owner. Grade stockpile area to match surrounding area grades and restore area in accordance to appropriate Specification Sections.

C. Excavation

1. Following clearing and grubbing, miscellaneous structure and debris removal, topsoil stripping, etc., excavate to finished subgrade (undisturbed soil or compacted soil layer) elevations shown on the Engineered Plans.
2. Place suitable excavated material in fill areas to finished subgrade elevations shown on the Engineered Plans.
3. Over excavate and remove unsuitable materials in areas requiring pavement and other structures including the following materials:
  - a. Frozen materials.
  - b. Materials subject to decomposition.
  - c. Clods of clay and stones larger than 3 inches.
  - d. Organic material including silts.
  - e. Soils with excessive moisture content.

4. Soils with excessive moisture content required to support pavement and other structure may not need to be removed if improvement by compaction, disking, drying and recompaction, or similar methods that when tested will meet optimum moisture content for compaction as specified.

D. Filling

1. Provide suitable excavated material that will meet compaction requirements in fill areas where pavements and other structures are shown on the Engineered Plans.
2. Begin filling operations starting at the lowest point of the fill, below the grade at the bottom of ravines, etc.
3. Spread fill material in successive uniform horizontal layers not exceeding 8 inches in depth over entire fill area before compaction.
  - a. Work each layer to break down clods over 6 inches in size and to secure uniform moisture content.
  - b. Where filling in 8 inches is not feasible, as in the case of filling in water or over steep slopes, construct fill in one layer to the minimum elevation at which equipment can be operated.
    - (1) Construct fill layers above this elevation in layers of the specified depth.
    - (2) On side of hills, too steep to operate hauling equipment, over low wet ground, in marshes, or if filling in water, provide a single layer, just thick enough to support the hauling equipment while placing subsequent layers.
  - c. For embankments spread individual layers evenly to uniform thickness throughout and approximately parallel with the finished grade for the full width of the embankment.

E. Grading

1. Maximum slope within right of way shall be 4:1 unless prior approval is secured from the Municipal Engineer or Director of Public Works.
2. Provide finish grade subgrade foundation within following tolerances:
  - a. When subgrade is prepared for placement of Granular Subbase or finished grading construction outside pavement areas, then elevation of finished surface shall not vary by more than 0.10 foot from prescribed elevation.

- b. When subgrade is prepared for placement of Crushed Aggregate Base Course, then elevation of finished surface, at time the next layer is placed, shall not vary by more than 0.05 foot above or 0.10 foot below prescribed elevation.
  - c. When subgrade is prepared for placement of Asphaltic or Concrete Base, Stabilized Base, or Surface Course, then elevation of finished surface at time next layer is placed, shall not vary by more than 0.05 foot from prescribed elevation.
3. Subgrade Intermediate Consolidation and Trimming
- a. Provide temporary drainage and efficient management of surface water.
    - (1) At the end of each workday, consolidate and trim the subgrade to aid drainage and to protect against erosion.
    - (2) Consolidate and trim those portions of the subgrade surface disturbed, operated over, or constructed during that workday.
    - (3) Consolidate and trim until float material is pressed firmly against the subgrade and produces a tight, smooth, well-drained surface.
    - (4) If rain is imminent during the workday, consolidate and trim the subgrade before the rain falls to avoid ponding and erosion.
  - b. No compensation will be provided for methods necessary to dry materials that have excessive moisture added due to surface water.
4. In lawn or unpaved areas foundations, finish areas to receive topsoil to within not more than 0.10 feet above or below required subgrade elevations.
5. In walkway foundation, shape surface of areas under walks with finish surface not more than 0.05 feet above or below required subgrade elevation.
6. In excavated slopes or areas and embankment slopes or areas designated to be covered with topsoil or salvaged topsoil, undercut or underfilled to the necessary depth to provide for the specified amount of topsoil or salvaged topsoil to be placed and finished to the required grade lines and sections.

7. Upon completion of finish grading in sloped areas with tracked equipment, provide a last pass to leave track mark imprints that are perpendicular to the direction of runoff flow. Blade work is not required during directional tracking.

F. Compaction and Moisture Requirements

1. Degree of compaction is expressed as a percentage of maximum density obtained by laboratory test procedure. This percentage of maximum density is provided from results of field test procedures in accordance to ASTM D1556.
2. Compact material using standard compaction methods unless the contract specifies special compaction.
  - a. Deposit, spread, and level material in layers generally no thicker than 8 inches before compaction. Compact each layer of material until the compaction equipment achieves no further significant consolidation. Provide the required compaction for each layer before placing any material for a succeeding layer.
  - b. Do not compact material if the moisture content causes excessive rutting by the hauling equipment, or excessive displacement or distortion under the compacting equipment. If these conditions exist, allow the materials to dry before compacting. If necessary, accelerate drying the materials by aerating or by using blade graders, harrows, discs, or other appropriate equipment to manipulate the material.
  - c. If the material does not contain sufficient moisture to compact properly, add water in quantities the engineer deems necessary to aid, accelerate, and secure effective compaction.
  - d. All embankment material placed within the limits of assumed one to one slopes extending outward and downward from the outer limits of the finished shoulder lines or back of curb shall be compacted in accordance with these specifications.
3. Compaction is required to a minimum of 95% of maximum dry density as determined by AASHTO Method T99 (Standard Proctor) will be required.
4. Building Pads:

- a. Fill placed in areas designated on the Engineered Plans or in the specifications to support one- and two-story buildings shall be placed in lifts not to exceed eight inches and compacted to a minimum of 98% of maximum dry density as determined by AASHTO Method T99. Engineer makes no representation regarding soil suitability for foundations or other structural applications.
5. Embankments Used for Impoundments:
    - a. The compaction requirements for the full width and depth of all embankments that will function as temporary or permanent water impoundments for ponds or dams shall meet a minimum of 95% of maximum dry density as determined by AASHTO Method T99.
  6. Maintain proper soil moisture contents for compaction in accordance to optimum moisture content as determined by ASTM D1557. Use Proctor to determine acceptance moisture contents for soil compaction.
- G. Topsoil Placement / Re-spread
1. Place topsoil within the areas indicated on the Engineered Plans. Place in a manner and thickness in accordance to applicable Specification Sections.

### **3.03 BORROW**

- A. Obtain satisfactory soil imported from off-site locations and placed on site for use as general fill. Moving of material from one location within the project site to another location within the project site is not considered borrow.
- B. Obtain suitable borrow material from the following source:
  1. The Contractor shall negotiate with property owners or others from whom the Contractor proposes to obtain borrow material. Obtain any permits that may be required associated with the borrow site.
- C. Use material with suitable engineering properties obtained from work done under other contract bid items to reduce the quantity of borrow material required.
- D. Excavate borrow site(s) in a manner that allows accurate measurement of the material excavated and incorporated in the Work. Dispose of unsuitable materials, debris, resulting from preparing the site such as; stone, boulders, stumps, trees, logs, brush.
- E. Strip available topsoil, or other soil favorable to plant growth, overlying the borrow site.

1. Stockpile the topsoil in sufficient quantities to cover all surfaces of excavated areas from 4 to 6 inches deep.
  2. If the topsoil overlying the site is less than 4 inches in depth, replace the topsoil to the original depth.
  3. After trimming and finishing the site, spread the salvaged material uniformly over excavated areas of the borrow site unless otherwise specified.
- F. Place borrow as required to obtain final site elevations.

**END OF SECTION**

**SECTION 31 23 13**  
**SUBGRADE PREPARATION**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Unclassified excavation and grading
  - 2. Filling and compacting
  - 3. Preparation of subgrade
  - 4. Proof rolling
  - 5. Unstable subgrade/Excavation Below Subgrade (EBS)
  - 6. Drainage during construction
  - 7. Finish Grading

**1.02 REFERENCES**

- A. American Society for Testing and Materials (ASTM)
  - ASTM D1140 Test for Amount of Material in Soils Finer than the No. 200 Sieve
  - ASTM D1556 Test for Density of Soil in Place by the Sand-Cone Method
  - ASTM D1557 Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Lb (4.54 kg) Rammer and 18 in. (457 mm) Drop
  - ASTM D2216 Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
  - ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
  - ASTM D4318 Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
  - ASTM D6938 Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- B. American Association of State Highway and Transportation Officials (AASHTO):
  - AASHTO Method T99 Moisture-Density Relations of Soils

### **1.03 ALLOWANCES**

- A. If so stated in the specification “Allowances”, installation testing will be paid as an allowance. All other testing will be incidental to the Work.
- B. If there is no reference in the specification section to “Allowances”, then testing costs will be incidental to other Work items.

### **1.04 SUBMITTALS**

- A. Informational Submittals
  - 1. Field or Site Quality Control Submittals – Submit two (2) copies of the result of quality control testing (include locations where testing was performed)

### **1.05 QUALITY ASSURANCE**

- A. Qualifications - Testing Agencies: Contractor shall secure soil sampling and testing by a qualified testing agency, acceptable to Owner and independent from Contractor.
- B. Testing Requirements: Test soil materials for suitability for intended purpose. Determine mechanical analysis, liquid and plastic limit, and moisture-density curve (ASTM D1557) for each type of soil encountered. Test in accordance with standard recognized procedures.
  - 1. Determine optimum moisture content and maximum density for compaction in accordance with ASTM D1557.
  - 2. Conduct field density test in accordance with ASTM D1556 and/or D6938.
  - 3. Minimum frequency for field density testing shall be two (2) acceptable tests per project or as follows, whichever number is greater:
    - a. One moisture/density test per 500 feet of roadway and in each compacted fill layer.
  - 4. Additional Density Testing:
    - a. Perform additional density testing under the following circumstances:
      - (1) Soil density does not meet project requirements.
      - (2) Change in method of compaction.
      - (3) Change in source or quality of soil.

- (4) Disturbed cut areas.
5. Where field-testing indicates that soils are below specified density, provide additional compaction and testing at no additional expense to the Owner.

## **PART 2 - PRODUCTS**

### **2.01 MATERIALS**

- A. Backfill and Fill Materials: Soil used for borrow, fill, backfilling shall meet the requirements of soil class as shown on Engineered Plans or stated in Specifications. Material shall be satisfactory soil materials free from waste, frozen materials, vegetation and other deleterious matter.
  1. As a minimum, all soils shall meet the requirements of Soil Class G-1 (Clean Earth Fill) as specified in the appropriate Specification Section. Soil Class G-1 shall be any soil material either excavated on the project site or obtained from borrow areas.
  2. Soil materials unsuitable and, therefore, not approved for this classification are:
    - a. Soils with high organic contents such as: topsoil, peat, muck, organic silts, and clays, marls, etc.
    - b. Manmade or rubble filled soils containing such materials as: foundry sand, fly ash cinders, asphalt, and concrete rubble, etc.
    - c. Silty soils such as: rock flour, loess, etc.
    - d. Soils with gravel larger than 3-inch.
    - e. Silty clay or clays with high plasticity (CH soils as defined in ASTM D2487).
    - f. All soil contaminated with hazardous waste materials as defined by the EPA.
- B. Excavation Below Subgrade (EBS) Backfill
  1. EBS areas shall be backfilled with granular material as stated in the Bid Form for EBS Backfill.
  2. If available on site and determined to be acceptable by the Engineer to remediate areas of failing/yielding subgrade, fill subgrade with satisfactory materials excavated from other sections of the project.

## **PART 3 - EXECUTION**

### **3.01 GRADING TOLERANCES**

- A. Finish grade subgrade foundation within following tolerances:
  - 1. When subgrade is being prepared for placement of Granular Subbase or is being finished for acceptance of grading construction, then elevation of finished surface shall not vary by more than 0.10 foot from plan elevation at any point where measurement is made.
  - 2. When subgrade is being prepared for placement of Crushed Aggregate Base Course, then elevation of finished surface, at time the next layer is placed, shall not vary by more than 0.05 foot above or 0.10 foot below prescribed elevation at any point where measurement is made.
  - 3. When subgrade is being prepared for placement of Asphaltic or Concrete Base, Stabilized Base, or Surface Course, then elevation of finished surface at time next layer is placed, shall not vary by more than 0.05 foot from prescribed elevation at any point where measurement is made.
- B. Subgrade Intermediate Consolidation and Trimming
  - 1. Provide temporary drainage and efficient management of surface water.
  - 2. Provide work necessary to dry materials that have excessive moisture added due to surface water.
  - 3. At the end of each work day, consolidate and trim the subgrade to aid drainage and to protect against erosion.
    - a. Consolidate and trim those portions of the subgrade surface disturbed, operated over, or constructed during that workday.
    - b. Consolidate and trim until float material is pressed firmly against the subgrade and produces a tight, smooth, well-drained surface.
    - c. If rain is imminent during the workday, consolidate and trim the subgrade before the rain falls to avoid ponding and erosion.
- C. Lawn or Unpaved Areas Foundations: Provide finish areas to receive topsoil to within not more than 0.10 feet above or below required subgrade elevations.
- D. Walkway Foundation: Shape surface of areas under walks with finish surface not more than 0.05 feet above or below required subgrade elevation.

### **3.02 GENERAL**

- A. Excavated slopes or areas and embankment slopes or areas, designated to be covered with topsoil or salvaged topsoil, shall be undercut or underfilled to the necessary depth to provide for the specified amount of topsoil or salvaged topsoil to be placed and finished to the required grade lines and sections.
- B. Upon completion of finish grading on sloped areas, with tracked equipment, perform a last pass to leave track mark imprints that are perpendicular to the direction of runoff flow. Blade work is not required during directional tracking.

### **3.03 EXCAVATION AND GRADING**

- A. Following any required/specified clearing and grubbing, miscellaneous structure and rubble removal, topsoil stripping, etc., excavation to subgrade shall be performed to provide a finished subgrade prepared for the application of crushed aggregate, curb and gutter, sidewalks and topsoil as shown on the Engineered Plans.

### **3.04 FILLING**

- A. Use suitable excavated material for roadway construction, and at other locations shown on the Engineered Plans. Segregate and stockpiled suitable excavated material or place material to satisfy fill areas.
- B. Begin filling operations starting at the lowest point of the fill, below the grade at the bottom of ravines, etc.
- C. Spread fill material in successive uniform horizontal layers not exceeding 8 inches in depth over entire fill area before compaction.
  - 1. Each layer shall be worked to break down clods over 6 inches in size and to secure uniform moisture content.
  - 2. Where filling in 8 inches is not feasible, as in the case of filling in water or over steep slopes, construct fill in one layer to the minimum elevation at which equipment can be operated. Fill layers above this elevation shall be constructed in layers of the specified depth.

### **3.05 PREPARATION OF SUBGRADE**

- A. Prepare or restore the subgrade by removing vegetation; excavating and removing materials of any nature encountered above the required elevations; filling depressions occurring below the required elevations; and smoothing, shaping, and compacting the subgrade to the required grade, section, and density.
- B. Shape and compact the subgrade for the full width of the roadbed, to the required lines, grade, cross-section, and density well in advance of base laying operations.

1. Remove stones over 6 inches in greatest dimension encountered during the operations.
  2. Water subgrade as required or permit to dry to proper consistency and rolling the entire area with an approved self-propelled roller.
  3. Unless specified otherwise, uniformly compact the subgrade to not less than the density for standard compaction of the particular material existing in the subgrade.
  4. Maintain the prepared subgrade ahead of the base laying operations in a smooth condition and at not less than specified density.
  5. Remove any ruts or surface irregularities produced by hauling or other equipment or other traffic.
  6. Correct soft or yielding areas, holes, or other defects that occur due to traffic, hauling, poor drainage, unstable materials, or from any other cause before placing the base.
  7. Remove snow or ice, if any, from the foundation before placing the base.
- C. If the earth subgrade construction was substantially completed under a previous contract, do not presume that the previously completed work conforms to the requirements under this section.

### **3.06 COMPACTION AND MOISTURE REQUIREMENTS**

- A. Compaction: Before placing materials, complete any required clearing and grubbing of the site and prepare the roadway foundation as specified above. Compact material using standard compaction methods unless the contract specifies special compaction.
1. Deposit, spread, and level material in layers generally no thicker than 8 inches before compaction. Compact each layer of material until the compaction equipment achieves no further significant consolidation. Provide the required compaction for each layer before placing any material for a succeeding layer.
  2. Do not compact material if the moisture content causes excessive rutting by the hauling equipment, or excessive displacement or distortion under the compacting equipment. If these conditions exist, allow the materials to dry before compacting. If necessary, accelerate drying the materials by aerating or by using blade graders, harrows, discs, or other appropriate equipment to manipulate the material.

3. If the material does not contain sufficient moisture to compact properly, add water in quantities necessary to aid, accelerate, and secure effective compaction.
  4. All embankment material placed within the limits of assumed one to one slopes extending outward and downward from the outer limits of the finished shoulder lines or back of curb shall be compacted in accordance with these specifications.
- B. Compaction is required to a minimum of 95% of maximum dry density as determined by AASHTO Method T99 (Standard Proctor) will be required.
- C. In addition to maintaining drainage during construction, at the end of each workday consolidate and trim the subgrade to aid drainage and to protect against erosion.
1. Consolidate and trim those portions of the subgrade surface disturbed, operated over, or constructed during that workday.
  2. Consolidate and trim until material is pressed firmly against the subgrade and produces a tight, smooth, well-drained surface.
  3. If rain is imminent during the workday, consolidate and trim the subgrade before the rain falls to avoid ponding and erosion.
- D. Proper soil moisture contents for compaction are to be maintained in all soils.
1. Optimum moisture content as determined by ASTM D1557.
  2. Use Proctor to determine acceptance moisture contents for soil compaction.

### **3.07 EXCAVATION BELOW SUBGRADE (EBS)**

- A. Remove deposits of frost-heave material, unstable silty soils, water-bearing soil, or other undesirable foundation materials from the area within the roadway slopes to such depths as ordered by the Engineer.
- B. Should excavation below subgrade (EBS) be required in an area of completed base course construction, restore the base course in the area of EBS.

### **3.08 FINISH GRADING**

- A. Complete grading, trimming, and shaping before constructing the subbase, base, or surface courses.

1. Transition constructed slopes with adjacent terrain to be smooth and gradual and that conform to the required Engineered Plans cross-sections and grades.
2. Use blading or other operations to smooth any ridges left by grading or excavating equipment and crests of cut banks.
3. During grading operations and pending acceptance of grading or placement of subbase, base, or surface course, provide continuous maintenance of the entire roadbed and perform blading and repair work necessary to keep the grade smooth and to the required grade and cross-section specified.
4. Refill and compact washouts caused by erosion.

### **3.09 TESTING**

- A. Perform compaction and density tests at locations determined by the Engineer. Where tests indicated that the subgrade does not conform to the compaction density specified, replace subgrade material or re-work until it does conform to the requirements.

### **3.10 PROOF (TEST) ROLLING**

- A. Prior to placing granular subbase or base course material, test the subgrade strength by proof rolling.
- B. Proof roll finished cut or fill subgrades by rolling with a fully loaded tandem axle dump truck. Proof Roll shall be performed under the supervision of the Municipal Engineer or the Director of Public Works.
- C. Contractor may be required to provide a weight ticket associated with the loaded test vehicle.
- D. Proof rolling shall involve running loaded trucks over the entire roadway (pavement plus shoulders or extent beyond back of curb) width.
- E. Stabilize weak or yielding areas in the subgrade due to deflection, pumping, rolling, or other failures.
- F. A subsequent proof roll test will be required for all repaired/stabilized areas within the subgrade.
- G. In the event that weather, or other conditions change the condition of the subgrade after initial proof roll test and/or stabilization has been performed, a proof roll test of the entire subgrade will be required after such event.

- H. Take necessary precautions to protect existing structures from damage during proof roll test.

### **3.11 DRAINAGE DURING CONSTRUCTION**

- A. During construction, maintain roadway, ditches, and channels in a well-drained condition at all times by keeping the excavation areas and embankments sloped to the approximate section of the proposed earth grade.
  - 1. Perform blading or leveling operations when placing embankments and during the process of excavation.
  - 2. If it is necessary during the performance of the work to interrupt existing surface drainage, sewers, or under drainage, provide temporary drainage until completing permanent drainage work.
- B. If storing salvaged topsoil on the right-of-way during construction operations, stockpile it to prevent restriction with or obstruction of surface drainage. Seal subgrade surfaces intermediate subgrade consolidation and trimming.
- C. Protect and maintain existing tile drains, sewers, and other subsurface drains that should continue in service without change. Repair, at no expense to the Owner, any damage to drainage system resulting from the contractor's operations.

**END OF SECTION**

**SECTION 31 23 33  
TRENCHING AND BACKFILL**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Trenching and Backfill
  - 2. Rock Excavation
  - 3. Dewatering
  - 4. Compaction
  - 5. Flowable Fill
  - 6. Materials Testing
  - 7. Excess Material
- B. This section applies to below ground pressure and gravity pipe lines.

**1.02 REFERENCES**

- A. WisDOT Standard Specification Section 608.3.5
- B. American Society for Testing and Materials (ASTM):
  - ASTM D698 Laboratory Compaction Characteristics of Soil Using Standard Effort
  - ASTM D1556 Density and Unit Weight of Soil in Place by the Sand-Cone Method
  - ASTM D1586 Standard Method for Penetration Test and Split-Barrel Sampling of Soils
  - ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Application
  - ASTM D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- C. American Association of State Highway and Transportation Officials (AASHTO):
  - AASHTO Method T99 The Moisture Density Relationship of Soils Using a 5.5 lb Hammer and a 12-Inch Drop (Standard Proctor)
  - AASHTO Method T191 Density of Soil in place by the Sand-Cone Method

AASHTO Method T310      In-Place Density and Moisture Content of Soil and  
Soil Aggregate by Nuclear Methods (Shallow  
Depth)

**1.03 ALLOWANCES**

- A. If so stated in the specification “Allowances”, installation testing will be paid as an allowance. All other testing will be incidental to the Work.
- B. If there is no reference in the specification section to “Allowances”, then testing costs will be incidental to other Work items.

**1.04 SUBMITTALS**

- A. Informational Submittals: Submit two (2) copies of the results of quality control testing (include location where test was performed for each result):
  - 1. Materials source testing.
  - 2. Background testing
  - 3. Installation testing.
  - 4. Results of density testing.
  - 5. Certificate of Insurance – Rock Blasting
  - 6. Dewatering Permits

**1.05 QUALITY ASSURANCE**

- A. Testing Requirements:
  - 1. Unless covered under the “Allowances” section, Contractor shall pay for soil sampling and testing by a qualified testing agency, acceptable to Owner and independent of Contractor. Contractor is responsible for any retests and sampling required should initial tests fail, at no additional expense to Owner.
    - a. Conditions causing additional testing and gradation testing (retests):
      - (1) Soil density does not meet project requirements
      - (2) Change in method of compaction
      - (3) Change in source or quality of bedding or backfill material

2. Test soil materials for suitability for intended purpose. Determine mechanical analysis, liquid and plastic limit, and moisture-density curve (ASTM D698/AASHTO T99) for each type of soil encountered. Test in accordance with standard recognized procedures.
  - a. Perform at least two field density tests in random compacted backfill layers for every 400 linear feet of trench, or fraction thereof.
3. Density tests shall be at randomly selected locations and in accordance with ASTM D1556/AASHTO T191 or ASTM D2922/AASHTO T310.
4. Forward all test results to Engineer prior to Contractor receiving payment for related Work.
5. Acceptable test results do not relieve the Contractor from making corrections to the tested work during the warranty period.

## **PART 2 - PRODUCTS**

### **2.01 NATIVE BACKFILL MATERIAL**

- A. Unless otherwise specified, use excavated material as backfill material. Use excavated material consisting of materials that, in the judgement of the Engineer, are suitable for backfilling.
  1. All backfill for trenches within roadways and within 2' of back of curb shall be select granular backfill.
  2. Backfill outside of the above limits shall be native backfill unless material is unacceptable to Director of Public Works or Municipal Engineer. Notify Director of Public Works or Municipal Engineer to make determination.
- B. Topsoil, peat, organic soils, and materials containing slag, cinders, foundry sand, debris, and rubble, or soil with less than required bearing capacity as determined by Engineer are unsuitable materials.
- C. Backfill material shall be free of:
  1. Vegetation or other organic material.
  2. Concrete or concrete fragments.
  3. Stones larger than 3 inches.
  4. Frozen material.
  5. Blasted rock.

## **2.02 GRANULAR BEDDING**

- A. Crushed Stone Bedding
  - 1. Provide ¾” crushed rock bedding material of Soil Class A-7 in accordance to the appropriate Specification Section.

## **2.03 GRANULAR BACKFILL**

- A. Provide granular backfill material in accordance with Crushed Aggregate Base Course Gradation #2.
  - 1. All backfill for trenches within roadways and within 2’ of back of curb shall be select granular backfill.

## **2.04 CELLULAR CONCRETE BACKFILL**

- A. Provide cellular concrete to backfill trenches and excavations around manholes.
- B. Cellular concrete consisting of 1 part cement, 1 part fly ash, 8 parts sand by volume with a target water / cement ratio of 0.65.
- C. Just prior to placing the slurry, run the mixer at mixing speed for one full minute to insure an even mixture. No additional water will be allowed to the mixture.
- D. Compaction of cellular concrete backfill is not required.

## **PART 3 - EXECUTION**

### **3.01 EXISTING STRUCTURES AND UTILITIES**

- A. Existing Underground Improvements:
  - 1. Location and size of existing underground improvements, including pipes, wires, culverts, and conduits, are shown on Engineered Plans insofar as records are available or surface markings indicate.
  - 2. Prior to trenching, determine the exact location of underground structures and coordinate location with the owner(s) of the structures/utilities.
- B. Remove concrete or asphalt surfaced walks and pavements, trees and other site improvements in accordance with appropriate Specification Sections.
- C. Unknown Underground Structure:
  - 1. When unknown existing underground structure occupies space required for proposed utility, Contractor shall immediately notify Engineer.

2. If change in location of proposed improvement is required, then Contractor shall arrange for all relocations.
- D. Underground structures or utilities that do not occupy space required for proposed utility, but are relocated for convenience of Contractor shall be paid for by Contractor.
- E. When proposed utility is installed below an existing structure, backfill area with granular fill and mechanically compact fill, in layers not to exceed 6 inches in depth, to 95% of standard proctor.

### **3.02 TRENCHING**

- A. Remove and salvage topsoil in accordance to the appropriate Specification Sections.
- B. During trenching for new pipe or structures, remove existing pipe located in the same location or above the new pipe intended to replace existing pipe.
- C. Trench size shall be of adequate width and depth to allow proper construction of proposed utilities.
- D. Keep loss of pavement to a minimum within improved streets.
- E. Width of excavation below top of pipe shall be no more than 2 feet wider than outside diameter of pipe; except, minimum trench width shall be 30 inches.
- F. Excavate bell holes large enough to eliminate any excessive pressure on the bell.
- G. Unauthorized Over Excavation: Excavation below required level will be backfilled at Contractor's expense with suitable material and compacted to density of the undisturbed soil.
- H. Backfill Timing:
  1. Not more than 100 feet of trench is to be open in advance of pipe laying unless otherwise permitted by Engineer.
  2. In all cases, backfilling must occur within 200 feet of completed pipe laying.
- I. No compensation will be allowed for methods necessary to dry materials that have excessive moisture added due to surface water.

### **3.03 FOUNDATION**

- A. Prepare a uniform foundation for pipe.
- B. Unstable Foundation:

1. Remove and replace all undesirable material encountered below the trench bottom, such as organic soils, etc., which cannot adequately support the proposed pipe.
2. Contact Engineer when unstable foundation material is encountered.

### **3.04 BEDDING**

- A. Deposit all bedding material uniformly and simultaneously on each side of pipe to prevent lateral displacement.
- B. Plastic Pipe:
  1. Use granular bedding materials for all plastic pipe.
  2. Provide bedding as shown on Engineered Plans, pipe embedment details.
  3. Uniformly compact material under and around pipe.
  4. Shape bottom of bedding to fit contour of pipe.
- C. RCP
  1. Bed pipe in carefully placed material on trench bottom as shown on the Engineered Plans.

### **3.05 BACKFILL**

- A. Provide pipe bedding as required for the type of pipe installed per pipe embedment details as shown on plans.
- B. Place backfill material in maximum 12 inch lifts.
- C. Backfill material not to include: debris, frozen material, large clods or stones, organic matter, or other unstable materials.
- D. Place backfill in such a manner that will not disturb alignment of pipe.

### **3.06 TRENCH COMPACTION**

- A. Mechanical Compaction:
  1. Use mechanical compaction to compact backfill in trenches in 12 inch layers from one foot above top of pipe to finished grade to minimum density of 95% Standard Proctor.
- B. Areas Required: Mechanical compaction will be required for all trenches.

- C. Backfill trench to last pipe joint (not to exceed 10 feet) at the end of each work day.

### **3.07 ROCK EXCAVATION**

- A. Rock material that is igneous, metamorphic, or sedimentary rock or stone geologically in place and boulders over one cubic yard in volume in trenches that cannot be removed using a hydraulic backhoe or power shovel and therefore requires use of pneumatic breakers, rock trenchers or drilling and blasting for removal will be considered rock excavation as determined by the Engineer.
- B. Contact the Engineer when rock is believed to be encountered. The Engineer will determine whether the material is rock.
- C. Remove rock to a minimum of 6 inches below the bottom of pipe or excavation elevation and replaced with suitable material properly compacted.
  - 1. The thickness of the granular bedding material, granular fill material, or earth cushion shall be 6 inch minimum.
  - 2. Prepare the trench or excavation subgrade satisfactorily with hand tools and portable compaction equipment.
  - 3. In rock excavation, the bottom of the trench shall not be less than 30 inches wide or greater than 18 inches wider than the outside diameter of the pipe.
- D. Remove rock using methods other than drilling and blasting such as pneumatic breakers and rock trenchers.
- E. Blasting (Use only as approved by Engineer)
  - 1. Adhere to the Wisconsin Administrative Code on Explosives and all local ordinances that regulate blasting.
  - 2. Provide blasting so as to not damage adjacent property including but not limited to structures, above ground and underground utilities, culverts, sewers, services, pavements and parking lots.
  - 3. The use of these explosives and initiation systems are to be in accordance with the instructions and recommendations of the suppliers.
  - 4. Unless otherwise approved by the Owner, all blasting shall occur between the hours of 8:00 a.m. and 5:00 p.m., Monday through Friday.
  - 5. When drilling through the overburden soils and weathered rock for trench blasting, the drill holes may require casing to remain open for the time it takes to drill and load the complete blasting pattern.

6. Blasting will be permitted only after Contractor secures all necessary permits, has certified, licensed blaster present for all blasting operations, receives Engineer's approval, receives Owner's approval, and takes proper precaution to protect adjacent completed work, persons, and adjacent property.
7. Provide video tapes and photos of all structures within the blasting zone prior to blasting and repair all damages caused by blasting at their own expense.
8. If blasting is not permitted, excavate rock by excavating, drilling, cutting, jack hammer, pre-splitting, expansive ripper tooth, pneumatic hole punch, or rock breaker equipment.
9. Erect signboards of adequate size stating that blasting operations are taking place in the area, and such signs are to be clearly visible at all points of access to the area. Follow all requirements of the Wisconsin Department of Safety and Professional Services (Chapter SPS 307).
10. Demonstrate proof that the Contractor or their blasting subcontractor has the minimum insurance requirements as provided within the Supplemental General Conditions of these Contract Documents.

### **3.08 DEWATERING TRENCHES**

- A. Determine groundwater conditions.
- B. Provide and maintain necessary means and methods to dewater excavation as required.
- C. Dispose of water.
- D. Prevent runoff and dewatering system discharge from entering excavation.
- E. Secure permits from regulatory and governmental agencies governing dewatering.
  1. If it becomes necessary to pump more than 70 gpm, then wells will be considered High Capacity Wells and shall be subject to WDNR approval as described in NR812.12 Wisconsin Administrative Code.
  2. Should High Capacity Wells be necessary, Contractor shall obtain appropriate permits from DNR at following location: Wisconsin Dept. of Natural Resources, Private Water Supply Section, PO Box 7921, Madison, WI 53707.
- F. Correct damage caused to private wells due to dewatering.

- G. Maintain a water supply to private and public wells affected by the dewatering operation.
- H. Dewater to a minimum depth of 12 inches below excavations.
- I. Maintain dewatering operation until backfill and compaction procedures are completed.
- J. Groundwater Disposal
  - 1. Convey groundwater to point of discharge through pipelines.
    - a. Open ditches and trenches are not permitted.
    - b. Use of Owner's utilities not permitted without written consent.

### **3.09 SHEATHING**

- A. General:
  - 1. Provide sheathing necessary to protect nearby facilities or pavement surface.
- B. Construction:
  - 1. Prevent soil from entering trench either below or through such sheathing.
  - 2. Engineer may allow tight sheathing to be set in place rather than be driven; provided, that ground conditions are suitable and trench is properly spot braced prior to placing of sheathing.
  - 3. Immediately fill all voids behind sheathing with gravel backfill.
  - 4. Remove sheathing after trench is backfilled.
- C. Sheathing Left in Place:
  - 1. Engineer may order, in writing, some or all of sheathing to remain in place.
  - 2. Upper portion within two feet of street surface cut off and removed.
  - 3. All voids left by the removal of the sheathing shall be carefully filled by appropriate measures.
- D. Minor bracing, shoring, or portable trench boxes will not be considered sheathing.

### **3.10 EXCESS MATERIAL**

- A. Disposal:
  - 1. Responsibility of Contractor.
  - 2. Is considered incidental to pipe installation.
- B. Disposal of Surplus Excavated Material includes:
  - 1. Remove surplus excavated material from the site as soon as it is determined it will not be used for backfill material.
  - 2. Dispose of pavement separately from soils material.
  - 3. Dispose of surplus material which includes:
    - a. Loading and hauling.
    - b. Dumping and leveling.
    - c. Providing a dump site (when not specified by Owner).
      - (1) Conform with governing authorities including the obtaining of required permits.
      - (2) No limit on haul distance.
  - 4. Do not dispose of excavated surplus material in state waters, floodplain, or wetlands without written approval of the appropriate regulatory agency.

**END OF SECTION**

**SECTION 31 25 00**  
**EROSION AND SEDIMENTATION CONTROLS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Temporary Erosion and Sediment Controls
    - a. Temporary Grading Practices for Erosion Control
    - b. Temporary Seeding
    - c. Temporary Earth Berm or Channel
    - d. Temporary Perimeter Control and Slope Products
    - e. Temporary Ditch Checks
    - f. Temporary Culvert Pipe Checks
    - g. Temporary Silt Fence
    - h. Temporary Sediment Bale Barrier
    - i. Temporary Sediment Basin
    - j. Temporary Sediment Trap
    - k. Temporary Silt Curtain
    - l. Temporary Turbidity Barrier
    - m. Temporary Storm Drain Inlet Protection
    - n. Temporary Stone Tracking Pads
    - o. Temporary Dust Control
    - p. Dewatering
  - 2. Permanent Erosion and Sediment Control
    - a. Permanent Seeding and Fertilizing
    - b. Permanent Erosion Mats
    - c. Vegetative Buffers

- d. Mulching
  - e. Soil Additives for Erosion Control
  - f. Permanent Rip Rap
3. Maintenance and Reporting

## 1.02 REFERENCES

- A. Wisconsin Department of Transportation (WisDOT)
- WisDOT Erosion Control, Product Acceptability Lists for Multi-Modal Applications (PAL), latest edition.
- B. American Society for Testing and Materials (ASTM)
- |            |  |
|------------|--|
| ASTM D1388 | Test Method for Stiffness of Fabrics   |
| ASTM D2487 | Test Method for Classification of Soils for Engineering Purposes   |
| ASTM D3776 | Test Method for Mass Per Unit Area (Weight) of Woven Fabric  |
| ASTM D4355 | Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus) |
| ASTM D4491 | Test Method for Water Permeability of Geotextiles by Permittivity  |
| ASTM D4632 | Test Method for Grab Breaking Load and Elongation of Geotextiles   |
| ASTM D4751 | Test Method for Determining Apparent Opening Size of a Geotextile  |
| ASTM D4833 | Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products                |
| ASTM D5035 | Test Method for Breaking Strength and Elongation of Textile Fabric (Strip Method)                                    |
| ASTM D5338 | Test Method for Determining Aerobic Biodegradation of Plastic Materials Under Controlled Composting Conditions       |
- C. Wisconsin Department of Natural Resources (WDNR)
- Stormwater Technical Standards, <http://dnr.wi.gov/runoff/stormwater/techstds.htm>  
 Best Management Practices  
 Construction Site Inspection Report Form 3400-18
- D. Local erosion control plans and ordinances.

## 1.03 SUBMITTALS

- A. Action Submittals

1. Product Data
    - a. Provide product data showing listed on WisDOT PAL approval list.
    - b. Provide product data for manufactured products demonstrating conformance with the Specification.
  2. Delegated Design Submittals
    - a. Provide plan for additional proposed erosion and sediment control.
    - b. Provide rip rap design for severe erosion is anticipated.
- B. Informational Submittals
1. Field or Site Quality Control Submittals
    - a. Submit weekly to Engineer one (1) copy of erosion control Construction Site Inspection Report(s).

## **PART 2 - PRODUCTS**

### **2.01 SEED**

- A. Temporary Seeding
1. Provide seed species and application rates in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1059 "Seeding".
  2. Fertilizer is not required.
- B. Permanent Seeding
1. Provide permanent seeding and fertilizer including vegetative buffers in accordance with the appropriate Specification Section.

### **2.02 TEMPORARY PERIMETER CONTROL AND SLOPE INTERRUPTION PRODUCTS**

- A. Provide perimeter control and slope interruption products in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1071 "Interim Manufactured Perimeter Control and Slope Interruption Products".
- B. Products shall be listed on WisDOT Erosion Control, Product Acceptability Lists for Multi-Modal Applications (PAL), latest edition for the appropriate application.

## **2.03 STRAW BALES AND ROCK FILLED FILTER BAGS**

### **A. Rock Filled Filter Bags**

1. Minimum unfilled size of 18" x 30".
2. Construct bag of high density polyethylene as manufactured by Erotex.
3. Seal bag with a high density polyethylene draw string knitted directly into the bag opening in a rolled seam using minimum of 480 denier polyester sewing yarn.
4. Fill bag with well graded coarse aggregate conforming to Soil Class A-7 in accordance to the appropriate Specification Section.

### **B. Straw Bales**

1. Provide straw bales with rectangular surfaces tightly compacted of grain straw.
2. Bales shall be tightly bound with twine.
3. The material in the bales shall be dry, free of grain, weed seed and mold.

### **C. Support Post**

1. Wood or steel construction, minimum length 4 feet.
2. Wood Posts: 2" x 2" or equivalent steel posts.

## **2.04 SILT FENCE**

### **A. Geotextile Fabric**

1. Provide either woven or non-woven polyester, polypropylene, stabilized nylon, polyethylene or polyvinylidene chloride fabric.
2. Provide fabric with the minimum strength values in the weakest principal direction.
3. Non-woven fabric may be needle punched, heat bonded, resin bonded or combination thereof.
4. Fabric shall meet the following requirements:
  - a. If silty soils on-site then the following can be used:
    - (1) Grab Tensile Strength: ASTM D4632 101 lbs. (450 N)

- (2) Apparent Opening Size: ASTM D4751 0.3 mm
- (3) UV Resistance Strength Retained: ASTM D4355 70 at 500 Hours (%)
- (4) Permittivity (per second): ASTM D4491 0.14
- b. If sandy soils on-site then the following shall be used:
  - (1) Grab Tensile Strength: ASTM D4632 101 lbs. (450 N)
  - (2) Apparent Opening Size: ASTM D4751 0.3 mm to 0.8 mm
  - (3) UV Resistance Strength Retained: ASTM D4355 70 at 500 Hours (%)
  - (4) Permittivity (per second): ASTM D4491 0.14
- B. Support Posts
  - 1. Wood or steel construction minimum length 5 feet.
  - 2. Wood posts - 2" x 2" or equivalent steel posts.
- C. Silt fence shall conform to the Wisconsin Department of Natural Resources Conservation Practice Standard #1056 "Silt Fence".

## **2.05 RIP RAP**

- A. Rip rap may be used for construction of permanent erosion control or temporary ditch checks, and sediment trap outlets.
- B. Provide as follows:
  - 1. Provide minimum thickness of 1.0 feet measured perpendicular to the base.
  - 2. More than 50 percent of stones shall weigh more than 50 lb.
  - 3. If severe erosion is anticipated, submit riprap design to the Engineer.
- C. Rip rap for permanent erosion control shall be in accordance to the appropriate Specification section.

## **2.06 SILT CURTAIN**

- A. Provide silt curtain materials in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1070 "Silt Curtain".

## **2.07 TURBIDITY BARRIER**

- A. Provide turbidity barrier materials in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1069 "Turbidity Barrier".

## **2.08 STORM DRAIN INLET PROTECTION**

- A. Provide storm drain inlet protection materials in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1060 "Storm Drain Inlet Protection for Construction Sites".
- B. Products shall be listed on WisDOT Erosion Control, Product Acceptability Lists for Multi-Modal Applications (PAL), latest edition are acceptable for the appropriate application.

## **2.09 STONE TRACKING PADS**

- A. Provide select crushed material or 3" to 5" clear or washed stone aggregate.
- B. All material shall be retained on a 3-inch sieve.

## **2.10 EROSION MATS**

- A. In urban areas all erosion mat shall be Class I, Type A. In all other areas erosion mat shall be per the engineered plans.
- B. Provide non-channel erosion mat products in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1052 "Non-Channel Erosion Mat".
- C. Provide channel erosion mats products in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1053 "Channel Erosion Mat".
- D. Products shall be listed on WisDOT Erosion Control, Product Acceptability Lists for Multi-Modal Applications (PAL), latest edition for the appropriate application.
- E. Netting
  - 1. Netting, if used, shall not exceed 15% of the total blanket weight.
  - 2. Bond the netting to the parent material to prevent separation for the life of the project (minimum two months).
- F. Provide 100% organic biodegradable netted products, including parent material, stitching, and netting.
- G. Anchoring Devices

1. Anchoring and components for temporary erosion mats shall be completely biodegradable as determined by ASTM D5338.
2. Materials shall be environmentally safe for soil and groundwater.
3. Do not use petroleum based plastics or composites.
4. Do not use materials which may present a hazard from splintering or spearing.
5. Design anchors to hold a minimum of two months and be substantially degraded within four months during the summer (warm soil conditions).

## **2.11 MULCH**

- A. Provide mulch materials in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1058 "Mulching for Construction Sites".
- B. Mulch Anchoring Devices
  1. Where netting is required use polypropylene plastic, or biodegradable netting

## **2.12 SOIL ADDITIVES FOR EROSION CONTROL**

- A. Soil Binder/Fiber Stabilizer
  1. Shall be a cementitious soil binder added to wood cellulose fiber mulch or a bonded fiber matrix.
  2. Shall show similar vegetative density and sediment loss standards as temporary erosion mats.
- B. Provide anionic polyacrylamine (PAM) as a soil binding agent in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1050 "Erosion Control and Application of Anionic Polyacrylamide".

## **PART 3 - EXECUTION**

### **3.01 TEMPORARY EROSION AND SEDIMENT CONTROLS**

- A. General
  1. Provide temporary erosion and sediment controls as shown on Engineered Plans and additional erosion and sediment controls as determined by Contractor to be required based on construction means and methods prior to start of excavation.

2. Submit to Engineer proposed plan for additional erosion and sediment controls.
  3. Minimize disturbed areas.
  4. Place excavated trench material on the high side of the trench where appropriate.
  5. Locate soil stockpiles no closer than 25 feet of a roadway, wetland, or drainage control channel and control by covering the pile with tarpaulins, temporary seed and mulch or other suitable means, if the pile is exposed for 14 days or more.
  6. When it is necessary to cross waterways, provide crossing structures for machinery.
  7. Repair, replace, and maintain erosion and sedimentation structures until vegetation is re-established or permanent structures installed.
  8. Remove temporary erosion control structures and accumulated sediment and/or debris when vegetation is established.
- B. Temporary Grading Practices for Erosion Control
1. Provide construction operations to minimize erosion and sediment transport during grading operations and other excavations.
  2. Provide grade practices in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1067 "Grading Practices for Erosion Control - Temporary".
- C. Temporary Seeding
1. Provide temporary seeding to disturbed exposed soil areas that will not be brought to final grade or on which land-disturbing activities will not be performed for a period greater than 30 days, and requires vegetative cover for less than one year.
  2. Provide temporary seeding in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1059 "Seeding".
- D. Temporary Earth Berm or Channel

1. Provide an earth berm or channel to intercept, or convey surface water runoff located above disturbed areas to limit runoff onto the site, across slopes to reduce slope length, below slopes to divert excess runoff to stabilized outlets, at or near the perimeter of the construction site to keep sediment from leaving the site, and diversions of sediment-laden water to sediment control facilities.
  2. Provide earth berms or channels in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1066 "Construction Site Diversion".
- E. Temporary Perimeter Control and Slope Interruption Products
1. Provide perimeter control and slope interruption products, other than sediment bale barriers and silt fence covered elsewhere, to detain or slow the flow of sediment-laden sheet flow runoff from small areas of disturbed soil.
  2. Provide these products to reduce uninterrupted slope length to slow the velocity of runoff to retain transported sediment from disturbed areas.
  3. Provide perimeter control and slope interruption products in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1071 "Interim Manufactured Perimeter Control and Slope Interruption Products".
- F. Temporary Ditch Checks
1. Provide temporary ditch checks prior to working near or adjacent to swales, ditches, channels and other areas of concentrated flow.
  2. Construct temporary ditch checks with erosion bales, rock filled filter bags, manufactured ditch check products or rip rap.
  3. Support with hard wood or steel posts.
  4. Periodically remove sediment to maintain effective function. Sediment build up shall never be greater than  $\frac{1}{2}$  the height of the device.
  5. Provide ditch checks in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1062 "Ditch Check (Channel)".
- G. Temporary Culvert Pipe Checks
1. Provide rock filled filter bags immediately after installing new culverts and before beginning earth-disturbing activities in areas drained by existing culverts.

2. Place rock bags on the inlet end of the culvert only.
3. Leave rock bags in place until slopes and ditches are stable and turf develops enough to make future erosion unlikely.
4. Periodically remove sediment to maintain effective function. Sediment build up shall never be greater than ½ the height of the device.
5. Remove and dispose of the used rock bags off-site or in Engineer approved locations.

H. Temporary Silt Fence

1. Provide temporary silt fence around the construction site where sheet form of runoff is possible.
2. Periodically remove sediment to maintain effective function. Sediment build up shall never be greater than ½ the height of the device.
3. Provide silt fence in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1056 "Silt Fence".

I. Temporary Sediment Bale Barrier

1. Provide sediment bale barrier to intercept sediment-laden sheet flow from small drainage areas of disturbed soil where protection is required for less than 3 months.
2. Provide bale barrier in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1055 "Sediment Bale Barrier (Non-Channel)".

J. Temporary Sediment Basin

1. Provide sediment basins in areas up to 100 acres of concentrated flow or points of discharge where runoff is directed into the basin.
2. Provide sediment basins at locations accessible for clean out.
3. Provide sediment basin in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1064 "Sediment Basin".

K. Temporary Sediment Trap

1. Provide sediment traps in areas up to 5 acres of concentrated flow or points of discharge where runoff is directed into the basin.
2. Provide sediment traps at locations accessible for clean out.

3. Provide sediment trap in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1063 "Sediment Trap".

L. Temporary Silt Curtain

1. Provide silt curtain where construction activities such as bridge construction, rip rap placement, utility work, streambank restoration, boat launches and dredging intrude or are directly adjacent to a waterway or waterbody.
2. Provide silt curtain for calm water conditions where it will not be subjected to wind, wave, or current to settle out coarse and granular soils where water depth at the time of construction is greater than or equal to 4 feet.
3. Provide silt curtain in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1070 "Silt Curtain".

M. Temporary Turbidity Barrier

1. Provide turbidity barrier where construction activities such as bridge construction, rip rap placement, utility work, streambank restoration, boat launches and dredging are in or near a waterway or waterbody.
2. Provide turbidity barriers in conditions with fine soils and flow velocities not exceeding 5 feet per second, unless additional reinforcement is installed.
3. Provide turbidity barrier in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1069 "Turbidity Barrier".

N. Temporary Storm Drain Inlet Protection

1. Provide storm drain inlet protection at inlets near the site where storm water could carry silt and sediment to the drain.
2. Periodically remove sediment to maintain effective function.
3. Provide storm drain inlet protection in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1060 "Storm Drain Inlet Protection for Construction Sites".

O. Temporary Stone Tracking Pads

1. Provide stone gravel mats at site vehicle entrance and site exit locations to prevent tracking of soil on roads or other pavements.

2. Collect tracked soil and clean from paved roads near the construction site the same day it occurs.
  3. Provide stone tracking pads in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1057 "Stone Tracking Pad and Tire Washing".
- P. Temporary Dust Control
1. Provide dust control measures for construction activities including minimizing soil disturbance, applying mulch and establishing vegetation, water spraying, surface roughening, applying additives (polymers), spray-on tackifiers, chlorides, and barriers.
  2. Provide dust control in accordance with the Wisconsin Department of Natural Resources Conservation Practice #1068 "Dust Control On Construction Sites".
- Q. Dewatering
1. Discharge trench water to filter barrier prior to release into a drainage way.
  2. Provide a compartmented container, settling basin, filter, or other appropriate best management practice through which sediment-laden water is conveyed to trap and retain the sediment.
  3. Remove sediment from water generated from dewatering activities in accordance with Wisconsin Department of Natural Resources Conservation Practice #1061 "Dewatering".

### **3.02 PERMANENT EROSION AND SEDIMENT CONTROL**

- A. Permanent Seeding and Fertilizing
1. Provide in accordance to the appropriate Specification Sections.
- B. Permanent Erosion Mats
1. Provide erosion mats to protect channels and slopes from erosion and act as turf reinforcement during and after the establishment of grass.
  2. Site Preparation
    - a. Place seed and fertilizer prior to placing permanent erosion mat.
    - b. Ground surface shall be smooth and compact.

- c. Remove all rocks, dirt clods, stumps, roots, grass clumps, trash and other obstructions from lying in direct contact with the soil surface and the erosion mat.

3. Installation:

- a. Refer to Engineered Plans for anchor trench (at ends, checks and edges) installation procedures.
- b. Anchor trenches shall be 12" deep.
- c. Compact anchor trench backfill.
- d. Place staples in end and check trenches spaced at 12 inches.
- e. Provide in accordance with manufacturer's recommendations.
- f. Roll width overlaps shall be 12" at edges. Pin or staple every 3 feet along overlap length.
- g. Splice roll end overlaps by overlapping (in the direction of water flow) two feet with the upstream portion of the mat on top of the downstream portion. This overlap shall receive at least three pins or staples with a maximum spacing of 12".
- h. Pins or staples shall be 6" in length minimum driven flush with the mat. In loose soil, pins or staples shall be 12" in length minimum.
- i. Place mat flat conforming to contours in soil surface. Do not stretch mat.
- j. Place mat from toe of slope toward top of slope.

4. Provide non-channel erosion mat in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1052 "Non-Channel Erosion Mat".

5. Provide channel erosion mats in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1053 "Channel Erosion Mat".

C. Vegetative Buffers

- 1. Provide minimum 25 foot wide dense vegetation in areas where sediment delivery is in the form of sheet and rill erosion from disturbed areas.
- 2. Locate the vegetative buffer along the entire length of the down slope edge of the entire disturbed area.

3. Provide vegetative buffers in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1054 "Vegetative Buffer for Construction Sites".

D. Mulching

1. Provide mulching on exposed soils in conjunction with temporary or permanent seeding.
2. Anchoring Mulch
  - a. In areas of seeding, provide crimping or netting to anchor the mulch.
3. Provide mulching in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1058 "Mulching for Construction Sites".

E. Soil Additives for Erosion Control

1. Provide soil additives where timely establishment of vegetative cover is absent or inadequate due to land disturbing activities or winter shutdown prevent establishment or maintenance of a cover crop.
2. Provide in accordance with the Wisconsin Department of Natural Resources Conservation Practice Standard #1050 "Land Application of Additives for Erosion Control".

F. Permanent Rip Rap

1. Provide rip rap in accordance to the appropriate Specification Sections.

### 3.03 MAINTENANCE

- A. Provide inspections of the construction site and implemented erosion and sediment control WDNR best management practices (BMPs) performed weekly and within 24 hours after a rainfall event of 0.5 inches or greater and rapid snow melt conditions.
1. Make any required repairs immediately.
  2. Maintain temporary erosion and sedimentation control structures until permanent soil erosion controls are completed and/or vegetation is established.
    - a. Repair damaged structures.
    - b. Replace lost structures.

3. Regularly remove sediment from deposition areas adjacent to erosion control structures without damaging structures.
  4. Refill eroded areas as required for grade stabilization.
  5. Maintain inspection reports on-site for Owner / DNR representatives.
- B. If the fabric on a silt fence or filter barrier decomposes or becomes ineffective prior to the end of the expected usable life and the barrier is still be necessary, replace the fabric promptly.
  - C. Remove sediment deposits after each major storm event and when deposits reach approximately one-half the height of the barrier.
  - D. Remove any sediment deposits remaining in place after the silt fence or filter barrier is no longer required and dress to conform with the existing grade, prepared and seeded.
  - E. Repair/restore any washed out areas.
  - F. Maintenance period to be entire project period including the one-year Correction Period.
  - G. Owner may direct Contractor to remove the temporary erosion control measures any time during the one-year Correction Period. Removal of the devices is incidental to the installation.
  - H. Construct permanent erosion control measures immediately after earthwork is completed.

### **3.04 ATTACHMENTS**

- A. Construction Site Inspection Form.

**END OF SECTION**

**Notice:** This form was developed in accordance with s. NR 216.48 Wis. Adm. Code for WPDES permittees' convenience; however, use of this specific form is voluntary. Multiple copies of this form may be made to compile the inspection report. Inspections of the construction site and implemented erosion and sediment control best management practices (BMPs) must be performed weekly and within 24 hours after a rainfall event 0.5 inches or greater.

<b>Construction Site Name and Location (Project, Municipality, and County):</b>		<b>Site/Facility ID No. (FIN):</b>	
<b>Onsite Contact/Contractor:</b>		<b>Onsite Phone/Cell:</b>	
<b>Note: Inspection reports, along with erosion control and storm water management plans, are required to be maintained on site in accordance with s. NR 216.48 (4) and made available upon request. PLEASE PRINT LEGIBLY.</b>			
<b>Date of inspection:</b>	<b>Time of inspection:</b> Start: _____ am <input type="radio"/> pm End: _____ am <input type="radio"/> pm	<b>Type of inspection:</b> <input type="radio"/> Weekly <input type="radio"/> Precipitation Event <input type="radio"/> Other (specify)	
<b>Weather/Site Conditions:</b> Temp. _____ °F Antecedent Soil Moisture _____ <input type="radio"/> Dry <input type="radio"/> Variable <input type="radio"/> Frozen (Thaw predicted in next week) <input type="radio"/> Wet <input type="radio"/> Melting Snow/slush	<b>Describe current phase of construction:</b>		
<b>Last Rainfall Depth:</b> _____ inches	<b>Scheduled Final Stabilization Date for Universal Soil Loss Equation (USLE) 1:</b>		
<b>Last Rainfall Date:</b> _____	<b>Project on Schedule?</b> <input type="radio"/> Yes <input type="radio"/> No		
<b>Name(s) of individual(s) performing inspection:</b>		<b>Inspector Phone/Cell:</b>	
I certify that the information contained on this form is an accurate assessment of site conditions at the time of inspection:			
<b>Inspector Signature</b>		<b>Date:</b>	
<b>Inspection Questions:</b>	<b>Yes</b>	<b>No (Identify Actions Required):</b>	<b>Location/Comments:</b>
1. Is the erosion control plan accessible to operators?	<input type="checkbox"/>	<input type="checkbox"/> Provide onsite copy	
2. Is the permit certificate posted where visible?	<input type="checkbox"/>	<input type="checkbox"/> Post certificate	
3. Is the current phase of construction on sequence with the site-specific erosion and sediment control plan, including installation/stabilization of ponds and ditches?	<input type="checkbox"/>	<input type="checkbox"/> Add sediment control <input type="checkbox"/> Install missing ditch/pipe/pond <input type="checkbox"/> Stabilize bare soil	
4. Are all erosion and sediment control BMPs shown on plan properly installed and in functional condition?	<input type="checkbox"/>	<input type="checkbox"/> Repair <input type="checkbox"/> Modify <input type="checkbox"/> Install/Replace	
5. Is inlet protection properly installed and functioning in all inlets likely to receive runoff from the site?	<input type="checkbox"/>	<input type="checkbox"/> Clean <input type="checkbox"/> Replace <input type="checkbox"/> Install	
6. Is the air free of fugitive dust resulting from construction activity and bare soil exposure?	<input type="checkbox"/>	<input type="checkbox"/> Apply water <input type="checkbox"/> Apply dust control product	
		<b>Actions Completed by Date &amp; Initials</b>	

Inspection Questions:	Yes	No (Identify Actions Required):	Location/Comments:	Actions Completed by Date & Initials
7. Is the public right of way curb line free of tracked soil and accumulation?	<input type="checkbox"/>	<input type="checkbox"/> Install tracking pad <input type="checkbox"/> Widen/lengthen pad <input type="checkbox"/> Amend stone/Add geotextile <input type="checkbox"/> Install wheel washing station <input type="checkbox"/> Close entrance/exit <input type="checkbox"/> Limit traffic across disturbed areas <input type="checkbox"/> Sweep road and curb line		
8. Are wetlands, lakes, streams, ditches, or storm sewers downstream of the site free of sedimentation and turbid water leaving the site? <sup>3</sup>	<input type="checkbox"/>	<input type="checkbox"/> Repair/Replace erosion control <input type="checkbox"/> Add sediment controls <input type="checkbox"/> Modify operations <input type="checkbox"/> Contact DNR to verify extent of cleanup required		
9. Is dewatering and/or vehicle and equipment washing being done in a manner that prevents erosion and sediment discharge?	<input type="checkbox"/>	<input type="checkbox"/> Install treatment train <input type="checkbox"/> Install energy dissipation <input type="checkbox"/> Modify discharge location <input type="checkbox"/> Modify intake to reduce sediment		
10. Are soil stockpiles existing for more than 7 days covered and stabilized?	<input type="checkbox"/>	<input type="checkbox"/> Seed <input type="checkbox"/> Install mat/mulch/polymer <input type="checkbox"/> Cover with tarp/plastic sheeting		
11. Are downstream channels and other downhill areas protected from scour and erosion?	<input type="checkbox"/>	<input type="checkbox"/> Install energy dissipation at outfall <input type="checkbox"/> Install ditch checks <input type="checkbox"/> Install slope interruption <input type="checkbox"/> Install onsite detention		
12. Are good housekeeping practices or treatment controls in place to prevent the discharge of chemicals, cement, trash, and other materials into wetlands, waterways, storm sewers, ditches, or drainage-ways? <sup>4</sup>	<input type="checkbox"/>	<input type="checkbox"/> Properly dispose of trash <input type="checkbox"/> Provide concrete washout station <input type="checkbox"/> Contact DNR to verify extent of cleanup required		
13. Is the plan reflective of current site operations and does it address all erosion and sediment control issues identified during the inspection?	<input type="checkbox"/>	<input type="checkbox"/> Revise sequence <input type="checkbox"/> Revise sediment control BMP <input type="checkbox"/> Revise erosion control BMP <input type="checkbox"/> Revise post-construction storm water BMP		
14. Are all areas where construction has temporarily ceased (and will not resume for more than 2 weeks) temporarily stabilized?	<input type="checkbox"/>	<input type="checkbox"/> Topsoil & seed <input type="checkbox"/> Install mat/mulch/polymer <input type="checkbox"/> Cover with tarp/plastic sheeting		
15. Are all areas at final grade permanently vegetated or stabilized with other treatments?	<input type="checkbox"/>	<input type="checkbox"/> Topsoil & seed <input type="checkbox"/> Install mat/mulch/polymer <input type="checkbox"/> Sod <input type="checkbox"/> Install stone base		
16. Have temporary sediment controls been removed in areas of the site that meet the permit definition of 'final stabilization'?	<input type="checkbox"/>	<input type="checkbox"/> Water to establish vegetation <input type="checkbox"/> Repair or reseed areas <input type="checkbox"/> Remove temporary practices		

<sup>3</sup> If sediment discharge enters a wetland or waterbody, the permittee should consult with DNR staff to determine if sediment cleanup and/or additional control measures are required.

<sup>4</sup> The permittee shall notify the DNR immediately via the spills hotline at (800)943-0003 of any release or spill of a hazardous substance to the environment in accordance with s. 292.11, Wis. Stats., and ch. NR 706, Wis. Adm. Code.

**SECTION 31 34 19**  
**GEOSYNTHETIC SOIL REINFORCEMENT**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
1. Woven and Non-Woven Geotextile Fabrics
  2. Geogrid

**1.02 REFERENCES**

- A. American Society for Testing and Materials (ASTM):
- |            |  |
|------------|--|
| ASTM D123  | Standard Terminology Relating to Textiles  |
| ASTM D1388 | Standard Test Methods for Stiffness of Fabrics   |
| ASTM D4354 | Standard Practice for Sampling Geotextiles for Testing   |
| ASTM D4491 | Standard Test Method for Water Permeability of Geotextiles by Permittivity   |
| ASTM D4533 | Standard Test Method for Trapezoid Tearing Strength of Geotextiles   |
| ASTM D4595 | Standard Test Method for Tensile Properties of Geotextiles by Wide-Width Strip Method  |
| ASTM D4632 | Standard Test Method for Grab Breaking Load and Elongation of Geotextiles  |
| ASTM D4751 | Standard Test Method for Determining Apparent Opening Size of Geotextiles  |
| ASTM D4759 | Standard Practice for Determining the Specification Conformance of Geosynthetics   |
| ASTM D4873 | Standard Guide for Identification, Storage and Handling of Geosynthetic Rolls  |
| ASTM D4884 | Standard Test Method of Strength of Sewn or Thermally Bonded Seams of Geotextiles  |
| ASTM D6241 | Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe           |
| ASTM D6637 | Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method                  |
| ASTM D7238 | Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus |
| ASTM D7737 | Standard Test Method for Individual Geogrid Junction Strength  |
| ASTM D7748 | Standard Test Method for Flexural Rigidity of Geogrids, Geotextiles and Related Products                                       |

- B. Geosynthetics Research Institute (GRI)
  - GRI GG2 Geogrid Junction Strength
  - GRI GG9 Torsional Behavior of Bidirectional Geogrids When Subjected to In-Plane Rotation
  - GRI GT13(a) Test Methods and Properties for Geotextiles Used as Separation Between Subgrade Soils and Aggregate – ASTM Version
- C. American Association of State Highway and Transportation Officials (AASHTO):
  - AASHTO M288 Geotextile Specification for Highway Applications

### **1.03 ALLOWANCES**

- A. If so stated in the specification “Allowances”, installation testing will be paid as an allowance. All other testing will be incidental to the Work.
- B. If there is no reference in the specification section to “Allowances”, then testing costs will be incidental to other Work items.

### **1.04 SUBMITTALS**

- A. Informational
  - 1. Provide, prior to delivery of the Geosynthetic material, a manufacturer's Certificate of Compliance that the Geosynthetic material meets the requirements of this Section.
  - 2. Manufacturer’s installation guide.
  - 3. Provide information tags from all rolls installed.

### **1.05 DELIVERY STORAGE AND HANDLING**

- A. All Geosynthetic materials shall be labeled, shipped, stored and handled in accordance with ASTM D4873.
- B. Do not use sharp instruments for handling geotextile.
- C. Do not leave geosynthetic materials directly exposed to sunlight for longer than manufacturer’s recommended time.
- D. Store geotextile fabric in a dry location until installed.

## PART 2 - PRODUCTS

### 2.01 GEOTEXTILE FABRIC MATERIAL

#### A. General

1. Provide geotextile fabric consisting of either woven or non-woven polyester, polypropylene, stabilized nylon, and polyethylene or polyvinylidene chloride.
  - a. All fabric shall have the minimum strength values in the weakest principle direction.
  - b. Non-woven fabric may be needle punched, heat bonded, resin bonded or combinations thereof.
2. The geotextile fabric shall be insect, rodent, mildew and rot resistant.
3. Clearly mark the geotextile fabric rolls showing the type of fabric.
4. If sewn seams are used, provide a field sewn seam sample produced from the geotextile fabric and thread and with the equipment to be used on the project, prior to its incorporation into the work.

#### B. Nonwoven Geotextile Fabric, Type HR

1. Type HR non-woven geotextile fabric shall be used beneath medium (greater than 400 lb. stones) and heavy (greater than 650 lb. stone) riprap.
2. The fabric shall comply with the following physical properties:

<u>Test</u>	<u>Method</u>	<u>Value</u> <sup>(1)</sup>
Grab Tensile Strength (lbs.)	ASTM D4632	300 min.
Puncture Strength (lbs.)	ASTM D6241	100 min.
Grab Elongation (%)	ASTM D4632	15 min.
Permittivity, sec	ASTM D4491	0.30 min.

<sup>(1)</sup>All numerical values represent minimum/maximum average roll values (i.e., the average of minimum test results on any roll in a lot should meet or exceed the minimum specified values).

3. The following fabrics are approved for Type HR:
  - a. Carthage — FX-160HS
  - b. Contech — C120NW
  - c. Mirafi — 1120N

C. Nonwoven Geotextile Fabric, Type R, Rip Rap

1. Use Type R nonwoven geotextile fabric beneath light riprap (less than 400 lb. stone).
2. The fabric must comply with the following special physical properties.

<u>Test</u>	<u>Method</u>	<u>Value (1)</u>
Grab Tensile Strength (lbs.)	ASTM D4632	205 min.
Puncture Strength (lbs.)	ASTM D6241	80 min.
Apparent Opening Size (U.S. Standard Sieve)	ASTM D4751	30 max.
Permittivity, sec <sup>(1)</sup>	ASTM D4491	0.12 min.

<sup>(1)</sup> All numerical values represent minimum/maximum average roll values (i.e., the average of minimum test results on any roll in a lot should meet or exceed the minimum specified values).

D. The following non-woven fabrics are approved for Type R:

1. Nilex — 4553
2. Carthage — FX-80HS
3. Contech — C-200
4. Mirafi — 180N

E. Woven Geotextile Fabric, Type SR, Subgrade Reinforcement

1. Use woven geotextile fabric subgrade reinforcement beneath roadway subbase and structures to reinforce existing subgrade soils.
2. Ground stabilization fabrics shall consist of woven polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride with the following requirements. Woven fabric shall have the minimum strength values in the weakest principle direction.
3. The fabric shall be insect, rodent, mildew and rot resistant.

4. The fabric shall comply with the following minimum physical requirements:

<u>Parameter</u>	<u>Method</u>	<u>Value</u>
Trapezoid Tear (lbs.)	ASTM D4533	100 lbs.
Permittivity (sec-1)	ASTM D4491	0.02
Apparent Opening Size (sieve size)	ASTM D4751	30/70
Ultraviolet Degradation (% strength retained)	ASTM D7238	70
Grab Tensile Strength (lbs.)	ASTM D4632-86	280 min.
Puncture Strength (lbs.)	ASTM D6241	115 min.
Mullen Burst (psi)	ASTM D3786	600 min.
Elongation at Required Strength (%)	ASTM D4632-86	25% max.

<sup>(1)</sup>All numerical values represent minimum/maximum average roll values (i.e., the average of test results on any roll in a lot should meet or exceed the minimum values in the table).

- F. The following woven fabrics are approved for Type SR:

1. Amoco (Nilex) — 2006
2. Carthage Mills — FX-66
3. Contech — C300
4. Mirafi — 600X

- G. Knitted, Woven or Non-Woven Geotextile Fabric, Type DP, Drainage Pipe/Underdrains

1. Use a geotextile of knitted, woven, or non-woven fibers of polypropylene, stabilized nylon, or polyethylene chloride. Do not use slit film woven fabrics for this application.
2. Use knitted fabric constructed from continuous yarn. Non-woven fabrics may be needle-punched, heat-bonded, resin-bonded, or combinations of the three types. Use woven fabrics constructed from monofilament yarns.
3. Use geotextile wraps of knitted construction that form a seamless sleeve and fit tightly over the pipe. If using geotextile wraps constructed from woven or non-woven fabric then tightly wrap and securely fix to the pipe.
4. Clearly mark the geotextile rolls to identify the type of fabric.

5. The fabric shall comply with the following minimum physical requirements:

<u>Test</u>	<u>Method</u>	<u>Value</u>
Minimum grab tensile strength	ASTM D4632	35 lbs.
Apparent Opening Size	ASTM D4751	No.30-200
Minimum permittivity	-----	1.35 s <sup>-1</sup>

All numerical values represent minimum/maximum average roll values (i.e., the average of test results on any roll in a lot should meet or exceed the minimum values in the table).

H. Non-woven geotextile fabrics, Type SAS, Soil Aggregate Separation:

1. Place nonwoven geotextile used shall be placed between subgrade soils and aggregates.
2. Nonwoven geotextile shall conform to GRI-GT13.
3. The geotextile fabric shall comply with the physical properties in Tables 2a, 2b or 2c and as shown on the Engineered Plans.

**Table 2a. Geotextile Properties Class 1(High Survivability)**

<u>Property</u> <sup>(1)</sup>	ASTM <u>Test</u>	<u>Unit</u>	Elongation	
			<u>&lt; 50%</u>	<u>≥ 50%</u>
Grab Tensile Strength	D4632	lb.	315	203
Trapezoid Tear Strength	D4533	lb.	112	79
CBR Puncture Strength	D6241	lb.	630	440
Permittivity	D4491	sec-1	0.02	0.02
Apparent Opening Size	D4751	in.	0.024	0.024
Ultraviolet Stability <sup>(2)</sup>	D7238	% Ret. At 500 hours	50	50

**Table 2b. Geotextile Properties Class 2 (Moderate Survivability)**

<u>Property</u> <sup>(1)</sup>	ASTM		Elongation <50%	Elongation ≥50%
	<u>Test</u>	<u>Unit</u>		
Grab Tensile Strength	D4632	lb.	248	158
Trapezoid Tear Strength	D4533	lb.	90	56
CBR Puncture Strength	D6241	lb.	500	320
Permittivity	D4491	sec-1	0.02	0.02
Apparent Opening Size	D475 1	in.	0.024	0.024
Ultraviolet Stability <sup>(2)</sup>	D7238	% Ret. At 500 hours	50	50

**Table 2c. Geotextile Properties Class 3 (Low Survivability)**

<u>Property</u> <sup>(1)</sup>	ASTM		Elongation < 50%	Elongation ≥ 50%
	<u>Test</u>	<u>Unit</u>		
Grab Tensile Strength	D4632	lb.	180	113
Trapezoid Tear Strength	D4533	lb.	68	41
CBR Puncture Strength	D6241	lb.	380	230
Permittivity	D4491	sec- I	0.02	0.02
Apparent Opening Size	D475 I	in.	0.024	0.024
Ultraviolet Stability <sup>(2)</sup>	D7238	% Ret. At 500 hours	50	50

<sup>(1)</sup> All values are minimum average roll values (MARV) except AOS, which is a maximum average roll value (MaxARV) and UV stability, which is a minimum average value.

<sup>(2)</sup> Evaluation to be on 50mm strip tensile specimens after 500 hours exposure.

## 2.02 GEOGRID MATERIAL

### A. General

1. Provide geogrid which is dimensionally stable and able to retain its geometry under construction stresses.
2. Provide geogrid that is resistant to damage during construction, ultraviolet degradation, and all forms of chemical and biological degradation encountered in the soil on which it is placed.
3. Provide geogrid that consists of either single or joined multiple layers of a uniform square or rectangular grid of bonded, formed or fused polymer tensile strands.
4. Provide polyester, polypropylene, polyamide, or polyethylene material that maintains dimensional stability during handling, placing, and installation.

5. Provide geogrid that is at least 6.0 feet wide.
- B. Geogrid-Single Layer Bi-axial, Type SR, Subgrade Reinforcement
1. Use geogrid subgrade reinforcement beneath roadway subbase and structures to reinforce existing subgrade soils.
  2. Geogrid shall comply with the following minimum physical requirements:

<u>TEST</u>	<u>METHOD</u>	<u>VALUE</u> <sup>(1)</sup>
Tensile Strength at 5% Strain (both principal directions in lb./ft.)	D6637	450 min
Flexural Rigidity (both principal directions in mg/cm)	D7748	150,000 min
Aperture Area (in <sup>2</sup> )	Inside Measurement <sup>(2)</sup>	5.0 max
Aperture Dimension (in)	Inside Measurement <sup>(2)</sup>	0.5 min

<sup>(1)</sup> All numerical values represent minimum/maximum average roll values. Average test results from all rolls in a lot must conform to the tabulated values.

<sup>(2)</sup> Aperture area and aperture dimension for joined multi-layer geogrids are determined based on measurement of a single layer of the geogrid.

3. The following single layer bi-axial geogrid are approved:
  - a. Propex - BaseGrid 11
  - b. Tensar – BX1100
  - c. Nilex – BX Type 1

### **PART 3 - EXECUTION**

#### **3.01 GENERAL PREPARATION AND PLACEMENT**

- A. Geotextile Fabric
1. Grade the area to be covered by the geotextile to a smooth, uniform condition, free from ruts, potholes, and protruding objects such as rocks or sticks. Do not allow traffic or construction equipment on the placed geotextile material. Dispose of material with defects, rips, holes, flaws, deterioration, or other damage. Do not use defective material in the work.

2. Spread the geotextile material immediately ahead of the covering operation. Lay geotextile material smooth without wrinkles or folds on the prepared subgrade in the direction of construction traffic. Remove wrinkles and folds by pulling geotextile material taut as required. Use the manufacturer's recommended method to hold geotextile material in place until the specified cover material is placed. Overlap geotextile materials a minimum of 2 feet. Overlap in the direction shown on the Engineered Plans.
3. On curves, cut or fold geotextile material to conform to the curve. Fold or overlap in the direction of construction and hold in place using pins, staples, or piles of fill or rock.
4. Do not cover geotextile material until inspected for damage. Make repairs following the manufacturer's recommendation or use a patch of the same material placed over the damaged area, overlapped at least 3 feet from the edge of any part of the damage.
5. Place fill over geotextile material by dumping onto previously placed material and pushing the material into place. Do not operate any construction equipment directly on geotextile material under any circumstances. Place the fill material in uniform layers so that there is a minimum lift thickness (loose) of 8 inches between geotextile material and equipment tires or tracks at all times. The minimum thickness of the first lift is 8 inches. Do not allow construction equipment to turn on the first lift of material above geotextile material. Do not blade the first lift placed over geotextile material. Spread piles as soon as possible after dumping to minimize the potential for localized subgrade failure due to overloading of the subgrade.
6. Do not use sheepsfoot or studded compaction equipment on the first lift placed over geotextile material. Stop vibrator on compaction equipment if pumping occurs. Do not operate any construction equipment that results in rutting in excess of 3 inches on the first lift. If rutting exceeds 3 inches, decrease the construction equipment size and/or weight or increase the lift thickness. Use only rubber-tired rollers for compaction if any foundation failures occur when placing subsequent lifts. Compact all lifts to the moisture and density requirements for earth embankment required within these specifications. Do not blade material down to remove ruts. Fill any ruts or depressions with additional material and compact to the specified density.

B. Geogrid

1. Place geogrid as the Engineered Plans show or engineer directs. Pull flat and secure using pins, staples, or other devices to prevent movement or displacement. Lap butt joints between roll ends at least 12 inches unless the plans or special provisions specify otherwise. Overlap parallel strips at least 6 inches. Do not operate vehicles or construction equipment directly on geogrid.
2. Cover small rips, tears, or defects in the geogrid with an additional section of geogrid secured in place overlapping the damaged area by at least 3 feet in all directions. Remove and replace geogrid sections with large rips, tears, defects, or other damage as the engineer directs before backfilling.
3. After placement, backfill the geogrid to the depth and with the type of material the plans or specifications require. Place, spread, and compact backfill conforming to the standard spec or special provision requirements for that backfill material, except ensure that the initial lift over the geogrid is at least 4 inches deep. Do not cover the geogrid until inspected for damage. Make repairs following the manufacturer's recommendation or use a patch of the same material placed over the damaged area, overlapped at least 3 feet in all directions.
4. Place fill over the geogrid material by dumping onto previously placed material and pushing the material into place. Do not operate any construction equipment directly on the geogrid under any circumstances. Place the fill material in uniform layers so that there is a minimum lift thickness (loose) of 6 inches between the geogrid and equipment tires or tracks at all times. The minimum thickness of the first lift is 6 inches. Do not allow construction equipment to turn on the first lift of material above the geogrid material. Spread piles as soon as possible after dumping to minimize the potential for localized subgrade failure due to overloading of the subgrade
5. Do not displace or damage the geogrid during backfill operations. The engineer may direct the contractor to repair or replace damaged, displaced, or otherwise defective geogrid and may require equipment and operations changes to prevent further damage or displacement.

### **3.02 SEAMS**

#### **A. Geotextile Fabric – Type F**

1. Sew the seams of the geotextile with thread having the same or greater physical properties as the material or bond by heat.
2. Test seams in accordance to ASTM D4884.

3. Seams shall develop a tensile strength equal to or greater than 90 percent of the required grab tensile strength of the fabric, unless otherwise specified.
- B. Geotextile Fabric – Types HR, R, SR, SAS
1. Secure lapped section together using manufacturers approved methods and anchoring devices.
- C. Geogrid
1. Secure lapped sections together using manufacturer approved ties, straps, clips, or other devices.

### 3.03 NON-WOVEN GEOTEXTILE FABRIC - TYPES HR, R, F AND SR

- A. Grade the area smooth and remove all stones, roots, sticks or other foreign material, which would interfere with the fabric being completely in contact with the soil.
- B. Place the fabric loosely and parallel to the direction of water movement.
1. Provide pinning or stapling as recommended by manufacturer to hold the geotextile in place.
  2. Join separate pieces of fabric by overlapping or sewing according to Table 3.

**Table 3. Maximum Spacing for Securing Pins**

<u>Slope</u>	<u>Spacing (feet)</u>
Steeper than 3H to Lv	2
From 3H to IV to 4H to IV	3
Flatter than 4H to IV	5

3. Place the fabric in the overlapped joints with a minimum overlap of 24 inches in the direction of flow.
- C. After placement, do not expose the fabric longer than 48 hours prior to covering. Cover damaged areas with a patch of fabric using a 3-foot overlap in all directions. Place riprap from the base of the slope upward.
- D. Do not allow freefall of riprap to prevent damage to the fabric.

### **3.04 WOVEN GEOTEXTILE FABRIC SUBGRADE REINFORCEMENT AND NONWOVEN GEOTEXTILE FABRIC**

- A. Prior to the placement of geotextile fabric, grade smoothed and shaped to the required grade and section. After the fabric has been placed, do not permit traffic or construction equipment to travel directly on the fabric.
- B. Roll out the fabric on the excavation and pull taut manually to remove wrinkles.
- C. Join separate pieces of fabric by overlapping or sewing as required by the manufacturer.
- D. Place the fabric in the overlapped joints with a minimum overlap of 24 inches.
- E. Provide weights or other methods to prevent lifting of the fabric by wind.

### **3.05 GEOTEXTILE PROTECTION**

- A. Protect the geotextile at all times during construction from contamination by surface runoff. Remove and replace any geotextile so contaminated with uncontaminated geotextile.
- B. Replace any damaged geotextile.
- C. Schedule the work so that the covering of the geotextile with a layer of the specified material is completed within seven (7) calendar days after placement of the geotextile.
- D. Protect the geotextile from damage prior to and during the placement of riprap or other materials.
  - 1. Limit the height of drop to less than 300 mm (1 foot), or place a cushioning layer of sand or gravel on top of the geotextile before placing the material, or other methods deemed necessary.
  - 2. Take care to ensure that the utilized cushioning materials do not impede the flow of water.
  - 3. Before placement of riprap or other materials, demonstrate that the proposed placement technique will not cause damage to the geotextile.
  - 4. Equipment is not allowed on the unprotected geotextile.

**END OF SECTION**

**SECTION 31 37 00  
PERMANENT RIPRAP**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Placing riprap.
  - 2. Grouted riprap.
  - 3. Providing geotextile fabric.

**1.02 ALLOWANCES**

- A. If so stated in the specification “Allowances”, installation testing will be paid as an allowance. All other testing will be incidental to the Work.
- B. If there is no reference in the specification section to “Allowances”, then testing costs will be incidental to other Work items.

**PART 2 - PRODUCTS**

**2.01 MATERIALS**

- A. Riprap Stone
  - 1. Provide in accordance with the appropriate Specification Section.
- B. Riprap Grout
  - 1. Provide an air-entrained mortar or concrete to fill the voids between riprap stones in grouted riprap.
  - 2. Provide fine aggregate or a combination of fine and coarse aggregate with a gradation that results in a grout with a consistency that allows complete filling of the riprap voids.
  - 3. Provide grout conforming to the following mixture requirements:
    - a. Contains 470 pounds or more for Portland cement per cubic yard of grout. Class C fly ash may be substituted for up to 30% of the required Portland cement.
    - b. Contains enough water to achieve a 3-inch slump. Any additional workability required to completely fill the riprap voids shall be achieved with admixture without increasing the w/cm ratio.

- c. Contains 9% or more air for mixes with a nominal top size aggregate less than 3/8 inch or 7% or more air for a mix with 3/8 inch or large aggregate.

C. Geotextile

- 1. Riprap shall be placed on a layer of geotextile fabric as indicated on the Engineered Plans.
  - a. Light Riprap: The fabric shall be geotextile fabric, Type R (Riprap)
  - b. Medium, Heavy and Extra Heavy Riprap: The fabric shall be geotextile fabric, Type HR (Heavy Riprap).
- 2. Provide geotextile materials in accordance to the appropriate Specification Section.

**PART 3 - EXECUTION**

**3.01 PREPARATION**

- A. Prepare the bed for the riprap by excavating, shaping the slopes, and constructing the toe for riprap installation.
- B. Install specified geotextile within prepared riprap bed area.

**3.02 INSTALLATION**

- A. Placing Light Riprap
  - 1. Place by hand with larger stones in lower courses. Lay stones perpendicular to the slope with close, broken joints, firmly bed in the slope, and thoroughly compact. Chink spaces between stones to make the finished surface even and tight.
  - 2. Unless specified otherwise, make riprap at least one foot thick, measured perpendicular to the slope.
  - 3. Do not place riprap against, or in contact with, concrete surface before the end of the concrete's curing and protection period.
- B. Placing Medium, Heavy and Extra-Heavy Riprap
  - 1. Place medium, heavy, and extra-heavy riprap by any mechanical means, not dumping, that produce a completed job within reasonable tolerances of the typical section shown on the Engineered Plans. Limit handwork to the quantity necessary to fill large voids or to correct segregated areas.

C. Placing Grouted Riprap

1. When the Engineered Plans require using grouted riprap, place the stone as specified above under 3.02 A and 3.02 B. Fill the spaces between the stones with cement grout. Use sufficient grout to completely fill voids, except leave the face surface of the stone exposed.
2. Place grout from the bottom to the top and then sweep the surface with a stiff broom. After completing the grouting, cure the surface. During cold weather, protect the concrete as required within these specifications.

**END OF SECTION**

**SECTION 32 05 13**  
**SOILS FOR EXTERIOR IMPROVEMENTS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Bank Run Soils
  - 2. Manufactured and Special Soils

**1.02 REFERENCES**

- A. American Society for Testing and Materials (ASTM)
  - ASTM C144 Spec. for Aggregate for Masonry Mortar
  - ASTM C207 Spec. for Hydrated Lime for Masonry Purposes
  - ASTM C602 Spec. for Agricultural Liming Materials
  - ASTM D75 Sampling Aggregates
  - ASTM D422 Particle Size Analysis of Soils
  - ASTM D1140 Test for Amount of Material in Soils Finer than the No. 200 Sieve
  - ASTM D2216 Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures
  - ASTM D2487 Classification of Soils for Engineering Purposes
  - ASTM D4318 Test Method for Liquid Limit, Plastic Limit, and Plasticity of Soils
  - ASTM D5268 Standard Specification for Topsoil Used for Landscaping Purposes

**1.03 ALLOWANCES**

- A. If so stated in the specification “Allowances”, installation testing will be paid as an allowance. All other testing will be incidental to the Work.
- B. If there is no reference in the specification section to “Allowances”, then testing costs will be incidental to other Work items.

**1.04 SUBMITTALS**

- A. Informational Submittals
  - 1. Test and Evaluation Reports
    - a. Provide test reports showing the results of required material testing.

- b. Provide topsoil analysis performed in accordance with ASTM D5268 and demonstrating the topsoil meets Soil Conservation Service specified soil types. Also, submit results of test for nutrient levels and provide recommendations for fertilizer type and application.
- 2. Field or Site Quality Control Submittals
    - a. Daily delivery tickets for each load of material delivered to the site.

## **1.05 QUALITY ASSURANCE**

- A. An independent testing laboratory approved by the Owner shall be obtained by the Contractor and provide quality control testing.

## **PART 2 - PRODUCTS**

### **2.01 BANK RUN SOILS**

- A. Soil Class F-1 (Topsoil)
  - 1. Topsoil shall meet the definition and specification stated in ASTM D5268 and meets one of the following SCS (Soil Conservation Service) soil textures:
    - a. Loam.
    - b. Sandy loam.
    - c. Silt loam.
    - d. Silty clay loam.
    - e. Clay loam.
  - 2. The topsoil shall consist of adequate mineral content to support the growth of the intended vegetation and shall not contain herbicides that would be detrimental for the intended use.
  - 3. The topsoil shall have adequate fertility for quick establishment of vegetation.
  - 4. The pH of the topsoil shall be between 6.0 and 7.0.
  - 5. Topsoil shall be free from deleterious substances.
  - 6. Pulverize the topsoil in place such that 100 percent passes the 1-inch (25 mm) sieve.

- B. Soils Class F-2 (Compost/Topsoil)
  - 1. Same as Topsoil above except compost/topsoil defined as a mixture of topsoil and soil that is a byproduct of composting (compost).
- C. Soil Class G-1 (Clean Earth Fill #1)
  - 1. Any soil material excavated on the project site or obtained from borrow areas.
  - 2. Soil materials unsuitable and, therefore, not approved for this classification are:
    - a. Soils with high organic contents such as: topsoil, peat, muck, organic silts, and clays, marls, etc.
    - b. Manmade or rubble filled soils containing such materials as: foundry sand, fly ash cinders, asphalt, and concrete rubble, etc.
    - c. Silty soils such as: rock flour, loess, etc.
    - d. Soils with gravel larger than 3-inch.
    - e. Silty clay or clays with a high plasticity (CH soils as defined in ASTM D2487).
    - f. All soil contaminated with hazardous waste materials as defined by the EPA.
- D. Soils Class G-2 (Clean Earth Fill #2)
  - 1. Same as Clean Earth Fill #1 above except shall not contain gravel larger than 1½-inch.

## **2.02 MANUFACTURED AND SPECIAL SOILS**

- A. Soil Class H-1 (Polymer Treated and Chemically Treated Bentonite)
  - 1. Bentonite is defined as being largely composed of sodium montmorillonite (a clay mineral).
  - 2. Contain an optimum level of anionic, non-ionic or organic polymer to maximize wetting, expansion, and dispersing action in all types of soils.
  - 3. Shall be high swelling which is defined as the ability of 2 grams of the base bentonite, when mechanically reduced to -100 sieve, to swell in water to an apparent volume of 16.0 cc's, or more when added a little at a time to 100 cc's of distilled water in a graduate. Swelling action shall be indefinitely reversible.

4. Shall have a colloid content exceeding 85 percent as measured by evaporating the suspended portion of a 2 percent solution after 24 hours of sedimentation in a graduated beaker.
  5. Shall have a mineralogical composition of 90 percent minimum montmorillonite with 10 percent maximum sediments of feldspar, micas, and unaltered volcanic ash.
  6. No frozen material.
- B. Soil Class H-1 (Polymer Treated Bentonite)
1. Have properties equal to American Colloid Company Volcloy SG-40 Federal Bentonite Fluid Stop 610, or equal.
- C. Soil Class H-2 (Chemically Treated Bentonite)
1. Chemical treated to resist reaction and degradation from contact with the contaminant being stored.
  2. Have properties and composition equal to America Colloid Company Volcloy Saline Seal - 100, Federal Bentonite Marine Seal 123, or equal.

## 2.03 SOURCE QUALITY CONTROL

- A. Tests and Inspections
1. To establish acceptability of material, perform tests for each soils class in accordance to the following standards:
  2. Topsoil and Compost/Topsoil:
    - a. ASTM D2487
  3. Clean Earth Fill:
    - a. ASTM D2487
  4. In addition to the above, furnish a soil analysis of Topsoil and Compost/Topsoil:
    - a. pH
    - b. Phosphorus
    - c. Potassium
    - d. Soluble Salts

- e. Calcium
  - f. Magnesium
5. Source sample all soils in accordance with ASTM D75.
  6. Perform one (1) acceptable test for each type of material at each source.

### **PART 3 - EXECUTION**

#### **3.01 APPLICATION**

- A. Use the soil classification as specified or stated in Specification Sections or on Engineered Plans.
- B. Place material in accordance with the Engineered Plans and appropriate Specification Sections for the type of work performed.

**END OF SECTION**

**SECTION 32 05 16**  
**AGGREGATES FOR EXTERIOR IMPROVEMENTS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Rip Rap
  - 2. Crushed Rock
  - 3. Concrete Aggregate
  - 4. Crushed Stone and Gravel
  - 5. Granular Backfill
  - 6. Sand

**1.02 REFERENCES**

- A. American Society for Testing and Materials (ASTM)
  - ASTM C33 Specification for Concrete Aggregates.
  - ASTM C88 Test for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
  - ASTM C117 Test for Material Finer than No. 200 Sieve in Mineral Aggregates by Washing.
  - ASTM C131 Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
  - ASTM C136 Sieve Analysis of Fine and Coarse Aggregates.
  - ASTM C144 Spec. for Aggregate for Masonry Mortar.
  - ASTM C207 Spec. for Hydrated Lime for Masonry Purposes.
  - ASTM C535 Test for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
  - ASTM D75 Sampling Aggregates.
  - ASTM D448 Spec. for Standard Sizes of Coarse Aggregate for Highway Construction.
  - ASTM D1241 Spec. for Materials for Soil-Aggregate Subbase, Base, and Surface Courses.
  - ASTM D2216 Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures.
  - ASTM D2487 Classification of Soils for Engineering Purposes.
  - ASTM D4318 Test Method for Liquid Limit, Plastic Limit, and Plasticity of Soils.

### **1.03 ALLOWANCES**

- A. If so stated in the specification “Allowances”, installation testing will be paid as an allowance. All other testing will be incidental to the Work.
- B. If there is no reference in the specification section to “Allowances”, then testing costs will be incidental to other Work items.

### **1.04 SUBMITTALS**

- A. Informational Submittals
  - 1. Source Quality Control Submittals
    - a. Provide test reports showing the results of required material testing.
  - 2. Daily delivery tickets for each load of material delivered to the site.

### **1.05 QUALITY ASSURANCE**

- A. An independent testing laboratory approved by the Owner shall be obtained by the Contractor and provide quality control testing.

## **PART 2 - PRODUCTS**

### **2.01 RIP RAP**

- A. Provide durable field or quarry stone that is sound, hard, dense, resistant to the action of air and water, and free of seams, cracks, or other structural defects.
- B. Provide stone pieces with a length and width no more than twice the thickness.
- C. Concrete slabs may not be substituted for stone.
- D. Provide stones conforming to the size requirements for the riprap grade shown on the Engineered Plans. Riprap shall be furnished as listed below.
  - 1. Light Riprap: 12 inches thick
  - 2. Medium Riprap: 18 inches thick
  - 3. Heavy Riprap: 24 inches thick
  - 4. Extra Heavy Riprap: 30 inches thick

## 2.02 CRUSHED ROCK

### A. General

1. Material shall be clean, sound, hard, dense, durable, field or quarry stone which is free from seams, cracks, or other structural defects. It shall be angular material from shot rock (blasted) or crushed rock having substantially all face of which have resulted from artificial crushing.
2. Loss due to sulfate soundness test shall not exceed 10 percent.
3. Loss due to abrasion test shall not exceed 40 percent.
4. No frozen material.

### B. 3/4-inch Crushed Rock Chips Gradation (Soil Class A-7)

1. ASTM D448-No. 67

<u>Sieve Size</u>	<u>% Passing by Weight</u>
1-inch	100
3/4-inch	90-100
3/8-inch	20-55
No. 4	0-10
No. 8	0-5

## 2.03 CONCRETE AGGREGATE

### A. General

1. Aggregate shall be hard, strong, durable particles free from seams, cracks, and other structural defects.
2. Rounded to subangular.
3. Free from organic impurities and debris.
4. No frozen material.

B. Coarse Aggregate Gradation (Soils Class B-1)

1. ASTM C33 - No. 3

<u>Sieve Size</u>	<u>% Passing by Weight</u>
2 ½-inch	100
2-inch	90-100
1 ½-inch	35-70
1-inch	0-15
½-inch	0-5

C. Coarse Aggregate Gradation (Soil Class B-2)

1. ASTM C33 - No. 7

<u>Sieve Size</u>	<u>% Passing by Weight</u>
¾-inch	100
½-inch	90-100
3/8-inch	40-70
No. 4	0-15
No. 8	0-5

D. Fine Aggregate Gradation (Soil Class B-3)

1. ASTM C33

<u>Sieve Size</u>	<u>% Passing by Weight</u>
3/8-inch	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	2-10

E. Masonry Sand Gradation (Soil Class B-4)

1. ASTM C144

<u>Sieve Size</u>	<u>Percent Passing Natural Sand</u>	<u>Manufactured Sand</u>
No. 4	100	100
No. 8	95 to 100	95 to 100
No. 16	70 to 100	70 to 100
No. 30	40 to 75	40 to 75
No. 50	10 to 35	20 to 40
No. 100	2 to 15	10 to 25
No. 200	---	0 to 10

**2.04 GRANULAR BACKFILL**

- A. Provide granular material in accordance with Crushed Aggregate Base Course Gradation #2.

**2.05 SOURCE QUALITY CONTROL**

- A. To establish acceptability of material, perform tests for each soils class in accordance to the following standards:
1. Soils Class A and C:
    - a. ASTM C88.
    - b. ASTM C131 (for coarse aggregates smaller than 1½ inches).
    - c. ASTM C136.
    - d. ASTM C535 (for coarse aggregates 1½ inches and larger).
    - e. ASTM C117 (use when aggregate contains materials finer than No. 200 sieve).
  2. Soils Class B:
    - a. ASTM C88.
    - b. ASTM C117.
    - c. ASTM C136.
  3. Source sample all soils and aggregates in accordance with ASTM D75.

4. Perform one (1) acceptable test for each type of material at each source.

### **PART 3 - EXECUTION**

#### **3.01 APPLICATION**

- A. Use the soil classification as specified or stated on Engineered Plans.
- B. Place material in accordance with the Engineered Plans and appropriate Specification Sections for the type of work performed.

**END OF SECTION**

**SECTION 32 11 23**  
**AGGREGATE BASE COURSES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Materials testing.
  - 2. Foundation preparation.
  - 3. Crushed aggregate base course for roads, shoulders, and parking areas.
  - 4. Preparation of crushed aggregate base course for paving.

**1.02 REFERENCES**

- A. American Association of State Highway and Transportation Officials (AASHTO):
  - AASHTO T2            Sampling Stone, Slag, Gravel, Sand, and Stone Block for Use as Highway Materials
  - AASHTO T27        Sieve Analysis of Fine and Coarse Aggregates
  - AASHTO T37        Sieve Analysis of Mineral Filler
  - AASHTO T89        Determining the Liquid Limit of Soil
  - AASHTO T90        Determining the Plastic Limit and Plasticity Index of Soils
  - AASHTO T104      Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
  
- B. American Society for Testing and Materials (ASTM):
  - ASTM D1557        Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Lb. (4.54 kg) Rammer and 18-In. (457 mm) Drop.
  
  - ASTM D6938        Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

**1.03 ALLOWANCES**

- A. If so stated in the specification “Allowances”, installation testing will be paid as an allowance. All other testing will be incidental to the Work.
  
- B. If there is no reference in the specification section to “Allowances”, then testing costs will be incidental to other Work items.

## **1.04 SUBMITTALS**

### **A. Informational:**

1. Submit two (2) copies of the results of quality control testing (include location where test was done):
  - a. Materials source testing.
    - (1) Aggregate supplied from a previously approved source provide source testing report and approval letter from Owner the material was supplied.
  - b. Crushed aggregate base material installation testing.
  - c. Additional density and gradation testing, if required.
2. Submit daily one copy of weight tickets showing the net weight for each truckload of crushed aggregate base material delivered and placed. Tickets will only be considered for payment if received on the same day the material is placed.
3. Field quality control testing results.

## **1.05 QUALITY ASSURANCE**

- ### **A. Obtain an independent testing laboratory approved by the Owner to provide quality control testing.**

## **1.06 DELIVERY, STORAGE, AND HANDLING**

### **A. Aggregates**

1. Store aggregates to prevent contamination by foreign matter or by aggregates of different sizes.

### **B. Delivery of Aggregates**

1. Vehicles used to transport aggregates shall be of a type to minimize loss of materials and excessive segregation of particles.

## **PART 2 - PRODUCTS**

### **2.01 MATERIALS**

#### **A. Aggregates**

1. Provide aggregates consisting of hard, durable particles of crushed stone or crushed gravel and a filler of natural sand, stone sand or other finely divided mineral matter.
    - a. Remove oversize material by screening or by crushing to required sizes.
    - b. Provide composite material free from organic matter, shale, and lumps or balls of clay and conforming to the gradation requirements below.
  2. Liquid Limit and Plasticity Index:
    - a. Aggregate including any blended filler shall have a liquid limit of not more than 25 and a plasticity index of not more than 6.
  3. Fracture Count:
    - a. At least 58 percent of particles retained on the No. 4 sieve shall have at least one fractured face.
  4. Soundness:
    - a. When the fraction of aggregate retained on the No. 4 sieve is subjected to five cycles of the sodium sulfate soundness test, weighted loss shall not exceed 18 percent by weight.
  5. Filler for Blending:
    - a. Additional mineral filler required to meet gradation requirements or for satisfactory binding of material shall be uniformly blended with base course material at the screening plant.
    - b. Mineral fillers shall be free from agglomerations or lumps and shall contain not more than 15 percent of material retained on a No. 4 sieve.
  6. Moisture Content: Not to exceed 7 percent.
- B. Do not use material produced from recycled material as aggregate base course without written approval of the Owner.

C. Aggregate Gradation Requirements

1. Gradation No. 1 (3 inch material):

<u>Sieve Size</u>	<u>% By Weight Passing Crushed Gravel/Stone</u>
3 inch	90-100
1½ inch	60-85
¾ inch	40-65
No. 4	15-40
No. 10	10-30
No. 40	5-20
No. 200	2-12

2. Gradation No. 2 (1¼ inch material)

<u>Sieve Size</u>	<u>% By Weight Passing</u>	
	<u>Crushed Gravel</u>	<u>Crushed Stone</u>
1¼ inch	95-100	95-100
¾ inch	70-93	70-93
3/8 inch	45-80	45-80
No. 4	30-63	30-63
No. 10	20-48	20-48
No. 40	8-28	8-28
No. 200	4-10(1)	2-12(1)

(1) Limited to 8.0 percent for base placed between new and old pavement.

3. Gradation No. 3 (¾ inch material)

<u>Sieve Size</u>	<u>% By Weight Passing</u>	
	<u>Crushed Gravel</u>	<u>Crushed Stone</u>
1 inch	100	100
¾ inch	95-100	95-100
3/8 inch	50-90	50-90
No. 4	35-70	35-70
No. 10	15-55	15-55
No. 40	10-35	---
No. 200	8-15	5-15

## **2.02 SOURCE QUALITY CONTROL**

- A. Test aggregate material per the following requirements:
  - 1. Sampling: AASHTO T2.
  - 2. Sieve Analysis:
    - a. AASHTO T27 for aggregates including fracture count.
    - b. AASHTO T37 for mineral fillers.
  - 3. Liquid Test: AASHTO T89.
  - 4. Plasticity Index: AASHTO T90.
  - 5. Soundness: AASHTO T104 using sodium sulfate

## **PART 3 - EXECUTION**

### **3.01 PREPARATION OF FOUNDATION**

- A. Prepare the foundation for crushed aggregate base course in accordance with requirements of applicable section(s) within these specifications.
- B. Do not place the base course on a foundation that is soft or spongy or one that is covered by ice or snow.
- C. Do not place base material on a dry or dusty foundation when existing condition would cause rapid dissipation of moisture from base material and hinder or preclude its proper compaction.
  - 1. Apply water to such dry foundations and rework or recompact as necessary.

### **3.02 CRUSHED AGGREGATE BASE COURSE INSTALLATION**

- A. Use gradations per the typical sections in the Engineered Plans.
- B. Construct crushed aggregate base course to the width, thickness, section and location shown on the Engineered Plans.
  - 1. Do not exceed 6 inches of compaction thickness for 1¼ or ¾ inch material; 9 inches for 3 inch material.
    - a. Install and compact approximate equal thicknesses when multiple courses are required.

C. Spreading Base Material

1. Proceed with the work such that the hauling equipment will travel over the previously placed material.
2. Route hauling equipment as uniformly as possible over all portions of the previously constructed layers of the base course.
3. Deposit the material on the foundation or previously placed layer in such a manner as to minimize segregation and to facilitate spreading to a uniform layer of the required dimensions.

D. Compaction

1. After a layer of aggregate has been placed and spread to the required thickness, width, and section, it shall be compacted.
2. If the material is deficient in moisture content, to attain the required density, add necessary moisture during compaction operations by means, which provides a uniform application.
3. Compact each layer or course placed to at least 95 percent of the maximum dry density as determined by the Modified Proctor Test (ASTM D1557).
4. Rework or remove areas where proper compaction is not obtainable due to segregation of materials, excess fines or other deficiencies Replace removed material with material that will yield the desired results.
5. Prior to and during compaction operations, shape and maintain the material to the proper dimensions.

E. Proof (Test) Rolling

1. Prior to paving operations, test the base course strength by proof rolling. Proof roll finished base course by rolling with a fully loaded tandem axle dump truck. Contractor may be required to provide a weight ticket associated with the loaded test vehicle. Proof rolling shall involve running fully loaded trucks over the entire roadway (pavement plus shoulders or extent beyond back of curb) width. Stabilize weak or yielding areas in the base course by removing the placed/existing base course material and replace with clean base aggregate. A subsequent proof roll test will be required for all repaired/stabilized areas within the base course. In the event that weather, or other conditions change the condition of the base course after initial proof roll test and/or stabilization has been performed, a proof roll test of the entire base course will be required after such event.

Take necessary precautions to protect existing structures from damage during proof roll test.

F. Excavation Below Completed Base Course

1. Should excavation below subgrade (EBS) be required in an area of completed base course construction, stabilization and restoration of weak or yielding areas shall be addressed in accordance with these specifications: Excavation Below Subgrade.

G. Maintenance

1. Provide maintenance of the base course until surface paving is complete or until the base is otherwise accepted.

H. Dust Control

1. Minimize the dispersion of dust from the base course by the application of water or other approved dust control materials.

I. Preparation of Base for Paving

1. Prior to paving, perform all necessary scarifying, shaping, and compacting to provide the required cross-sectional contour, a profile free from abrupt changes in elevation, and a surface free from pits, holes, depressions, or projections above the normal surface.
2. Remove any standing or ponded water, and ice or snow from the base before paving begins.

### 3.03 FIELD QUALITY CONTROL

A. Installation Testing

1. Perform a minimum of one (1) moisture/density test in accordance with ASTM D6938 (Nuclear Method) per 20,000 sq. ft. per layer of base course placed.
2. Perform a sieve analysis conforming to the following. Frequency shall be per WisDOT Standard Specification Section 730.
  - a. AASHTO T27 for aggregates including fracture count.
  - b. AASHTO T37 mineral fillers.

B. Provide additional Density and Gradation Testing when:

1. Aggregate density does not meet project requirements.
  2. There is a change in method of compaction.
  3. There is a change in source or quality of aggregate.
- C. Once the crushed aggregate base course is complete the Contractor shall schedule a walk through with the Sanitary District, the Municipal Engineer, and the Developer's Engineer. The Contractor shall correct all deficiencies prior to acceptance of the work.

**END OF SECTION**

**SECTION 32 12 00  
FLEXIBLE PAVING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Hot Mix Asphalt (HMA)
- B. Tack Coat

**1.02 REFERENCES**

- A. State of Wisconsin Department of Transportation (WisDOT)
  - 1. WisDOT Standard Specifications for Highway and Structure Construction (“State Specifications”), current edition, and all supplemental and interim supplemental specifications, as they may pertain, with the exception of the following items which shall not apply:
    - a. Method of measurement and basis of payment.
    - b. Quality Management Program (QMP).
    - c. Pavement density incentives.
  - 2. Asphaltic concrete pavement shall comply and be constructed in accordance with:
    - a. WisDOT 450, General Requirements for Asphaltic Surface
    - b. WisDOT 455, Asphaltic Materials
    - c. WisDOT 460, Hot Mix Asphalt Pavement (HMA)

**1.03 ALLOWANCES**

- A. If so stated in the specification “Allowances”, installation testing will be paid as an allowance. All other testing will be incidental to the Work.
- B. If there is no reference in the specification section to “Allowances, then testing costs will be incidental to other Work items.

**1.04 SUBMITTALS**

- A. Action Submittals:
  - 1. Submit two (2) copies of each asphaltic concrete mix design proposed for the project.

B. Informational Submittals:

1. Submit two (2) copies of the results of quality control testing.
2. Submit daily one (1) copy of weight tickets showing the net weight for each truckload of asphalt delivered and placed. Provide gross, tare, and net weights as well as date, time, ticket number, project, and mix type. Tickets will only be considered for payment if received on the same day the material is placed.

**1.05 QUALITY ASSURANCE**

A. Testing:

1. Obtain an independent testing laboratory approved by the Owner to provide quality control testing.
2. Testing agency shall perform a minimum of one density test for every 1,500 square yards of each layer of pavement placed or fraction thereof.
3. Retests are required within testing areas not meeting minimum density requirements.
4. If density testing results are below minimum requirements, submit proposed corrective action to Engineer.

**1.06 FIELD OR SITE CONDITIONS**

A. Place asphaltic mixture only on a prepared, firm, and compacted base, foundation layer, or existing pavement substantially surface-dry and free from loose and foreign material. Do not place pavement over frozen subgrade or base, when roadbed is unstable or during rain or snow.

B. Cold Weather Paving

1. Remove Subsections 450.3.2.1.1(1) of the State Specifications and replace with the following:
  - a. Asphaltic pavement shall not be placed when the air temperature in the shade and away from artificial heat sources is less than 36 ° F. If Engineer allows placing asphaltic mixtures below the specified minimum temperature, either at the Contractor's request or to complete the Work to the stage the contract requires, the Work will be performed at the Contractor's risk. Final inspection of the asphaltic concrete pavement will be deferred until May of the following year. Before final acceptance of the Work, restore all

pavement damage or defects the Engineer attributes to temperature or other weather conditions. Repair or replace areas of pavement as identified by the Engineer.

C. Wet Weather Conditions

1. In the event of sudden or impending rain, material in transit will be permitted to be laid at the Contractor's risk providing the pavement is free of standing water and the proper temperature of the delivered asphalt material is maintained. Approval to unload the trucks in transit shall in no way relax the requirements of quality, density, or smoothness of the asphalt being placed.

**PART 2 - PRODUCTS**

**2.01 ASPHALT PAVEMENT MATERIALS**

A. Asphaltic pavement shall be in accordance with requirements for WisDOT Standard Specifications except as noted in the following:

1. Hot mix asphalt pavement shall be per the typical section in the

B. Aggregate in the pavement mix shall conform to Section 460 of WisDOT "State Specifications", and comply with the minimum layer thicknesses as listed below:

<u>Gradation No.</u>	<u>Nominal Size</u>	<u>Minimum Layer Thickness</u>
3	3/4" (19.0 mm)	2.25"
4	1/2" (12.5 mm)	1.50"
5	3/8" (9.5 mm)	1.50"

C. Pavement Mix Design

1. Prior to beginning construction, submit copies of the State approved design mixes for materials proposed to be used on this project.
2. Produce and incorporate the asphaltic mixture in the Work on the basis of job-mix formula. The Contractor shall be responsible for the asphaltic job-mix design report, conforming to Section 460 of WisDOT Standard Specifications, and shall submit a signed copy of the report to the Engineer for review at least two weeks prior to start of paving operations.

**2.02 TACK COAT MATERIALS**

A. Tack coat material shall be an asphalt emulsion, conforming to Section 455 of WisDOT State Specifications, diluted with an equal amount of water and applied at a consistent rate of 0.05 to 0.15 gallons per square yard or as directed by the Engineer.

## **2.03 EQUIPMENT**

- A. Paver: The paver shall have sufficient power and traction to operate on grades. Screed extensions with static extensions shall not exceed 12 inches. The paver shall have the ability to pave widths necessary to meet the lane paving width/passes requirements. Paver must have the ability to control the asphalt thickness and ride quality using a contact or non-contact grade reference system.
- B. Vibratory rollers shall conform to Section 450 of WisDOT Standard Specifications.

## **PART 3 - EXECUTION**

### **3.01 SURFACE PREPARATION**

- A. Prepare a compacted foundation in accordance with these specifications. All required corrections; filling of potholes, sags, depressions, must be addressed. Edges of match points, curb and gutter, castings, etc. must be cleared of excess material that may prevent installation of the specified pavement thickness.
- B. Prepare foundation such that the finished asphalt at the curb flange shall be ¼” above the curb flange.

### **3.02 PAVEMENT THICKNESS**

- A. The pavement thickness shall match the existing thickness unless the minimum thickness(es) specified within these specifications apply.
- B. Place pavement in two or more lifts conforming to Section 460 of WisDOT Standard Specifications. The maximum compacted thickness of individual layers shall not exceed four inches for lower layers and three inches for upper layers.

### **3.03 TEMPERATURE OF ASPHALT PLACED**

- A. All asphalt (both upper and lower layers) shall be delivered to the project site at a temperature not lower than 250 °F.

### **3.04 TACK COAT**

- A. Apply a thin, uniform layer of tack coat to each lower layer prior to placing succeeding layer. Apply the tack coat the same day that the next layer is placed. Do not place pavement until the tack coat emulsion has broken (water and asphalt separate) or is tacky to the touch.

### **3.05 PAVEMENT PASSES**

- A. Do not straddle the centerline with the paver. Either 2 or 4 passes shall be used. No 3 pass paving will be allowed.

### 3.06 PAVEMENT COMPACTION

- A. All pavements shall be built in accordance with the Maximum Density Method per Section 460 of WisDOT Standard Specifications. The maximum specific gravity value shall be indicated on the asphaltic job-mix design report.
- B. Compact pavements to a density not less than that shown in the table below:

Minimum Required Density [1]			
Location	Layer	Percent of Target Maximum Density	
		Mixture Type	
		LT and MT	HT
Traffic Lanes [2]	Lower	93.0 [3]	93.0 [4]
	Upper	93.0	93.0
Side Roads, Crossovers, Turn Lanes, & Ramps	Lower	93.0 [3]	93.0 [4]
	Upper	93.0	93.0
Shoulders & Appurtenances	Lower	91.0	91.0
	Upper	92.0	92.0

[1] The table values are for average lot density. If any individual density test result fall more than 3.0 percent below the minimum required target maximum density, the engineer may investigate the acceptability of that material.

[2] Includes parking lanes.

[3] Minimum reduced by 2.0 percent for a lower layer constructed directly on crushed aggregate or recycled base courses.

[4] Minimum reduced by 1.0 percent for a lower layer constructed directly on crushed aggregate or recycled base courses.

- C. Verify the degree of compaction and submit a report to the Engineer which includes date paved, date tested, test locations, and degree of compaction.
- D. All compaction (rolling) operations shall be performed during daylight hours.
- E. Replace pavement full lane width with all joints saw cut and tacked when:
  1. Minimum density is not met.
  2. Minimum asphalt content is not met.
  3. There is significant segregation, raveling, rutting, or deformation.

**END OF SECTION**

**SECTION 32 16 13**  
**CONCRETE CURB AND GUTTER**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Curb and gutter construction
  - 2. Reinforced curb and gutter
  - 3. Backfilling
  - 4. Curb and gutter replacement sections

**1.02 REFERENCES**

- A. American Society for Testing and Materials (ASTM)
  - ASTM A615 Spec. for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
  - ASTM C31 Making and Curing Concrete Test Specimens in the Field
  - ASTM C33 Spec. for Concrete Aggregate
  - ASTM C39 Test for Compressive Strength of Cylindrical Concrete Specimens
  - ASTM C94 Spec. for Ready-Mixed Concrete
  - ASTM C143 Test for Slump of Portland Cement Concrete
  - ASTM C150 Spec. for Portland Cement
  - ASTM C172 Sampling Fresh Concrete
  - ASTM C231 Test for Air Content of Freshly Mixed Concrete by the Pressure Method
  - ASTM C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
  - ASTM C1315 Spec. for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
  - ASTM D1557 Test Methods for Moisture-Density Relations of Soils and Soils-Aggregate Mixtures Using 10-Lb. (4.54 Kg) Rammer and 18-In. (457 mm) Drop
  - ASTM D1751 Spec. for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
  - ASTM E329 Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction

- B. American Concrete Institute (ACI)
  - ACI 305 Recommended Practice for Hot Weather Concreting
  - ACI 306 Recommended Practice for Cold Weather Concreting
  - ACI 347 Guide to Formwork for Concrete
  
- C. American Association of State Highway and Transportation Officials (AASHTO)
  - AASHTO M 148 Curing Compounds
  
- D. State of Wisconsin Department of Transportation (WisDOT)
  - 1. WisDOT Standard Specifications for Highway and Structure Construction (“State Specifications”), current edition, and all supplemental and interim supplemental specifications, as they may pertain, with the exception of the following items which shall not apply:
    - a. Method of measurement and basis of payment.
    - b. Quality Management Program (QMP).
    - c. Incentive Programs.
  - 2. Portland cement concrete shall comply and be furnished in accordance with:
    - a. WisDOT 501, Concrete

### **1.03 ALLOWANCES**

- A. If so stated in the specification “Allowances”, installation testing will be paid as an allowance. All other testing will be incidental to the Work.
- B. If there is no reference in the specification section to “Allowances”, then testing costs will be incidental to other Work items.

### **1.04 SUBMITTALS**

- A. Action Submittals
  - 1. Current concrete design mix of composition and strength testing results for design mix for each type of concrete.
- B. Informational Submittals
  - 1. Results of all installation testing.

## 1.05 QUALITY ASSURANCE

- A. Employ an independent testing laboratory approved by the Owner to provide testing services as follows:
  - 1. Material Acceptance Testing:
    - a. Design mix.
  - 2. Installation Testing:
    - a. Slump.
    - b. Air-entrainment.
    - c. Compressive strength test.
  - 3. Additional Testing:
    - a. Perform under following circumstances:
      - (1) Material failure.
      - (2) Change in ready-mix source.
      - (3) Design mix changes requested by Contractor.
- B. The following shall be in accordance with the stated references:
  - 1. Inspection and Testing: ASTM E329.
  - 2. Sampling: ASTM C172.
  - 3. Slump: ASTM C143.
  - 4. Air-Entrainment: ASTM C231.
  - 5. Compressive Strength Test: ASTM C31 and C39.
- C. Perform tests required by this section with the following frequency:
  - 1. One test daily or one per 100 cubic yards placed, whichever number is greater.
- D. Compressive strength test shall consist of four standard test cylinders made from a single batch of concrete:

1. Test one cylinder at 7 days.
2. Test two cylinders at 28 days.
3. Remaining cylinder shall be tested in the event prior tests fail.
4. Compressive strength tests shall be considered satisfactory when 28-day tests meet the following:
  - a. Test results equal or exceed specified compressive strength.
  - b. No individual test falls more than 500 psi below specified compressive strength.
5. Failure of compressive strength tests shall result in following additional testing:
  - a. Provide two core samples of each portion of work affected and perform compressive strength tests.
  - b. Replace work if core samples do not equal or exceed specified compressive strength.

## **PART 2 - PRODUCTS**

### **2.01 CONCRETE**

#### **A. Concrete**

1. Conform to ASTM C94 and the following:
  - a. All concrete shall be Grade A, air-entrained, in conformance with WisDOT Section 501.
  - b. Seven-day compressive strength: 3000 psi Minimum
  - c. Twenty-eight day compression strength 4,000 psi Minimum.
  - d. Maximum Aggregate Size: 1½ inches.
  - e. Air Content (percent): 6.0 percent ± 1.5 percent.
  - f. Slump:
    - (1) Slip-Formed Concrete Pavement: 2.5 inches or less.

- (2) Not Slip-Formed with Surface Vibration Concrete Pavement: 1.5 to 3 inches.
- (3) Not Slip Formed with Internal Vibration: 1 to 3 inches.

2. Admixtures to lower freezing point of concrete are not permitted.

## 2.02 AGGREGATES

A. Conform to ASTM C33.

## 2.03 EXPANSION JOINT

A. Conform with ASTM D1751.

B. Thickness:  $\frac{3}{4}$  inch.

## 2.04 REINFORCEMENT BAR

A. Conform with ASTM A615.

B. Grade 60.

C. Minimum Bar Size: #4.

## 2.05 CURING MATERIALS

A. Linseed Oil (White Pigmented)

1. Furnish liquid membrane-forming curing compounds composed of a blend of boiled linseed oil and high viscosity, heavy bodied linseed oil emulsified in a water solution conforming to AASHTO M 148, Type 2 Class B. Test material at an application rate of 1 gallon per 200 square feet.
2. Waive drying time requirements. The chemical requirements (volumes are exclusive of added pigments) are as follows:

<b>Oil Phase (50+/-4% by volume)</b>	<b>(Percent By Mass)</b>
Boiled Linseed Oil	80
Z-8 Viscosity Linseed Oil	20
Water Phase (50 +/-4% by volume)	100

## 2.06 CRUSHED AGGREGATE BASE MATERIAL

- A. Construct curb and gutter on a layer of compacted base aggregate dense base course, placed to the thickness matching the subgrade elevation of the curb and gutter to the subgrade elevation of the adjacent pavement, with a minimum of 6 inches of base course.
- B. Provide base material conforming Gradation #2 of these specifications.
  - 1. Aggregates shall consist of hard, durable particles of crushed stone or crushed gravel and a filler of natural sand, stone sand or other finely divided mineral matter.
  - 2. Remove oversize material by screening or by crushing to required sizes.
  - 3. Composite material shall be free from organic matter, shale, and lumps or balls of clay and shall conform to the gradation requirements below.
- C. Liquid Limit and Plasticity Index
  - 1. Aggregate, including any blended filler, shall have a liquid limit of not more than 25 and a plasticity index of not more than 6.
- D. Fracture Count
  - 1. At least 45 percent of particles retained on the No. 4 sieve shall have at least one fractured face.
- E. Soundness
  - 1. When the fraction of aggregate retained on the No. 4 sieve is subjected to five cycles of the sodium sulfate soundness test, weighted loss shall not exceed 18 percent by weight.
- F. Filler for Blending
  - 1. Additional mineral filler required to meet gradation requirements or for satisfactory binding of material shall be uniformly blended with base course material at the screening plant.
  - 2. Mineral fillers shall be free from agglomerations or lumps and shall contain not more than 15 percent of material retained on a No. 4 sieve.
- G. Moisture content shall not exceed 7 percent.

## **PART 3 - EXECUTION**

### **3.01 PLACING AND GRADING BASE COURSE**

- A. Provide a minimum of 6 inches of base material.
- B. The subgrade shall be prepared by fine grading to the lines, grades, and cross-sections shown on the Engineered Plans as required for placing the curb and gutter.
- C. Compact to minimum 95 percent modified proctor density (ASTM D1557).

### **3.02 CATCH BASINS/INLETS**

- A. Adjust catch basins/inlets to curb and gutter elevation.

### **3.03 FORMS**

- A. Conform to ACI 347.
- B. Provide forms of the size and type of material required to properly construct the curb and gutter as required.
- C. Properly brace or tie together forms to maintain position and shape.
- D. Clean and coat forms with clear, non-staining mineral or paraffin base form oil prior to placement of the concrete against the forms.
- E. Removal of Forms
  - 1. The forms may be removed provided the concrete obtains sufficient strength so as not to be damaged and will retain its shape.
  - 2. Protect the curb and gutter until the concrete has attained design strength.

### **3.04 SLIPFORM CONSTRUCTION**

- A. The use of slipform equipment will be acceptable.
- B. Coordinate the operations of mixing, delivering, and placing of the concrete to provide uniform progress with minimum stopping and starting of the curb machine.
- C. The curb machine shall be capable of placing the specified curb and gutter section with an adequate amount of vibration to preclude the possibility of honeycomb formation.

### **3.05 ENVIRONMENTAL REQUIREMENTS**

- A. Hot Weather Concreting
  - 1. Follow ACI 305 whenever mean surrounding air temperature equals or exceeds 80°F (27°C).
  - 2. Do not place concrete whenever air temperature equals or exceeds 90°F (32°C).
- B. Cold Weather Concreting
  - 1. Follow ACI 306 whenever mean surrounding air temperature is below 40°F (4.5°C).
- C. Do not place concrete during rain, sleet, or snow unless protection is provided.

### **3.06 PLACING CONCRETE**

- A. Construct curb and gutter on the prepared and moistened foundation in one course.
- B. Construct curb and gutter to the required lines and grades as shown on the Engineered Plans.
- C. Place concrete by using the slipform or fixed form method.
- D. Consolidate concrete as follows:
  - 1. Slipform: Mechanical vibration.
  - 2. Fixed Form: Mechanical vibration or spading against forms.
- E. Adjacent to Rigid Pavement
  - 1. Curb and gutter constructed adjacent to rigid pavement may be integral or placed separately.
  - 2. Curb and gutter placed separately from abutting rigid pavement shall be constructed with tie bars as shown on the Engineered Plans and/or place #4 x 24" long bars at 3' C/C.
- F. Contraction Joints
  - 1. Install at a maximum of 10-foot intervals.

2. If curb and gutter is installed adjoining rigid pavement, contraction joints shall be spaced to match joints in the abutting pavement.
  3. Cut to a minimum depth of 1/3 the depth of the pavement.
  4. If installed by sawing, saw as soon as practicable after concrete has set sufficiently to preclude raveling during the sawing and before any shrinkage cracks occur.
  5. If shrinkage cracks develop, the cracked section of curb and gutter shall be removed and replaced in a manner required by this Section.
- G. Place expansion joints at the locations shown of Engineered Plans and/or as follows:
1. 300 feet maximum spacing on both tangents and curves.
  2. At the PC and PT of horizontal curves.
  3. Adjacent to existing expansion joints in abutting concrete paving.
  4. Three feet each side of drainage structures.
  5. Place at right angles to the flow line and surface of the gutters.
  6. Reinforcing bars shall not extend through expansion joint.
- H. Place depressions for handicapped ramps at the required locations and widths shown on the Engineered Plans.
- I. Protection of Work
1. Provide measures/devices to protect all Work from all potential sources of damage should the source be mechanical or environmental. All damaged Work will be replaced.

### **3.07 REINFORCEMENT**

- A. Provide where shown on the Engineered Plans and/or as stated in these specifications.
- B. Reinforcement at all curb and gutter spanning lateral trenches for a length of 20 feet and 10 feet each side of inlets.

- C. At points of replacements adjacent to existing curb and gutter and tie-ins to existing curb and gutter.

### **3.08 FINISHING**

- A. Thoroughly trowel and brush or lightly broom the face surfaces of the curb and gutter prior to concrete set.
- B. Round exposed edges of the curb and gutter to ¼ inch radius, both front and back, and edges adjacent to expansion joints.
- C. Pointed with mortar composed of three parts sand and one part Portland cement honeycombed areas as soon as possible after the curb and gutter has been placed.

### **3.09 CURB RAMPING**

- A. Provide depressed and sloped curb at curb ramping locations and driveways shown on the Engineered Plans.
- B. Provide appropriate longitudinal slope on curb as shown on the Engineered Plans for curb ramps and for driveways.

### **3.10 TAPERED CURB ENDS**

- A. A tapered curb section shall be constructed at the ends of the curb and gutter where shown on Engineered Plans. The tapered sections shall be 3 feet long and end with a 2 inch high curb. A contraction joint shall be placed at the end of the tapered section.

### **3.11 CURING**

- A. Start curing activities as soon as free water has disappeared from the surface of concrete after placing and finishing.
- B. Apply curing compound to all exposed surfaces by spraying a uniform coating in such a manner as to provide a continuous water impermeable surface. Apply in accordance with manufacturer's recommendations to limit loss of water to not more than 0.40 kg/m<sup>2</sup> in 72 hours.
- C. Under hot weather conditions, conform to ACI 305.
- D. Under cold weather conditions, conform to ACI 306.
- E. During curing period, protect concrete from damaging mechanical disturbances, water flow, loading, shock, and vibration.

### **3.12 BACKFILLING**

- A. Do not backfill curb and gutter until the compressive strength reach the required/minimum 7 day test results.
- B. Backfill areas behind the curb and gutter with compacted excavated material or granular material except for curb adjacent to landscape areas that will require 4 inches of topsoil.
- C. Compact backfill material to 85 percent Modified Proctor density (ASTM D1557).
- D. All backfilling shall be completed within two weeks of curb and gutter installation.
- E. Roadways shall not be open to any traffic until curb and gutter backfilling has been completed.
- F. Do not pave adjacent to curb and gutter until backfilling is completed.
- G. Immediately restore any backfill that has settled.

### **3.13 REPLACEMENT OF CURB AND GUTTER SECTIONS**

- A. Prior to Pavement
  - 1. Damaged curb and gutter section shall be removed to the nearest joints both sides of the damaged area.
  - 2. Aggregate base course shall be compacted prior to installing new curb and gutter. Additional base course shall be added as necessary.
- B. After Pavement Installation:
  - 1. Adjacent to Flexible Pavement - A minimum of 1 foot of pavement adjacent to the curb and gutter replacement section shall be saw cut, removed and replaced.
  - 2. Adjacent to Rigid Pavement – Saw cut joint at curb flange adjacent to pavement. Insert required number of tie bars into adjacent pavement prior to installation of curb and gutter replacement section.
- C. Ties to Adjacent Curb and Gutter Sections:

1. Curb and gutter replacement section shall be installed using two (2) #4 (1/2") x 18" long tie bars, evenly spaced in curb pan, driven 9 inches into adjacent curb and gutter.

### **3.14 OPENING TO TRAFFIC**

- A. Traffic shall not be allowed on the curb and gutter for a period of at least 7 days after placing or until the concrete has attained a compressive strength of at least 3,000 psi.

**END OF SECTION**

**SECTION 32 16 23**  
**CONCRETE SIDEWALKS AND DRIVEWAYS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Excavating
  - 2. Aggregate Base Course
  - 3. Sidewalk Construction
  - 4. Curb Ramp Construction
  - 5. Curb Ramp Detectable Warning Fields
  - 6. Driveway Construction

**1.02 REFERENCES**

- A. American Society for Testing and Materials (ASTM)
  - ASTM A185 Specification for Welded Steel Wire Fabric for Concrete Reinforcement.
  - ASTM C31 Making and Curing Concrete Test Specimens in the Field.
  - ASTM C33 Specification for Concrete Aggregate.
  - ASTM C39 Test for Compressive Strength of Cylindrical Concrete Specimens.
  - ASTM C94 Specification for Ready-Mixed Concrete.
  - ASTM C143 Test for Slump of Portland Cement Concrete.
  - ASTM C150 Specification for Portland Cement.
  - ASTM C172 Sampling Fresh Concrete.
  - ASTM C231 Test for Air Content of Freshly Mixed Concrete by the Pressure Method.
  - ASTM C1116 Standard specification for Fiber-Reinforced Concrete
  - ASTM C1315 Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
  - ASTM D1557 Test Methods for Moisture-Density Relations of Soils and Soils-Aggregate Mixtures Using 10-Lb. (4.54 Kg) Rammer and 18-In. (457 mm) Drop.
  - ASTM D1751 Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

- ASTM E329 Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.
- ASTM C618-15 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

B. American Concrete Institute (ACI)

- ACI 304 Measuring, Mixing, Transporting and Placing Concrete.
- ACI 305 Recommended Practice for Hot Weather Concreting
- ACI 306 Recommended Practice for Cold Weather Concreting
- ACI 347 Guide to Formwork for Concrete

C. American Association of State Highway and Transportation Officials (AASHTO)

- AASHTO M105 Standard Specification for Gray Iron Castings
- AASHTO M148 Curing Compounds

D. Americans with Disabilities Act (ADA)

Accommodations Guidelines

E. State of Wisconsin Department of Transportation (WisDOT)

1. WisDOT Standard Specifications for Highway and Structure Construction (“State Specifications”), current edition, and all supplemental and interim supplemental specifications, as they may pertain, with the exception of the following items which shall not apply:
  - a. Method of measurement and basis of payment.
  - b. Quality Management Program (QMP).
  - c. Incentive Programs.
2. Portland cement concrete shall comply and be furnished in accordance with:
  - a. WisDOT 501, Concrete

### 1.03 ALLOWANCES

- A. If so stated in the specification “Allowances”, installation testing will be paid as an allowance. All other testing will be incidental to the Work.
- B. If there is no reference in the specification section to “Allowances”, then testing costs will be incidental to other Work items.

## **1.04 SUBMITTALS**

- A. Action Submittals
  - 1. Current concrete design mix of composition and strength testing results for design mix for each type of concrete.
- B. Informational Submittals
  - 1. Results of all Quality Control testing.
  - 2. Daily load tickets of concrete placed.

## **1.05 QUALITY CONTROL**

- A. Employ an independent testing laboratory approved by the Owner to provide testing services as follows:
  - 1. Material Acceptance Testing:
    - a. Design mix.
  - 2. Installation Testing:
    - a. Slump.
    - b. Air-entrainment.
    - c. Compressive strength test.
  - 3. Additional Testing:
    - a. Perform under following circumstances:
      - (1) Material failure.
      - (2) Change in ready-mix source.
      - (3) Design mix changes requested by Contractor.
- B. The following shall be in accordance with the stated references:
  - 1. Inspection and Testing: ASTM E329.
  - 2. Sampling: ASTM C172.
  - 3. Slump: ASTM C143.
  - 4. Air-Entrainment: ASTM C231.

5. Compressive Strength Test: ASTM C31 and C39.
- C. Perform tests required by this section with the following frequency:
1. One tests daily or one per 100 cubic yards placed, whichever number is greater.
- D. Compressive strength test shall consist of four standard test cylinders made from a single batch of concrete:
1. Test one cylinder at 7 days.
  2. Test two cylinders at 28 days.
  3. Test remaining cylinder in the event prior tests fail.
  4. Compressive strength tests shall be considered satisfactory when 28-day tests meet the following:
    - a. Test results equal or exceed specified compressive strength.
    - b. No individual test falls more than 500 psi below specified compressive strength.
  5. Failure of compressive strength tests shall result in following additional testing:
    - a. Provide two core samples of each portion of work affected and perform compressive strength tests.
    - b. Replace work if core samples do not equal or exceed specified compressive strength.

## **PART 2 - PRODUCTS**

### **2.01 CONCRETE**

- A. Conform to ASTM C94 and the following:
1. All concrete shall be Grade A, air-entrained, in conformance with WisDOT Section 501.
  2. Seven-Day Compressive Strength: 3000 psi Minimum.
  3. Twenty-eight Day Compressive Strength: 4000 psi Minimum.
  4. Maximum Aggregate Size: 1½ inches.
  5. Air Content: 6 percent ± 1.5 percent.

- 6. Maximum Water-Cement Ratio: 0.44.
- 7. Slump:
  - a. Slip-Formed Concrete Pavement: 2.5 inches or less.
  - b. Not Slip-Formed with Surface Vibration Concrete Pavement: 1.5 to 4 inches.
  - c. Not Slip Formed with Internal Vibration: 1 to 3 inches
- B. Admixtures to lower freezing point of concrete are not permitted.

**2.02 CEMENT**

- A. Air-entrained concrete shall be prepared with Type I cement (ASTM C150).
- B. Air-entrained high-early strength concrete shall be prepared with Type IIIA cement (ASTM C150).

**2.03 AGGREGATES**

- A. Conform to ASTM C33.

**2.04 EXPANSION JOINT**

- A. Conform with ASTM D1751.
- B. Thickness: 1/2 inch.

**2.05 CURING MATERIALS**

- A. Linseed Oil (White Pigmented)
  - 1. Furnish liquid membrane-forming curing compounds composed of a blend of boiled linseed oil and high viscosity, heavy bodied linseed oil emulsified in a water solution conforming to AASHTO M 148, Type 2 Class B. Test material at an application rate of 1 gallon per 200 square feet.
  - 2. Waive drying time requirements. The chemical requirements (volumes are exclusive of added pigments) are as follows:

<u>Oil Phase (50+/-4% by volume)</u>	<u>(Percent By Mass)</u>
Boiled Linseed Oil	80
Z-8 Viscosity Linseed Oil	20
Water Phase (50 +/-4% by volume)	100

## **2.06 CRUSHED AGGREGATE BASE MATERIAL**

- A. Construct sidewalks and driveways on a layer of compacted base aggregate dense base course, placed to the thickness of:
  - 1. 4 inches for sidewalks, curb ramps and steps (excluding thickened sidewalk sections through driveways)
  - 2. 6 inches for driveways.
- B. Provide base material conforming:
  - 1. Use 1 ¼" crushed aggregate base course (Gradation No. 2).
  - 2. Aggregates shall consist of hard, durable particles of crushed stone or crushed gravel and a filler of natural sand, stone sand or other finely divided mineral matter.
  - 3. Remove oversize material by screening or by crushing to required sizes.
  - 4. Composite material shall be free from organic matter, shale, and lumps or balls of clay and shall conform to the gradation requirements below.

## **2.07 DETECTABLE WARNING FIELDS**

- A. Furnish warning field as listed within the WisDOT approved products list. Furnish warning fields with truncated domes and conforming to AASHTO M 105, Grade 30. Fields are to be provided in the lengths and widths shown on the Engineered Plans. Required field size may be achieved by use of segmented plate fields with all segments fastened to one another.
- B. Furnish warning field from the following manufacturer(s):
  - 1. Neenah Foundry Company
- C. Color: Provide warning field material in the following color:
  - 1. Natural Finish

## **PART 3 - EXECUTION**

### **3.01 PREPARING THE FOUNDATION**

- A. Prepare the foundation by excavating or filling to the required elevation of the subgrade. Tamp or compact the foundation to ensure stability. In cuts, make the foundation wide enough to allow placing forms and performing concrete placement and finishing. On embankments, construct the foundation at least 2 feet wider than the proposed concrete section and extend it at least one foot beyond each end of the concrete section.

- B. Unless specified otherwise, fill holes, ruts, and other depressions in the foundation with materials similar to those in the existing foundation. The contractor may use granular or aggregate base.
- C. Concrete driveway aprons are prohibited on roadways with a rural cross section.

### **3.02 PLACING AND GRADING BASE COURSE**

- A. Provide base material to the thickness specified within this Section.
- B. The subgrade shall be prepared by fine grading to the lines, grades, and cross-sections shown on the Engineered Plans.
- C. Compact to minimum 95 percent modified proctor density (ASTM D1557).
- D. Excess material shall be disposed of at a site provided by Contractor.

### **3.03 FORMS**

- A. Conform to ACI 347.
- B. Forms shall be of the size, shape, and depth to construct the sidewalk and driveway as required.
- C. Brace and tie together forms to maintain position and shape.
- D. Clean and coat forms with clear, non-staining mineral or paraffin base form oil prior to placement of concrete against forms.
- E. Surfaces in contact with concrete shall be free from frost, debris, and other deleterious material.
- F. Moisten the base prior to placement of concrete.
- G. Remove laitance and other unsound material before freshly placed concrete is placed against previously placed concrete.
- H. Protect concrete from damage until it has hardened sufficiently to resist damage.
- I. Sidewalk cross slope shall be 1.5% with a tolerance of 0.5%.

### **3.04 CONCRETE THICKNESS**

- A. Unless noted otherwise, furnish the following minimum thicknesses:
  - 1. Standard Sidewalks: 4 inches.
    - a. Sidewalks within driveways shall match the driveway thickness.

2. Curb Ramps: 6 inches.
3. Residential Driveway: 6 inches, or match existing, whichever is greater.
4. Commercial and Industrial Driveway: 7 inches, or match existing, whichever is greater.
5. Heavy Industrial Driveway: 9 inches, or match existing, whichever is greater.

### **3.05 SLIPFORM CONSTRUCTION – SIDEWALK**

- A. The use of slip form equipment will be acceptable.
- B. Coordinate the operations of mixing, delivering, and placing of the concrete to provide uniform progress with minimum stopping and starting of the sidewalk slip form machine.
- C. Slip form machine shall be capable of placing the specified sidewalk section with an adequate amount of vibration to preclude the possibility of honeycomb formation.
- D. Sidewalk cross slope shall be 1.5% with a tolerance of 0.5%.

### **3.06 ENVIRONMENTAL REQUIREMENTS**

- A. Hot Weather Concreting
  1. Follow ACI 305 whenever mean surrounding air temperature equals or exceeds 80°F (27°C).
  2. Do not place concrete whenever air temperature equals or exceeds 90°F (32°C).
- B. Cold Weather Concreting
  1. Follow ACI 306 and WisDOT Standard Specification Section 415.3.13 whenever mean surrounding air temperature is below 40°F (4.5°C).
- C. Do not place concrete during rain, sleet, or snow unless protection is provided.

### **3.07 PLACING CONCRETE**

- A. Conveying Concrete
  1. Convey concrete from mixer to place of final deposit by methods that will prevent separation or loss of materials.

2. Equipment for chuting, pumping, or pneumatically conveying concrete shall be capable of providing a supply of concrete at site of work without separation of ingredients and without interruptions sufficient to permit loss of plasticity between successive placements.

B. Depositing Concrete

1. Place concrete on prepared and moistened foundation in a single lift.
2. Deposit concrete as nearly as practicable to its final position to avoid segregation due to rehandling or flowing.
3. Carry on concreting at such a rate that concrete is at all times plastic, and flows readily into spaces between reinforcing.
4. Do not deposit concrete that has partially hardened or that has been contaminated by foreign materials.
5. Do not use retempered or remixed concrete.
6. After concreting is started, it shall be carried on as a continuous operation until placing a section is completed.
7. Thoroughly consolidate concrete by suitable means during placement, and thoroughly work concrete around reinforcement and embedded fixtures, and into corners of forms.

- C. Curb boxes located within concrete driveways shall have a 6" water valve box cover placed over the curb box.

### 3.08 CONTRACTION JOINTS

A. Locate in accordance with details and following criteria:

1. Through sidewalks at uniform intervals at a 5 foot typical spacing. Contraction joint spacing should typically match adjacent sidewalk sections.
2. Driveways: Place contraction joints parallel to curb line at 10 foot maximum spacing. Place contraction joints at right angles to the curb line at an 10 foot maximum spacing. Center joints to create symmetrical sections.
3. Joints shall not deviate more than five degrees from a right angle measured at intersecting joints or flatwork edge, and more than ½ inch from a straight line.

4. Contraction joints may be formed by tooled joints, sawed joints, or zip strips.
- B. Joint Dimensions
1. Depth:
    - a. Minimum 1 inch or one-fifth of slab depth whichever is greater.
  2. Width:
    - a. Minimum  $\frac{1}{8}$  inch for sawed joints,  $\frac{1}{4}$  inch for other types.
    - b. Maximum  $\frac{1}{4}$  inch for sawed joints,  $\frac{3}{8}$  inch for other types.

### **3.09 EXPANSION JOINTS**

- A. Install location and geometry of expansion joints as shown on the Engineered Plans or according to the following criteria:
1. At right angle or tee intersections.
  2. At sidewalk and stoop intersections.
  3. Where sidewalk and driveway adjoin vertical surfaces.
  4. Where sidewalk and driveway adjoin existing pavements.
  5. Maximum spacing 100 feet.
  6. Where miscellaneous structures impede sidewalk.
- B. Extend filler full width and depth of concrete, with top slightly below finished surface of concrete.

### **3.10 FINISHING**

- A. Strike off concrete to a true and even surface.
- B. Finish float and trowel surface smooth.
- C. Brush or lightly broom surface at right angles to traffic.

### **3.11 CURING**

- A. Start curing activities as soon as free water has disappeared from the surface of concrete after placing and finishing.

- B. Apply curing compound to all exposed surfaces by spraying a uniform coating in such a manner as to provide a continuous water impermeable surface. Apply in accordance with manufacturer's recommendations to limit loss of water to not more than 0.40 kg/m<sup>2</sup> in 72 hours.
- C. Maintain all exposed concrete surfaces moist for the first 7 days after placement
- D. Under hot weather conditions, conform to ACI 305.
- E. Under cold weather conditions, conform to ACI 306 and WisDOT Standard Specification Section 415.3.13.
- F. During curing period, protect concrete from damaging mechanical disturbances, water flow, loading, shock, and vibration.

### **3.12 EXISTING CONCRETE FLATWORK**

- A. When abutting to existing flatwork, provide the following:
  - 1. Saw cut existing concrete at construction limits.
  - 2. Install expansion joints between existing and new construction.

### **3.13 CURB RAMPS**

- A. Install curb ramps in the locations shown on the Engineered Plans.
- B. Provide ramp type, widths, cross slopes, running slopes and lengths as shown on the Engineered Plans.
- C. Install detectible warning fields to the orientation shown on the Engineered Plans for each ramp location. Install warning field plate in manner that all edges of the plate are flush with pavement.
- D. Ramps shall be constructed in accordance with current ADA and WisDOT requirements.

### **3.14 PROTECTION OF WORK**

- A. Place and maintain suitable barricades and, if necessary, provide personnel to keep traffic off the newly constructed pavement until pavement is opened for service. Protect the pavement against both public traffic and construction activities. Repair or replace pavement damaged by traffic or otherwise damaged before acceptance as the Engineer directs. Arrange to have available materials for protecting the unhardened concrete against rain damage.
- B. If rain is pending, cover unhardened concrete immediately with plastic or other approved material secured along pavement edges. Provide drainage as required to protect the work.

**3.15 OPENING TO TRAFFIC**

- A. Shall be in accordance with WisDOT Standard Specification Section 415.3.15.

**END OF SECTION**

**SECTION 32 17 23  
PAVEMENT MARKINGS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Epoxy
  - 2. Glass Beads
  - 3. Surface Preparation
  - 4. Application
  - 5. Protection of other Property
  - 6. Removing Pavement Markings

**1.02 REFERENCES**

- A. American Association of State Highway and Transportation Officials (AASHTO)
  - AASHTO M247 Standard Specification for Glass Beads Used in Pavement Markings
  - AASHTO M248 Ready-Mixed White and Yellow Traffic Paint

**1.03 ALLOWANCES**

- A. If so stated in the specification “Allowances”, installation testing will be paid as an allowance. All other testing will be incidental to the Work.
- B. If there is no reference in the specification section to “Allowances”, then testing costs will be incidental to other Work items.

**1.04 QUALITY ASSURANCE**

- A. The Contractor shall be experienced in this type of work and shall submit a statement of qualifications listing their experience when requested by the Engineer.

**1.05 SEQUENCING AND SCHEDULING**

- A. Schedule and coordinate pavement marking Work with other trades. Do not proceed with Work until all related Work necessary to complete the pavement marking is completed.

## **1.06 FIELD OR SITE CONDITIONS**

- A. Paint shall not be applied:
  - 1. When air temperature is below 40 degrees F.
  - 2. When air temperature is predicted to drop below 40 degrees F within 18 hours after application.
  - 3. When surfaces are too damp or moist.
  - 4. When relative humidity exceeds 85 percent or if the relative humidity is predicted to exceed 85 percent within 18 hours after application.

## **PART 2 - PRODUCTS**

### **2.01 EPOXY**

- A. General: Deliver materials to the job site unopened, in manufacturer's containers legibly marked with the contents, color, batch number, date manufactured, and manufacturer's name and address. Do not use material more than 1 1/2 years after its date of manufacture.
- B. Epoxy: Epoxy shall be fast cure. If Engineer requests, submit a certificate of compliance certifying that the epoxy supplied under the contract conforms to these specifications. Furnish epoxy from the following manufacturers:
  - 1. Sherwin-Williams
  - 2. Ennis Flint
  - 3. Poly Carb, Inc.
  - 4. Swarco

### **2.02 GLASS BEADS**

- A. Furnish dual coated glass beads treated for both moisture resistance and adherence conforming to AASHTO M247, Type I, except with a minimum of 80 percent true spheres. If Engineer requests, for each batch of beads actually furnished for the work, submit a certificate of compliance certifying that the beads supplied under the contract conform to these specifications. Furnish beads from the following manufacturers:
  - 1. Ennis-Flint
  - 2. Potters Industries

3. Hillcrest

**PART 3 - EXECUTION**

**3.01 PREPARATION OF SURFACES**

- A. Prepare the surface receiving marking to promote a good bond. Use equipment with a dust control system. Remove dust, dirt, oil, grease, loose paint, gravel, debris, or other materials and contaminants that might prevent bonding. Ensure that the surface is dry and free from frost, except the contractor may apply epoxy to damp pavement.
- B. Prepare concrete surfaces using brush-off blasting to remove curing compound, protective surface treatment on structures.
- C. Air blast or sweep milled asphaltic surfaces.

**3.02 EQUIPMENT**

- A. Epoxy: Use equipment that can spray both yellow and white material to produce uniform lines of the specified dimension. The equipment shall also be able to do the following:
  - 1. Apply lines both on the left and right sides, not necessarily simultaneously.
  - 2. Apply 2 lines simultaneously, with either line in a solid or intermittent pattern, in yellow or white.
- B. Glass Bead: The cycling mechanism used for applying lane skip lines shall produce uniform cycles. The equipment shall also have a device to register the daily-accumulated installed length for each gun. Use automatic, mechanical devices to apply glass beads to centerline, lane line, edgeline, and no-passing barrier line markings.

**3.03 APPLICATION**

- A. Delay application to:
  - 1. New concrete pavement for 28 days after pavement installation.
  - 2. Seal coated surfaces for at least 14 days after applying seal coat.
  - 3. New asphalt pavement for 7 days after pavement installation.

- B. For the initial application, apply epoxy uniformly across the line at or exceeding a wet film thickness as follows:
  - 1. 25 mils for seal coated surfaces, and epoxy overlay surfaces.
  - 2. 20 mils for asphalt or concrete rumble strip surfaces.
  - 3. 20 mils for tined or diamond ground concrete pavement surfaces.
  - 4. 15 mils for all other pavement surfaces.
  - 5. For subsequent applications, apply epoxy uniformly across the line at or exceeding wet film thickness of 16 mils for all pavement surfaces.
- C. Apply glass beads uniformly across the width of the line. For the initial application on new seal coat surfaces, apply at or exceeding 25.0 pounds per gallon of epoxy. For other pavement surfaces and subsequent applications on seal coat surfaces, apply at or exceeding 22.5 pounds per gallon of epoxy.
- D. Striping shall be installed according to the dimensions shown on the Engineered Plans.
  - 1. The Contractor is responsible for marking layout. If Contractor has regulatory concerns related to placement, widths, lengths, etc. as provided for on the Engineered Plans, coordinate with Engineer prior to installation of pavement marking in question.
- E. Finished markings shall be:
  - 1. Uniform in width.
  - 2. With sharp, well defined edges and ends.
  - 3. Straight, without waviness. Curves shall be smooth.
- F. Apply markings uniformly and smoothly so that no excess material collects at any point.
- G. Finished surface shall be free from streaks, pits, wrinkling, and other irregularities.
- H. Do not spray the paint when wind conditions preclude protecting adjacent work or property.

### **3.04 PROTECTION**

- A. Protect all adjacent work at all time during the striping. Upon completion, remove all paint spots from adjacent surfaces.
- B. Remove all debris generated by this work including but not limited to excess glass beads.

### **3.05 REMOVING PAVEMENT MARKINGS**

- A. Remove pavement markings from locations the Engineered Plans show or as the Engineer directs. Do not damage, discolor, leave a detrimental residue on the surface, or paint over existing markings. Provide a dust control system and remove accumulated sand or other materials.
- B. If blast cleaning within 10 feet of a lane open to public traffic, remove dust and other residue continuously while blast cleaning. Collect, haul, and dispose of dust or residue from removals. Repair damage caused by the Contractor's removal operations.

**END OF SECTION**



### **1.03 ALLOWANCES**

- A. If so stated in the specification “Allowances”, installation testing will be paid as an allowance. All other testing will be incidental to the Work.
- B. If there is no reference in the specification section to “Allowances”, then testing costs will be incidental to other Work items.

### **1.04 SUBMITTALS**

- A. Action Submittals
  - 1. Fertilizer
    - a. Furnish certification from supplier attesting to: Brand name, chemical analysis, and guarantee of analysis.
  - 2. Seed
    - a. Furnish certification of conformance with AOSA "Rules for Testing Seed" and attest to: Mix, age, weed content, purity, and germination.
- B. Informational Submittals
  - 1. Submit all tags from seed bags / containers.
  - 2. Submit two (2) full sets of manufacturer’s literature and installation instructions for each erosion mat product prior to installation.

### **1.05 QUALITY ASSURANCE**

- A. Test seed according to the methods and procedures used for sampling and analyzing seed for purity, germination, and noxious weed seed content specified in the current addition of the AOSA Rules for Testing Seed.

### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Store any seed delivered before use in a way that protects it from damage by heat, moisture, rodents, or other causes. Discard and replace any seed that becomes damaged.

## **PART 2 - PRODUCTS**

### **2.01 TOPSOIL**

- A. Imported Topsoil

1. Topsoil shall be Soil Class F-1 as required by these specifications. Furnish topsoil consisting of loam, sandy loam, silt loam, silty clay loam, or clay loam humus-bearing soils adapted to sustain plant life, and ensure this topsoil is in a pH range of 6.0 to 7.0.

B. Salvaged Topsoil

1. Topsoil salvaged from the project site may be used to restore lawn areas provided that the soil meets the requirements of paragraph A.1 above. If the volume of salvaged topsoil is not sufficient to restore all areas to the required depths, imported topsoil is required.

- C. Pulverize imported and salvaged topsoil completely breaking down all clods and lumps. The material shall be free of rocks, twigs and other foreign material. 100% of the material shall pass a one-inch sieve and at least 90% shall pass the No. 10 sieve (0.08 inch).

**2.02 SEED**

A. General Requirements

1. Conform to chapter ATCP 20 regarding noxious weed seed content and labeling.
2. Use seed within one year of the test date appearing on the label.

B. Lawn Type Turf

1. All lawn areas restored with topsoil, unless shown otherwise on Engineered Plans, shall be seeded with grass seed meeting the following requirements:

Species	Purity Minimum %	Germination Minimum %	Mixture Proportions in Percent
Kentucky Bluegrass	98	85	35
Red Fescue	97	85	20
Hard Fescue	97	85	20
Improved Fine Perennial Ryegrass	96	85	25

C. Steep Slope Areas Turf

1. All steep slope grass areas, except those areas where a lawn type turf is required and unless shown otherwise on the Engineered Plans, shall be seeded with grass seed meeting the following requirements:

Species	Purity Minimum %	Germination Minimum %	Mixture Proportions in Percent
Kentucky Bluegrass	98	85	6
Hard Fescue	97	85	24
Tall Fescue	92	85	40
Perennial Ryegrass	97	90	30

### 2.03 FERTILIZER

- A. Furnish fertilizers for seeding that are standard commercial packaged or bulk products in granular or liquid form conforming to ATCP Chapter 40.
- B. Each container of packaged fertilizer must be plainly marked with the analysis of the contents showing minimum percentages of total nitrogen, available phosphoric acid and soluble potash. Provide an invoice for each bulk material shipment indicating the minimum percentages of total nitrogen, available phosphoric acid and soluble potash in the contents.
- C. Furnish fertilizer meeting the following minimum requirements:
  - 1. Nitrogen, not less than 16%.
  - 2. Phosphoric Acid, not less than 6%.
  - 3. Potash, not less than 24%.
  - 4. The total of nitrogen, phosphoric acid and potash shall equal at least 50%.
  - 5. Fertilizer shall contain no phosphorus.

### 2.04 MULCH

- A. Mulch shall consist of straw or hay which are free of noxious weeds and other objectionable foreign matter.
- B. Mulch may be used on back slopes or fore slopes with low speed and low slope areas.

### 2.05 EROSION MAT

- A. Furnish erosion mat materials as specified within other sections of these specifications, within the current Wisconsin Erosion Control Product Acceptability List (PAL), and as indicated on the Engineered Plans.
- B. Erosion mat shall be used on ditch bottoms, and areas with steep slopes.

## **PART 3 - EXECUTION**

### **3.01 SITE PREPARATION**

- A. Grade subgrade to a uniform depth accommodating specified topsoil thicknesses in accordance with the following:
  - 1. Seeded Areas – Four (4) inches

### **3.02 TOPSOILING**

- A. After preparing and finishing the areas designated for topsoil to the required lines, grades, slopes and cross-sections, place and spread the topsoil to a uniform depth as follows:
  - 1. Seeded Areas – Four (4) inches settled
- B. Break down all clods and lumps using the appropriate equipment to provide a uniformly textured soil.
- C. Remove rocks, twigs, foreign material and clods that cannot be broken down. Dress the entire surface to present a uniform appearance.
- D. Topsoil shall not be compacted.
- E. Just before seeding, work the area being seeded with discs, harrows, or other appropriate equipment to obtain a reasonably even and loose seedbed.

### **3.03 SEEDING**

- A. Broadcast Seeding
  - 1. Utilize a machine or combination of machinery intended for seed sowing and which will produce the following:
    - a. Apply seed uniformly at the rate specified.
    - b. Cover seed with approximately ¼ inch of topsoil.
    - c. Roll lightly.
    - d. Apply seed at right angles to surface drainage.
  - 2. If broadcasting by hand, perform this work with satisfactory hand seeders and only when the air is calm enough to prevent seeds from blowing away.
- B. Hydroseeding

1. The hydroseeding machine shall have a built-in agitation system and operating capacity as sufficient to agitate, suspend and homogeneously mix a slurry containing seed, fertilizer, mulch and tackifier sufficient to meet or exceed minimum application rates. All materials shall be compatible with the hydroseeding process
2. During application, contain the hydroseeding mixture to within the required areas. Excessive overspray on sidewalks, roadways, private property, etc. shall be cleaned.

### **3.04 FERTILIZING**

- A. Uniformly apply the fertilizer selected for the seeding areas and incorporate into the soil by light discing or harrowing. If applying granular fertilizer, ensure it is well pulverized and free from lumps.
- B. If incorporating fertilizer into topsoiled areas, the contractor may apply it just before, and in conjunction with, final discing or harrowing, or if hand manipulating the topsoil, apply it just before final raking and leveling.
- C. If sowing seeding areas by hydroseeding, then fertilize by placing the required quantity of fertilizer in the tank, mixing with the water and the seed, agitating constantly, and apply during the seeding operation. If applying fertilizer this way then discing and harrowing after placement is not required.

### **3.05 APPLICATION RATES**

- A. Seeding
  1. Four (4) pounds per 1,000 square feet.
- B. Fertilizer
  1. Seven (7) pounds per 1,000 square feet.

### **3.06 MULCHING**

- A. Unless directed otherwise, place the mulch on the seed areas within two (2) days after completing the seeding. Place straw or hay uniformly over the area 1 to 1 ½ inches deep, using 2 to 3 tons of mulch per acre. Do not perform mulching during periods of excessively high winds that may prevent proper mulch coverage. Place the mulch loosely or open enough to allow some sunlight to penetrate and air to slowly circulate, but thick enough to shade the ground, conserve soil moisture, and prevent or reduce erosion. Maintain the mulched areas and repair all areas damaged by wind, erosion, traffic or other causes.
- B. Secure mulch by using one of the following methods:

1. Method "A":
  - a. Secure mulch with heavy twine or netting.
    - (1) Twine to be fastened with pegs or staples to form a grid of 6- to 10-foot spacing.
2. Method "B":
  - a. Immediately after spreading mulch, anchor in the soil by using a mulch crimper consisting of a series of dull, flat discs with notched edges. Equip the crimper with a ballast compartment to allow adjusting the weight for depth control.
  - b. Impress the mulch into the soil 1 ½ to 2 ½ inches deep in one pass of the crimper. Mulch crimpers are not to operate on steep slopes that may cause damage to the mulch, seedbed, or soil.

### **3.07 EROSION MAT**

- A. Install erosion mat over all areas with steep slopes and ditch bottoms.
- B. Install erosion mat materials within ditches and on side slopes greater than 10% as specified within other sections of these specifications and within the current Wisconsin Erosion Control Product Acceptability List (PAL).
- C. Install erosion mat materials as recommended by the product manufacturer(s) installation guidelines.

### **3.08 RESTORATION TIMETABLE**

- A. Weather permitting, seeding may be performed at any time during the growing season when soil conditions are suitable.
- B. All lawn restoration work in areas constructed during winter months shall be completed by May 15<sup>th</sup> of that year. All lawn restoration work in areas constructed after May 15<sup>th</sup> shall be completed in accordance with Paragraph A above.

### **3.09 MAINTENANCE AND MONITORING**

#### **A. Seeded Areas:**

1. Maintain all seeded areas performed under this contract, which includes the destroying of weeds within the seeded areas by cutting, or by other means, and preventing the weed plants from maturing to the bloom or flower stage. The term “weeds” as defined here shall constitute plant life other than those included within the seed mixture specified.
2. Maintain and monitor seeded areas upon initial seeding and throughout the Correction Period to ensure uniform and consistent growth of the specified seed, as determined by the Owner. Water seeded areas as required to establish proper growth. Fully established growth will be determined when average seed growth coverage is a consistent 85% of the seeded area with uniform density and color, is capable of resisting erosion, and growth is a minimum height of 3”.

- B. The cost of providing maintenance and monitoring will be considered incidental to other Work items within this section.

**END OF SECTION**

**SECTION 33 01 30.11**  
**TELEVISION INSPECTION OF SEWERS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Sewer Flow Control
  - 2. Sewer Line Cleaning
  - 3. Sewer Televising
  - 4. Documentation of Televising Results

**1.02 ALLOWANCES**

- A. If so stated in the specification “Allowances”, installation testing will be paid as an allowance. All other testing will be incidental to the Work.
- B. If there is no reference in the specification section to “Allowances”, then testing costs will be incidental to other Work items.

**1.03 SUBMITTALS**

- A. Action Submittals
  - 1. Provide one (1) copy of debris disposal dump tickets.
  - 2. Provide two (2) copies of television inspection logs and a PDF version.
  - 3. Provide two (2) copies of photographs and a PDF version.
  - 4. Provide two (2) copies of video recordings with an additional video identified as “back-up copy” of the video both on a flash drive.

**PART 2 - PRODUCTS**

**2.01 CLEANING EQUIPMENT**

- A. The equipment used for pipe cleaning shall be capable of removing dirt, grease, rocks, roots, and other deleterious materials without damaging the pipe system.
  - 1. Equipment may include high-velocity water jetting equipment, vacuum machines, hydraulically propelled equipment, or mechanically powered equipment.

2. Roots, large debris, and heavier deposits shall be removed with appropriate equipment.
- B. Mechanically operated cleaning equipment shall be of the movable dam type constructed in such a way that a portion of the dam may be collapsed at any time during the cleaning operation to protect against flooding of the pipe.
1. Sewer cleaning balls or other such equipment which cannot be collapsed instantly is not acceptable cleaning equipment.
  2. Provide the movable dam with equal diameter as the pipe being cleaned.
  3. Provide a flexible scraper around the outer periphery to insure total removal of grease.
- C. Truck mounted hydraulically propelled high velocity cleaning equipment.
1. Provide a minimum of 500 feet of  $\frac{3}{4}$  inch I.D. high pressure hose with a selection of two or more high velocity nozzles.
  2. Provide minimum 60 GPM nozzle capacity at a working pressure of 1000 to 2000 psi capable of producing a scouring action from  $15^\circ$  to  $45^\circ$  in all size pipe lines designated to be cleaned.
  3. Provide a high velocity gun adjustable from fine spray to narrow stream with a flow rate of  $3\frac{1}{2}$  to 27 GPM operating between 200 and 800 psi for washing and scouring manhole walls and floors.
  4. Provide a minimum 1500 gallon water tank capable of holding corrosive or caustic cleaning or sanitizing chemicals, if required by the Engineer, auxiliary engines and pumps, and hose reel.

## **2.02 TELEVISION EQUIPMENT**

- A. Provide self-propelled vehicle with cable equipment.
- B. Provide suitable mobile van or trailer enclosure for viewing closed circuit televising.
- C. Camera and reeled transmitting cable.
1. The television camera used for sewer inspection shall be specifically designed and constructed for such inspection.
  2. Provide camera capable of radial view for inspection of the top, bottom, and sides of pipe and for viewing up lateral connections.

3. Mount the camera on adjustable skids, or self-propelled, to keep it in the center of the pipe.
4. Provide high-intensity lighting, capable of lighting the entire periphery of the pipe at a distance of 5 feet, mounted on the camera capable of being dimmed or brightened remotely from the control panel.
5. The camera shall be operative in 100% humidity conditions and shall have a minimum of 650 lines of resolution and tested at 400 psi.
6. The view seen by the televising camera shall be transmitted to a monitor.
7. Provide camera, television monitor, and other components of the video system capable of producing a quality picture of the inside of the sewer.
8. Provide closed circuit transmitter, receiver station, video recorder with audio capability and TV monitor.
9. Provide Engineer's on-site use of televisions, video tape player and television monitor during inspection and for a reasonable time after televising has been completed (but not to exceed 21 days).
10. Still camera for photos from TV monitor.

### **PART 3 - EXECUTION**

#### **3.01 PREPARATION OF PIPELINE BEFORE TELEVISION**

##### **A. Flow Control**

1. Completely block off water or sewage from both upstream and downstream of section being televised providing bypass pumping, if necessary, to prevent sewage backup.
2. To effectively conduct cleaning and televising, provide flow control or pumping of sewage flows without backing up the sewer.
3. When sewer line flows are greater than 1/4 of the pipe diameter use one or more of the following methods of flow control.
  - a. Plugging or Blocking
    - (1) Insert a collapsible sewer line plug into the line at a manhole upstream from the section to be televised.
    - (2) During televising operation, flows shall be shut off or substantially reduced in order to either properly inspect the pipe.

- (3) After the televising, restore flows to normal.
  - b. Pumping and Bypassing
    - (1) Where pumping is required to adequately inspect the sewer by televising, provide pumping equipment, conduits, and other equipment necessary to bypass wastewater around the sewer section to be televised.
    - (2) Do not bypass wastewater to storm water drainage facilities or to surface.
  4. Stop any dewatering operations a sufficient time before televising to allow groundwater elevation to reach its normal level, but not less than 72 hours before televising.
- B. Sewer Cleaning
  1. Clean pipelines and manholes to be televised to degree to allow visual inspection of sewer interior.
  2. Thoroughly clean all sewer sections required to be televised removing dirt, grease, rocks, roots, and other deleterious materials.
  3. Clean sewer using hydraulically propelled high velocity cleaning equipment.
  4. Heavy mineral deposits, grease or roots, which cannot be removed by two passes with conventional cleaning nozzles, shall be removed by other heavy cleaning methods.
  5. At no time shall the jet nozzle be allowed to sit idle in the sewer section while water is being pumped through the nozzle.
  6. Ensure that the water pressure does not cause any damage or flooding to public or private property being served by the sewer section.
- C. Provide the following equipment and services:
  1. Traffic control signs, barricaded detours, flashers, follow MUTCD.
  2. Permits to work in public streets.
  3. Safety equipment including safety equipment for confined entry.
  4. Provide utilities required to perform the work such as water, electricity, etc.

D. Material Removal

1. Remove sludge, dirt, sand, rocks, roots, grease, and other solid or semi-solid material resulting from the cleaning operation at the downstream manhole of the sewer section being cleaned.
2. Dispose of removed material at a licensed site.

**3.02 SEWER TELEVISION**

- A. Move the television camera through the line in either direction at a uniform rate, stopping when necessary to insure proper documentation of the sewer's condition but in no case pull the television camera at a speed greater than 30 feet per minute.
- B. Provide telephone or other suitable means of communications between the two winches, the pulling unit, and the monitor control.
- C. Stop the camera at all defects and service connections and pan and tilt camera to obtain a clear picture of defect or service connection.
- D. Halt the camera and video record for a minimum of five seconds at each joint, lateral connection, leak, unusual condition, roots, collapsed sections, presence of scale or other defect.
- E. While video recording, provide an audio description of the line being televised, defects encountered, infiltration/inflow sources, etc.
- F. Provide manual winches, power winches, TV cable, and powered rewinds (or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions) to move the camera through the sewer line.
- G. Mount the camera such that it is level with the centerline of the sewer pipe.
- H. Provide a direct reading location meter, for accurately recording the location of the television camera with respect to the reference manhole, above ground, friction clamp device or other suitable equipment.
  1. Measure location of joints, connections or defects horizontal at the ground level by means of a target in front of the camera and a meter device accurate to 0.5 feet per 100 feet.
  2. The meter shall be capable of reducing readings for reverse movement of the camera and shall be capable of being manually rezoned for each new setup.

3. Check daily the accuracy of the measurement meter by use of a walking meter, roll-a-tape, or other suitable device.
  4. Footage measurements shall begin at the sewer line point of penetration of the upstream manhole.
  5. Footage shall be shown on the video data view and recorded at all times.
  6. Provide access to the Engineer to view the television screen during the process.
- I. Record on the audio system concurrently with the picture the following information:
1. Pipeline section being inspected designated by manhole numbers at each terminus of section.
  2. Date of survey.
  3. Type of pipe.
  4. Owner of pipeline.
  5. Name of televisor.
  6. Principal client.
  7. Description of defect with location.
- J. Superimpose on television image (and on tape) the following information:
1. Date.
  2. Section being televised.
  3. Footage from entering manhole.
- K. Produce still photographs from monitor of any defective section of the pipeline.

### **3.03 CORRECTION OF DAMAGE CAUSED BY TELEVISION OPERATIONS**

- A. Correct any damage to surfaces such as landscaping, pavement, sidewalks, roads, etc.
- B. Excavate and repair streets or property, to remove equipment lodged in sewers.
- C. Cleanup and/or provide restitution for damage caused to private property and sewer systems as a result of cleaning, televising or bypass pumping.

### 3.04 DOCUMENTING TELEVISION RESULTS

- A. Television Inspection Logs
  - 1. Provide typed or computer printed logs and acceptable to the Engineer.
  - 2. Printed location records shall clearly show the location, in relation to adjacent manholes of each infiltration point or defect discovered by the television camera.
  - 3. Provide an estimate of the flow rate of observed infiltration or inflow points.
  - 4. Provide record of other points of significance such as location of wyes or tees, joints, unusual conditions, roots, storm sewer connections, collapsed sections, presence of scale and corrosion, and other discernible features.
- B. Provide digital still or other standard color photographs taken during the video inspection.
- C. Digital Video Recordings.
  - 1. Provide recorded video of each sewer section in color as its own file/chapter in standard DVD format on an acceptable digital device.
  - 2. Alternately, digital video may be recorded onto a separate and external/portable digital hard drive that would be delivered to the Engineer/Owner as part of the submittal package.
  - 3. Provide video recording of a visual and audio record of the condition of the lines that may be replayed at a future date.
  - 4. Provide audio track (voice recording) with brief and informative comments on the sewer conditions.
  - 5. Upon completion of the work, submit all discs or hard drives recorded during the television inspection to the Engineer.
  - 6. Provide a back-up copy of the video to the Engineer.
- D. Digital Device Set-Up and Requirements.
  - 1. Provide finalized digital devices capable of being played on a computer in without the need for special software.
  - 2. A digital device can contain multiple sewer segments, but the entire length of any one sewer segment shall be on one device.

3. Provide each sewer section, designated as manhole to manhole, recorded in color indexed as a single chapter with chapter markers to allow easy selections of individual sections during playback.
- E. Digital video files shall include the following information:
1. Visual (on screen in corner):
    - a. Report number.
    - b. Date of television inspection.
    - c. Sewer section and number.
    - d. Current distance along reach (counter footage).
    - e. Printed labels on device with location information, date, format information and other descriptive information.
  2. Audio:
    - a. Date and time of television inspection, and the operator name.
    - b. Verbal confirmation of sewer section number and television direction in relation to direction of flow.
    - c. Verbal description of pipe size, type, and pipe joint length.
    - d. Verbal description and location of each pipe defect.
    - e. Type of weather during inspection.
  3. Television inspection report shall be typed or computer printed and shall include, but is not limited to, the following information:
    - a. Location of each point of leakage.
    - b. Location of any damaged sections, nature of damage, and location with respect to pipe axis.
    - c. Note any deflection (sags), offset joints, or obstructions.
    - d. Date, time, location, sewer section number, street name, reference manhole number (upstream and downstream), name of operator, inspector, and weather conditions.
    - e. Pipe diameter, pipe material, section length, depth of pipe, length between joints, and corresponding video identification.

- f. Direction of camera and direction of flow.
- g. A copy of the sewer service map used during the television inspection to identify the manhole numbering scheme used and any other pertinent data relevant to the televising operations.

**END OF SECTION**

**SECTION 33 05 05.30**  
**TESTING UTILITY PIPELINES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Hydrostatic Testing of Pressure Pipelines
  - 2. Low Pressure Air Testing
  - 3. Deflection Testing by Mandrel

**1.02 REFERENCES**

- A. American Society for Testing and Materials (ASTM)
  - ASTM D3034 Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
  - ASTM C828 Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Line.
  - ASTM F679S Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
  - ASTM C1244 Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.
  - ASTM C1107 Spec. for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
- B. American Water Works Association (AWWA)
  - AWWA C600 Installation of Ductile-Iron Water Mains and Their Appurtenances
  - AWWA C605 Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
  - AWWA C651 Disinfecting Water Mains
  - AWWA C906 Polyethylene (PE) Pressure Pipe and Fittings, 4 in. through 63 in., for Water Distribution and Transmission

**1.03 ALLOWANCES**

- A. If so stated in the specification “Allowances”, installation testing will be paid as an allowance. All other testing will be incidental to the Work.
- B. If there is no reference in the specification section to “Allowances”, then testing costs will be incidental to other Work items.

## 1.04 SUBMITTALS

### A. Informational Submittals

1. Field or Site Quality Control Submittals
  - a. Test reports and results.
  - b. Proposed method to correct deficiencies.
  - c. Record of deficiency repair method and location.

## PART 2 - PRODUCTS

### 2.01 EQUIPMENT

#### A. Hydrostatic Testing of Pressure Pipelines

1. Provide the pump, pipe connections, and all necessary apparatus for the pressure and leakage tests including gauges and metering devices.
2. Pressure gauges used for testing shall have no greater than 5 psi increment markings.

#### B. Low Pressure Air Test

1. Inflatable pipe plugs.
2. Bracing.
3. Compressor.
4. Hose and fittings.
5. Pressure gauge.

#### C. Deflection Test

1. Mandrel sizes shall be in accordance to the following:
  - a. PVC SDR 35 (ASTM D3034)

Pipe Size (Inches)	Mandrel Size (Inches)
8	7.28
10	9.08
12	10.79
15	13.20

b. PVC (ASTM F679)

Pipe Size (Inches)	Wall Thickness	Mandrel Size (Inches)
18	T-1A	16.13
18	T-2B	16.20
21	T-1A	19.00
21	T-2B	19.09
24	T-1A	21.36
24	T-2B	21.46
27	T-1A	24.06
27	T-2B	24.17

### PART 3 - EXECUTION

#### 3.01 PREPARATION

- A. Clean pipeline of any debris, soils, and construction material.
- B. Repair or replace piping, fittings, manholes, and other parts of the piping system that have visible defects or leakage before commencing tests, even though amount of leakage or pressure loss may be below the allowable limit.
- C. Provide traffic control and other safety equipment including confined space entry equipment, if required.

#### 3.02 HYDROSTATIC TESTING OF PRESSURE PIPELINES

- A. Provide hydrostatic pressure leakage tests in accordance to AWWA C600 as soon as possible after the pipe or section of pipe has been installed, concrete thrust blocking cured (min. 5 days), and the trench is completely backfilled.
- B. Provide hydrostatic pressure test at a pressure that is 1.5 times the normal operating pressure, but no more than the design pressure rating of the pipe and appurtenances.
- C. The test pressure shall not exceed the rated working pressure or differential pressure of the valves when the pressure boundary of the test section includes closed, resilient-seated gate valves or butterfly valves.
- D. Provide a tapping sleeve and valve assembly to the main and pressure test the assembly prior to making the tap.
  - 1. The required test pressure shall be determined in the same manner as for the pipe.
  - 2. The test is acceptable if there is no pressure drop in 165 minutes at test pressure.

- E. Slowly fill each segregated section of pipeline with water ensuring that all air is expelled.
1. The line shall stand full of water for at least twenty-four hours prior to testing to allow air to escape.
  2. If necessary, tap the main at points of highest elevation to expel air as the pipe is filled.
  3. Remove the corporation stops and plug the taps after successfully filling the pipeline and expelling all air.
- F. Apply the specified test pressure, measured at the point of lowest elevation, using a suitable pump connected to the pipe.
1. If the elevation of the high point of the pipeline being tested is such that the pressure during the testing will be below 85% of the required test pressure, then a separate test shall be performed on this section of pipeline.
  2. In lieu of a separate test, the test pressure measured at the lowest elevation may be increased, within the pressure rating of the pipeline material, such that the resulting pressure at the highest point exceeds 85% of the required test pressure.
  3. Conduct the test for at least two (2) hours at the required test pressure.
- G. Conduct a leakage test concurrently with the pressure test.
1. Leakage is the volume of water that is required to be supplied into the newly installed pipeline to maintain pressure within  $\pm 5$  psi of the test pressure after it is filled and purged of air.
  2. Measure the volume of water using a calibrated container or meter.
  3. Leakage shall not be greater than calculated by following equation:
 
$$L = \frac{SD\sqrt{P}}{148,000}$$

Where:

    - L = allowable leakage, in gallons per hour;
    - S = length of pipeline tested, in feet;
    - D = nominal diameter of pipe, in inches; and
    - P = average test pressure during pressure test in psi.
  4. If any leakage test discloses leakage greater than allowed by the above formula, then locate and repair defective material and perform pressure and leakage test until leakage is within specified allowance.

5. Any visible leaks shall be repaired regardless of amount of leakage.
6. Pressure Testing Against Existing Valves:
  - a. If the pressure test fails when pressure testing against an existing valve, investigate all possible sources of leaking.
  - b. After investigating all other possible sources of leaking and leakage testing still fails, the Engineer will make a determination whether or not the existing valve should be replaced.
  - c. If Engineer determines the valve should be replaced, Contractor shall replace valve:
    - (1) After the replacement of the valve, complete a pressure leakage test.
    - (2) If the pressure leakage test fails with the new valve installed, the Contractor shall further investigate the possible source of leaking and correct the leak.
    - (3) No compensation shall be made to the Contractor for removal and replacement of existing valve and box if the existing valve was not the cause of the leak.
    - (4) If the pressure leakage test passes due to the replacement of the existing valve, the Contractor shall be compensated for removal of the existing valve and installation of the new valve and box in accordance with the applicable contract bid item(s); or by change order if no bid items are provided.

### **3.03 LOW PRESSURE AIR TESTING**

- A. If approved by Engineer, low-pressure air test may be conducted in lieu of infiltration and ex-filtration tests.
- B. Preparation
  1. Install appurtenances including, but not limited to, wyes, tees, laterals, stubs, and structures prior to testing to ensure the system is being tested.
  2. Plug pipe outlets (including laterals) adequately to retain testing pressure.
  3. Visually inspect pipeline and repair visible defective joints and leaks.

C. Testing Procedure

1. Determine test time as follows:
  - a. Test times for pipeline segments with uniform pipe size shall be taken from test timetable list below.
  - b. Test times for pipeline segments longer than those shown and/or of non-uniform pipe size shall be calculated utilizing appropriate formulas in ASTM C828.
  - c. Provide low pressure air test in presence of Engineer.
  - d. Perform low pressure air test in accordance to ASTM C828.
  - e. Minimum specified time required for a 1.0 psig pressure drop from 3.5 psi to 2.5 psi for size and length of pipe indicated:

Pipe Dia, (in.)	Min. Time, (m:s)	Length for Min. Time, (ft)	Time for Longer Length, (s)	Specification Time for Length (L) Shown, (min:s)								
				100'	150'	200'	250'	300'	350'	400'	450'	
4	3:46	597	0.380*L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854*L	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520*L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24	
10	9:26	239	2.374*L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48	
12	11:20	199	3.418*L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38	
15	14:10	159	5.342*L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04	
18	17:00	133	7.694*L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41	

**3.04 DEFLECTION TESTING BY MANDREL**

- A. Perform deflection tests on PVC gravity pipeline.
- B. Pipe shall not exceed a deflection of 5%.
- C. Conduct test after final backfill has been in place a minimum of 30 days.
- D. Pull test mandrel without mechanical pulling devices.
- E. The pipeline will pass the test when the mandrel passes through the entire section of pipe between manholes or other structures in one pass pulled by hand without use of excessive force.

- F. Any section of pipeline failing to pass this test shall be repaired and retested.

**END OF SECTION**

**SECTION 33 05 07**  
**TRENCHLESS INSTALLATION OF UTILITY PIPING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Trenchless Installation of Carrier Pipe with Casing Pipe
  - 2. Trenchless Installation of Carrier Pipe without Casing Pipe

**1.02 REFERENCES**

- A. American Society for Testing and Materials
  - ASTM A36 Standard Specification for Carbon Structural Steel
  - ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
  - ASTM A139 Standard Specification for Electric-Fusion (Arc) - Welded Steel Pipe (NPS 4 and Over)
  - ASTM A193 Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
  - ASTM A240 Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
  - ASTM D149 Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
  - ASTM D638 Standard Test Method for Tensile Properties of Plastics
- B. American Welding Society
  - AWS D1.1 Structural Welding Code - Steel

**1.03 SUBMITTALS**

- A. Action Submittals
  - 1. Proposed installation methods and equipment along with plan to establish and maintain vertical and horizontal alignment.
  - 2. Shop drawings of casing spacers and proposed spacing.
- B. Informational Submittals

1. Submit certificate of compliance for steel casing pipe.
  2. Submit history of previous work completed of equivalent nature and scope.
  3. Submit qualification and experience statements of key personnel.
  4. Closeout Submittals
- C. Record Documentation of horizontal and vertical location of the installed casing pipe and carrier pipe.

#### **1.04 QUALITY ASSURANCE**

- A. Installer Qualifications
1. Company specializing in performing work of this Section with minimum five years documented experience.
    - a. Include projects of similar magnitude and conditions
    - b. Furnish list of references.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery and Acceptance Requirements
1. Accept system components on site in manufacturer's original containers or configuration.
  2. Inspect for damage.
- B. Storage and Handling Requirements
1. Provide temporary end caps and closures on piping and fittings maintaining in place until installation.
  2. Protect piping and jacking systems from entry of foreign materials and water by temporary covers, completing sections of work, and isolating parts of completed system.
  3. Use wooden shipping braces between layers of stacked pipe. Stack piping lengths no more than three layers high.
  4. Store field joint materials indoors in dry area in original shipping containers. Maintain storage temperature of 60 to 85 degrees F.
  5. Support casing and carrier pipes with nylon slings during handling.

## **PART 2 - PRODUCTS**

### **2.01 MATERIALS**

- A. Use pipe materials stated on Engineered Plans.
- B. Carrier Pipe
  - 1. Carrier Pipe Installed within Casing Pipe
    - a. Sanitary Sewer Gravity Pipe: Comply to appropriate Specification Section
    - b. Sanitary Sewer Force Main: Comply to appropriate Specification Section
      - (1) Restrained joint ductile iron pipe
      - (2) Restrained joint PVC pipe
      - (3) HDPE butt fused joint Pipe
    - c. Storm Sewer: Comply to appropriate Specification Section
    - d. Water Main: Comply to appropriate Specification Section
      - (1) Restrained joint ductile iron pipe
      - (2) Restrained joint PVC pipe
      - (3) HDPE butt fused joint pipe
  - 2. Carrier Pipe Installed without Casing Pipe
    - a. Sanitary Sewer Force Main: Comply to appropriate Specification Section
      - (1) Restrained joint ductile iron pipe
      - (2) Ball and socket joint ductile iron pipe
      - (3) Restrained joint PVC pipe
      - (4) HDPE butt fused joint pipe
    - b. Water Main: Comply to appropriate Specification Section
      - (1) Restrained joint ductile iron pipe

- (2) Ball and socket joint ductile iron pipe
- (3) Restrained joint PVC pipe
- (4) Thermal butt fused HDPE pipe

C. Casing Pipe

- 1. Provide steel casing pipe.
  - a. Use only new, steel pipe meeting the requirements of ASTM A139, Grade B; ASTM A53, Grade B.
  - b. Pipe may be welded or seamless.
  - c. Shall be manufactured in the U.S.A.
  - d. Provide minimum pipe diameter as shown on the Engineered Plans.
  - e. Provide pipe with minimum wall thickness in accordance with the following:
    - (1) Under roadways and other facilities:

Nominal Pipe Diameter (inches)	Nominal Wall Thickness (inches)
Under 14	0.282
14 and 16	0.282
18	0.312
20	0.344
24	0.406
26	0.438
30	0.469
32	0.500
36	0.532
42	0.563

Nominal Pipe Diameter (inches)	Nominal Wall Thickness (inches)
12" or less	¼" (0.2500")
Over 12" to 18"	5/16" (0.3125")
Over 18" to 22"	3/8" (0.3750")
Over 22" to 28"	7/16" (0.4375")
Over 28" to 34"	½" (0.5000")
Over 34" to 42"	9/16" (0.5625")
Over 42" to 48"	5/8" (0.6250")

2. Steel Pipe Joints

- a. Comply with SWS D1.1
- b. Weld joints full circumference with full penetrating weld.

D. Casing Spacers

1. Provide manufactured casing spacers to position carrier pipe in casing. Do not use wood skids.
2. Provide casing spacers meeting the following material requirements:
  - a. HDPE band/panel and riser meeting the requirements of ASTM D638.
  - b. Stainless steel or carbon steel band/panel and riser meeting the requirements of type 304 stainless steel according to ASTM A240 or carbon steel according to ASTM A36.
    - (1) Provide elastomeric PVC liner per ASTM D149.
    - (2) Provide abrasion resistant polymer spacer skid/runner with low coefficient of friction.
    - (3) Provide type 304 (18-8) stainless steel fasteners per ASTM A193.

E. Casing Pipe Annular Space Backfill Material

1. Provide M50 Grade Silica Sand Material.

F. Casing End Seal – Provide one of the following:

1. Minimum 1/8 inch thick manufactured synthetic rubber casing end seal with stainless steel bands and fasteners.
2. One of the following mortar mixes with minimum water to provide workable mixture:
  - a. Grout Mix No. 1: 1 part Portland cement, 1/4 part hydrated lime, 3 3/4 parts mortar sand (maximum).
  - b. Grout Mix No. 2: 1 part Portland cement, 1 part masonry cement, 6 parts mortar sand (maximum).
- G. Pressure Grout Mix: One part Portland cement and six parts mortar sand mixed with water to consistency for pressure grouting.
- H. Controlled Low Strength Materials (CLSM)
  1. Approximate quantities per cubic yard:
    - a. Cement: 50 pounds
    - b. Fly Ash: 250 pounds
    - c. Fine aggregate: 2,910 pounds
    - d. Water: 60 gallons
  2. A compressive strength of at least 50 psi at 28 calendar days.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verification of Conditions
  1. Verify connection to existing piping system size, location, and invert elevations are in accordance with the Engineered Plans.
  2. Verify existing conditions before starting work.

### **3.02 PREPARATION**

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities indicated to remain from damage.
- C. Notify and coordinate with utility company to remove and relocate utilities stated on Engineered Plans for removal or relocation.

- D. Protect plant life, lawns, rock outcroppings and other features remaining as portion of final landscaping.
- E. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- F. Establish minimum separation from other utility piping in accordance with the Specifications for piping type.

### **3.03 INSTALLATION**

- A. Pit or Approach Trench Excavation
  - 1. Excavate trenches in accordance to appropriate Specification Section
  - 2. Ensure casing entrance face is perpendicular to alignment.
  - 3. Excavate the minimum size pits necessary to safely and properly perform the work.
  - 4. Provide shoring, if conditions require.
  - 5. Provide dewatering, if conditions require.
- B. Trenchless Installation
  - 1. Select a method of installation appropriate for the soil conditions anticipated and will 1) allow the pipe to be installed to the desired line and grade within the specified tolerances; 2) prevent heaving or settlement of the ground surface or damage to nearby facilities; and 3) prevent damage to the carrier pipe and any lining materials within the carrier pipe.
  - 2. Installation Methods:
    - a. Auger Boring: A method that utilizes a rotating cutting head to form the bore hole and a series of rotating augers inside a casing pipe to remove the spoil.
    - b. Directional Drilling: A method for installing pipe from a surface-launched drilling rig. A pilot bore is formed and then enlarged by back reaming and removing the spoil material. The pipe is then pulled in place.
    - c. Open-ended Pipe Ramming: A method that involves driving a steel casing pipe with a percussive hammer. The front end of the casing pipe is open-ended. Spoils are removed from the pipe.

- d. Pipe Jacking: A method in which pipe is pushed into the ground with hydraulic jacks while soil is simultaneously excavated. Excavation is normally completed with a tunnel boring machine.

3. Line and Grade:

- a. Install pipe at line and grade that will allow the carrier pipe to be installed at its true starting elevation and grade within the specified maximum alignment deviation of the pipe centerline.

- b. When no deviation tolerances are specified, apply the following maximum deviations to the carrier pipe.

- (1) Gravity Pipe:

- i) Horizontally: plus or minus 1.0 foot per 100 feet;
- ii) Vertically: plus or minus 0.2 feet up to 100 feet; an additional plus or minus 0.1 foot per 100 feet thereafter. Backfall in pipe is not allowed.

- (2) Pressurized Pipe:

- i) Horizontally:  $\pm 2.0$  feet
- ii) Vertically:  $\pm 1.0$  foot. Maintain the minimum depth specified.

- c. Greater deviation or interference with other identified facilities may be cause for rejection.

- d. Check line and grade at every grade change and at least every 50 feet.

4. Deviation from Line and Grade:

- a. Provided adequate clearance remains for proper installation of the carrier pipe, the Contractor will be allowed to correct deviations in grade of a casing pipe in order to achieve design grade of the carrier pipe by:

- (1) Pouring an invert in the casing pipe, or

- (2) Shimming the carrier pipe with casing spacers to a uniform grade.

- b. The Engineer may reject installations deviating from the specified tolerances that cannot be adjusted to conform to the specified tolerances. If nonconforming installation is not rejected, provide all additional fittings, manholes, or appurtenances needed to accommodate horizontal or vertical misalignment, at no additional cost to the Owner.
    - c. Abandon rejected installation and place CLSM materials, at no additional cost to the Owner. Replace abandoned installations, including all additional fittings, manholes, or appurtenances required to replace rejected installations.
- C. Casing Pipe or Un-cased Carrier Pipe Installation:
  - 1. Install pipe by approved methods.
  - 2. Use a jacking collar, timbers, and other means as necessary to protect the driven end of the pipe from damage.
  - 3. Do not exceed the compressive or tensile strength capacity of the pipe during pushing or pulling operations.
  - 4. Bore head shall not extend beyond the casing pipe.
  - 5. Fully support bore hole at all times to prevent collapse. Insert pipe as soil is removed, or support bore with drilling fluid.
  - 6. Fully weld all casing pipe joints.
  - 7. Fill space between the inside of the bore hole and the outside of the pipe with pressure grout mix material if the space is greater than 1 inch.
- D. Carrier Pipe Installation through Casing:
  - 1. Clean dirt and debris from the interior of the casing pipe after installation.
  - 2. Install casing spacers on carrier pipe sections as necessary to support the pipe barrel according to the pipe manufacturer's recommendations subject to the following minimum requirements:
    - a. Install a spacer within 1 foot of each side of the carrier pipe joint and at a maximum spacing of 6 feet.
    - b. Do not allow the pipe to be supported by joint bells.
    - c. Lubricate casing spacers with drilling mud or flax soap. Do not use petroleum-based lubricants or oils.

3. Ensure that thrust loads will not damage carrier pipe joints. Provide thrust collars between joint shoulders of concrete pipe.
4. Provide timbers for sufficient cushioning between the end of the pipe pushed and the jacking equipment to prevent damage to the pipe. Do not allow the steel jack face to thrust against the unprotected pipe end.
5. Position jacks so the resulting force is applied evenly to the entire end of the pipe.
6. Assemble pipe joints in the jacking pit before pushing the carrier pipe into the casing.
7. Fill annular space between casing pipe and carrier pipe with silica sand material.
8. Close the end of the casing pipe around the carrier pipe with a casing end seal.

#### **3.04 PIT RESTORATION**

- A. Remove installation equipment and unused materials from the launching and receiving pits.
- B. When the carrier pipe extends beyond the limits of trenchless installation and into the bore pit, place bedding and backfill material according to appropriate Specification Section
- C. Place suitable backfill material in the pit. Apply the testing requirements of appropriate Specification Section.
- D. Restore the site to original condition or better.

**END OF SECTION**

**SECTION 33 05 27**  
**CORRUGATED METAL UTILITY PIPE**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Circular corrugated steel pipe.
  - 2. Arch-pipe corrugated steel pipe.
  - 3. Flared end sections.
- B. The products described are not installed under this Section.

**1.02 REFERENCES**

- A. American Society for Testing and Materials (ASTM)
  - ASTM A760 Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains.
- B. American Association of State Highway and Transportation Officials (AASHTO)
  - AASHTO M36 Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains.
  - AASHTO M190 Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches
  - AASHTO M 274 Standard Specification for Steel Sheet, Aluminum-Coated (Type 2), for Corrugated Steel Pipe

**1.03 SUBMITTALS**

- A. Action Submittals
  - 1. Shop Drawings
    - a. Submit shop drawings for sectional plate pipe, sectional plate arches, or sectional plate pipe arches.
    - b. Include shop detail, erection, and other drawings showing dimensions, sizes of material, details, and other information necessary for the complete fabrication and erection of the metal work.

B. Informational Submittals

1. Certificates
  - a. Submit manufacturer's certification that materials delivered comply with the requirements of this section and the referenced standard.
2. Manufacturers' Instructions
  - a. Submit recommendations for installation of pipe and fittings.

**1.04 QUALITY ASSURANCE**

A. Certifications

1. Provide manufacturer's certification that samples representing each lot have been tested and inspected in accordance with ASTM A760/AASHTO M36 and have been found to meet the requirements for material required per this Specification Section.

**1.05 DELIVERY, STORAGE, AND HANDLING**

A. Delivery and Acceptance Requirements

1. Package pipe and fittings to prevent damage during shipping.
2. Fittings shall be on pallets.
3. Use lifts for loading or unloading to avoid shock.
4. Do not drop materials.
5. Do not drag pipe or strike with hard objects which could scratch coatings.
6. Inspect pipe and pipe fittings when delivered to the site and prior to installation.
7. Reject pipe for any of the following:
  - a. Uneven laps.
  - b. Variation from a straight centerline of more than ½ inch.
  - c. Ragged or diagonal sheared edges.
  - d. Loose bolts or rivets.
  - e. Fasteners which are unevenly lined.

- f. Poorly formed seams.
- g. Illegible brand marking.
- h. Dents or bends in the metal.
- i. Elliptical shape on round pipe.
  - (1) The average inside diameter of the pipe shall not vary more than ½ inch or 1 percent, whichever is greater.
  - (2) Measure on the inside crest of the corrugations.
  - (3) Clearly mark rejected pipe as "REJECTED" with OSHA white or pink paint.

**B. Storage and Handling Requirements**

- 1. Provide safe storage for material.
- 2. Store materials to keep free from dirt and foreign matter.
- 3. Store fittings in a manner that will allow drainage and protect from freezing.

**PART 2 - PRODUCTS**

**2.01 MATERIALS**

- A. All products shall be manufactured in the U.S.A.
- B. Corrugated metal utility pipe may only be used for driveway culverts. Roadway cross culverts shall be reinforced concrete pipe.
- C. Pipe Material
  - 1. Mark each piece of pipe as follows:
    - a. Manufacturer's name or trademark.
    - b. Date of manufacture.
    - c. Pipe size.
  - 2. Corrugated steel pipe material, manufactured and fabricated in accordance with AASHTO M 274 or ASTM A929.
  - 3. Metallic Coating - Aluminum Type 2.

4. Circular pipe shall be Type I.
  5. Arch pipe shall be Type II.
  6. Perforated pipe shall be Type III, Class 1.
  7. Corrugation size 2-<sup>2</sup>/<sub>3</sub>" x 1/2" for pipe sizes 12" diameter through 84" diameter.
  8. Material sheet thickness:
    - a. 6" diameter - .052 inches
    - b. 8" diameter to 24" diameter - .064 inches
    - c. 30" diameter to 36" diameter - .079 inches
    - d. 42" diameter to 54" diameter - 0.109 inches
    - e. 60" diameter to 72" diameter - 0.138 inches
    - f. 78" diameter to 96" diameter - 0.168 inches
  9. Flared end sections shall meet the same requirements as the connecting pipe.
- B. Gaskets
1. Band of expanded rubber in accordance with ASTM A760/AASHTO M36.
- C. Band Connectors
1. Corrugations to match the pipe sections in accordance with ASTM A760/AASHTO M36.

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 33 05 31**  
**THERMOPLASTIC UTILITY PIPE**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Polyvinyl Chloride (PVC) Gravity Sewer Pipe
  - 2. Polyvinyl Chloride (PVC) Pressure Pipe (AWWA C900 CIPS)
  - 3. Thrust Restrained Joint Polyvinyl Chloride (PVC) Pressure Pipe for Trenchless Construction
- B. The products described are not installed under this Section.

**1.02 REFERENCES**

- A. American Society for Testing and Materials (ASTM)
  - ASTM D1784 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
  - ASTM D1785 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
  - ASTM D2241 Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
  - ASTM D2466 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
  - ASTM D2467 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
  - ASTM D2564 Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
  - ASTM D2665 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
  - ASTM D2672 Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement
  - ASTM D2855 Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets
  - ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

ASTM D3139	Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F679	Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fitting
ASTM F1336	Standard Specification for Poly (Vinyl Chloride) (PVC) Gasketed Sewer Fittings
ASTM F1866	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Schedule 40 Drainage and DWV Fabricated Fittings

B. American Water Works Association (AWWA)

AWWA C104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
AWWA C110	Ductile-Iron and Gray-Iron Fittings
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C153	Ductile-Iron Compact Fittings
AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)

### 1.03 SUBMITTALS

A. Action Submittals

1. Product Data
  - a. Provide product data sheets for all pipe and fittings.

B. Informational Submittals

1. Certificates
  - a. Certification of production date of all materials.
  - b. Manufacturer's certification that the materials delivered were manufactured, sampled, tested, and inspected in accordance with this specification and appropriate referenced standards.
2. Manufacturers' Instructions
  - a. Manufacturer's recommendations for assembly and installation.

### 1.04 QUALITY ASSURANCE

A. Certifications

1. Provide manufacturer's certification that materials delivered comply with the requirements of this section and the referenced standard.

## **1.05 DELIVERY, STORAGE, AND HANDLING**

### **A. Delivery and Acceptance Requirements**

1. Pipe shall be available to Engineer for inspection.
2. Inspect the pipe shipment to identify shifted loads, broken packaging or rough treatment, which could be an indication of damage.
3. Upon delivery insure that each pipe is clearly marked with the following information:
  - a. Manufacturer's name, trademark or logo.
  - b. Nominal size.
  - c. PVC cell classification.
  - d. Pipe stiffness designation, dimension ratio or schedule size and pressure class.
  - e. ASTM or AWWA specification designation.
  - f. National Sanitation Foundation approval (pipe for potable water).
  - g. Production date.
4. Reject pipe not clearly marked with the above information.
5. Reject damaged pipe.
6. Reject pipe if any of the following is identified:
  - a. Pitted or cratered.
  - b. Flaking.
  - c. Straightness varies more than ½ inch in 10 feet.
  - d. Any defect which prevents assembly according to manufacturer's recommendations.
  - e. Not utilized within one year of date of production.

B. Storage and Handling Requirements

1. Unload the pipe in a manner which will not put stress on the pipe or strike anything causing damage.
2. Place and store the pipe package units on level ground stacked no more than 8 feet high. Do not store close to heat sources.
3. Store gaskets away from excessive exposure to heat, direct sunlight, ozone, oil or grease.
4. Store solvent cement in tightly sealed containers away from excessive heat.
5. Handle pipe in a manner to prevent impact blows, abrasion damage, gouging or cutting.
6. When handling pipe in cold weather, provide additional care to prevent damage due to impact. Impact strength is reduced in cold weather.

**PART 2 - PRODUCTS**

**2.01 POLYVINYL CHLORIDE (PVC) GRAVITY SEWER PIPE MATERIALS**

A. Mainline Gravity Sewer Pipe

1. Pipe, fittings and repair couplings shall be manufactured and tested in accordance with the following standards:
  - a. Sizes 8 inch through 15 inch and depths up to 25 feet: ASTM D3034, PSM SDR-35 PVC.
  - b. Sizes 8 inch through 15 inch and depths greater than 25 feet: ASTM D3034, PSM SDR-26 PVC.
  - c. Sizes 18 inch through 48 inch and depths up to 25 feet: ASTM F679, PS46 PVC, T-1 minimum cell classification. Only acceptable for use as sanitary sewer. Storm sewer over 15 inch shall be RCP.
2. Elastomeric Gaskets: Conform to ASTM F477
3. Elastomeric Joints: Conform to ASTM D3212
4. Solvent Weld Joints: Not permitted.
5. Repair Couplings
  - a. Repair couplings for PVC SDR-35 pipe to PVC SDR-35 pipe shall

comply with ASTM 3034, PSM SDR-35 PVC and gasketed joints complying with ASTM F1336 with stops.

- b. Repair couplings for transition between ABS composite pipe and PVC shall be Fernco eccentric couplings with stainless steel shear rings, bands, nuts and housings.

**B. Sewer Services**

- 1. Manufactured and tested in accordance with ASTM D2665.
- 2. Fittings to conform to ASTM F1866.
- 3. Pipe for sizes 4-inch and 6-inch: Schedule 40
- 4. Solvent Weld Joints: ASTM D2672
- 5. Solvent Cements: ASTM D2564
- 6. Make joints in accordance with ASTM D2855.

**2.02 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE (AWWA C900 CIPS)**

- A. Pipe shall conform to AWWA C900 pressure class 235 psi, thickness class DR 18.
- B. Elastomeric gaskets shall be manufactured in conformance to ASTM F477.
- C. Joints shall conform to ASTM D3139
- D. Fittings
  - 1. Ductile Iron Fittings
    - a. Compact ductile iron mechanical joint conforming to AWWA C153 and A21.10.
    - b. Cement mortar lined conforming to AWWA C104.
    - c. Rubber gasket joints conforming to AWWA C111 and A21.11.
    - d. Tee-head bolts and hexagonal nuts shall be 304 stainless steel with an anti-seize mechanism.
    - e. All reducers shall be concentric.

**2.03 THRUST RESTRAINED JOINT PVC PRESSURE PIPE FOR TRENCHLESS CONSTRUCTION**

- A. Pipe shall conform to AWWA C900 pressure class 235 psi, thickness class DR 18.
- B. Provide twin elastomeric gaskets manufactured in conformance to ASTM F477.
- C. Design joints to be used with non-metallic couplings with high-strength flexible thermoplastic splines inserted into mating precision-machined grooves in the pipe and coupling to provide full 360 degree restraint.
- D. Fittings shall be ductile iron as specified above.

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 33 05 33.23  
POLYETHYLENE PRESSURE PIPE AND TUBING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Polyethylene Pressure Pipe 4 Inch and Larger Pipe
  - 2. Polyethylene Pressure Pipe 3 Inch and Smaller Pipe and Tubing
- B. The products described are not installed under this Section.

**1.02 REFERENCES**

- A. American Society for Testing and Materials (ASTM)
  - ASTM D638 Standard Test Method for Tensile Properties of Plastics
  - ASTM D1238 Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
  - ASTM D1505 Standard Test Method for Density of Plastics by the Density-Gradient Technique
  - ASTM D1598 Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
  - ASTM D1599 Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fitting
  - ASTM D2122 Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
  - ASTM D2290 Standard Test Method for Apparent Hoop Tensile Strength of Plastic or Reinforced Plastic Pipe
  - ASTM D2837 Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
  - ASTM D3261 Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
  - ASTM D3350 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
  - ASTM F2206 Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE)
  - ASTM F2880 Standard Specification for Lap-Joint Type Flange Adapters for Polyethylene Pressure Pipe in Nominal Pipe Sizes 3/4 in. to 65 in.

- B. American Water Works Association (AWWA)
  - AWWA C901 Polyethylene (PE) Pressure Pipe and Tubing, 3/4 In. (19 mm) Through 3 In. (76 mm), for Water Service
  - AWWA C906 Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. (100 mm Through 1,650 mm), for Waterworks

### **1.03 SUBMITTALS**

- A. Action Submittals
  - 1. Product Data
    - a. Provide product data sheets for all pipe and fittings.
- B. Informational Submittals
  - 1. Certificates
    - a. Certification of production date of all materials.
    - b. Manufacturer's certification that the materials delivered were manufactured, sampled, tested, and inspected in accordance with this specification and appropriate referenced standards.
- C. Manufacturers' Instructions
  - 1. Manufacturer's recommendations for assembly and installation.

### **1.04 QUALITY ASSURANCE**

- A. Certifications
  - 1. Provide manufacturer's certification that materials delivered comply with the requirements of this section and the referenced standard.

### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery and Acceptance Requirements
  - 1. Upon delivery inspect pipe and fittings for damage, cracks, holes, or foreign inclusions.
  - 2. Check date of production to verify the pipe will be installed within one year of date of production.
  - 3. Reject damaged pipe material and pipe not installed within one year of date of production.

B. Storage and Handling Requirements

1. Store pipe and accessories on flat level ground with no rocks or other objects under the pipe.

**PART 2 - PRODUCTS**

**2.01 POLYETHYLENE PRESSURE PIPE MATERIALS 4 INCH AND LARGER**

A. Pipe shall be high density polyethylene (HDPE) meeting the requirements of AWWA C906 standards.

1. Materials used for the manufacture of the HDPE pipe shall be made from a PE 4710 resin compound conforming to ASTM D3350 minimum Cell classification 445574C.
2. HDPE pipe shall be rated for use at a pressure class of 200 psi (DR 11) unless otherwise shown on the Engineered Plans or stated in the Bid Schedule.
3. Pipe shall be ductile iron pipe outside diameter.
4. Pipe shall be installed within one year of the production date.

B. Fittings

1. Butt Fusion Fittings

- a. Molded and fabricated fittings shall be high density polyethylene (HDPE) meeting the requirements of AWWA C906 standards.
- b. HDPE fittings shall be made of the same materials and at the same pressure class as the pipe.
  - (1) Molded fittings shall be manufactured, tested and marked in accordance to ASTM D3261.
  - (2) Fabricated fittings shall be manufactured, tested and marked in accordance to ASTM F2206.

2. Flanges and Mechanical Joint (MJ) Adapters

- a. Flanges and mechanical joint adapters shall be made of the same materials and at the same pressure class as the pipe.
- b. Flanges shall be made in accordance to ASTM F2880.
- c. Mechanical joint adapters shall be made in accordance to ASTM D3261

- d. Mechanical joint adapters shall be used to connect valves and other pipe unless stated otherwise on the Engineered Plans.
  - e. Markings for molded or machined flange adaptors or mechanical joint adaptors shall be per ASTM D3261.
3. Transition from HDPE to Ductile Iron Pipe or PVC Pipe
- a. Provide a molded flange connector adapter with a ductile iron back-up flange for making a flange to flange connection. If the connecting pipe is plain end then use an EBAA Iron Inc. Megaflange 2100 Restrained Flange Adaptor on the connecting pipe.
  - b. For buried connections use a mechanical joint connection adaptor with a mechanical joint flange backup connecting to a mechanical joint pipe ductile iron pipe and when connecting to a plain end PVC pipe provide an EBAA Iron Inc. use the series 15PF00 for Restraint for C900 PVC Pipe.
    - (1) Provide extended T-bolts for the connection.
    - (2) Provide stainless steel stiffener inserted in the pipe.
4. Provide transition joint pipe restrains at all joints within the following distances of the transition joint:
- a. 6" diameter pipe - 15 linear feet.
  - b. 8" diameter pipe - 19 linear feet.
  - c. 10" diameter pipe - 24 linear feet.
  - d. 12" diameter pipe - 28 linear feet.
  - e. 14" diameter pipe - 33 linear feet.
  - f. 16" diameter pipe - 36 linear feet.

C. Pipe and Fitting Identification

- 1. The pipe shall be marked in accordance to the standards to which it is manufactured and as follows:
  - a. Nominal size
  - b. Outside diameter base of ductile iron pipe sizes.
  - c. Dimension ratio

- d. Manufacturer's name or trademark
  - e. Standard materials designation code
  - f. Cell classification
  - g. Pressure class
  - h. Standard's designation (AWWA C906)
  - i. Manufacturer's production code
  - j. Date of Manufacture
  - k. Mark of certifying agency for potable water (NSF)
2. Color identification by use of stripes on pipe to identify pipe service.
- a. Blue for potable water.
  - b. Green for sewer.

## **2.02 POLYETHYLENE PRESSURE PIPE MATERIALS 3 INCH AND SMALLER**

- A. Pipe shall be high density polyethylene (HDPE) meeting the requirements of AWWA C901 standards.
- 1. Materials used for the manufacture of the HDPE pipe shall be made from a PE 4710 resin compound conforming to ASTM D3350 minimum Cell classification 445574C.
  - 2. HDPE pipe shall be rated for use at a pressure class of 250 psi (DR 9) unless otherwise shown on the Engineered Plans or stated in the Bid Schedule.
  - 3. Pipe shall be iron pipe size outside diameter.
  - 4. Pipe shall be installed within one year of the production date.
- B. Fittings
- 1. Butt Fusion Fittings

- a. Molded and fabricated fittings shall be high density polyethylene (HDPE) meeting the requirements of AWWA C901 standards.
  - b. HDPE fittings shall be made of the same materials and at the same pressure class as the pipe.
    - (1) Molded fittings shall be manufactured, tested and marked in accordance to ASTM D3261.
    - (2) Fabricated fittings shall be manufactured, tested and marked in accordance to ASTM F2206.
2. Flanges and Mechanical Joint (MJ) Adapters
- a. Flanges and mechanical joint adapters shall be made of the same materials and at the same pressure class as the pipe.
  - b. Flanged and mechanical joint adapters shall be made in accordance to ASTM D3261
  - c. Mechanical joint adapters shall be used to connect valves and other pipe unless stated otherwise on the Engineered Plans.
  - d. Markings for molded or machined flange adaptors or mechanical joint adaptors shall be per ASTM D3261.
3. Mechanical Fittings for Service Tubing
- a. Provide metal compression connections with ferrule and compression nut.
  - b. Provide a stainless steel insert stiffener to insert inside the tube.
  - c. Insert fittings shall not be used.
  - d. Mechanical fittings shall be engineered to prevent sliding or rotation.
4. Service Connections to Main Line HDPE Pipe
- a. Provide electrofusion saddles with brass threaded outlet, electrofusion saddles, sidewall fusion branch saddles, tapping tees, or mechanical saddles.
  - b. Provide outlet size as shown on the Engineered Plans.
  - c. Electrofusion saddles shall be made of the same materials and at the same pressure class as the pipe.

- d. The sidewall fusion branch saddles shall be made in accordance to ASTM D3261 or ASTM F2206.
- e. Tapping tees shall be made in accordance to ASTM D3261.

C. Pipe and Fitting Identification

- 1. The pipe shall be marked in accordance to the standards to which it is manufactured and as follows:
  - a. Nominal size
  - b. Outside diameter base of iron pipe sizes.
  - c. Dimension ratio
  - d. Manufacturer's name or trademark
  - e. Standard materials designation code
  - f. Cell classification
  - g. Pressure class
  - h. Standard's designation (AWWA C901)
  - i. Manufacturer's production code
  - j. Date of Manufacture
  - k. Mark of certifying agency for potable water (NSF)

D. Color identification by use of stripes on pipe to identify pipe service.

- 1. Blue for potable water.
- 2. Green for sewer.

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 33 05 33.30**  
**CORRUGATED HDPE DRAINAGE PIPE**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Corrugated, perforated HDPE drainage pipe material.
- B. Products Furnished or Supplied but not Installed under this Section.

**1.02 REFERENCES**

- A. American Society for Testing and Materials (ASTM)
  - ASTM D3212                      Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
  - ASTM F667                      Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings
- B. American Association of State Highway and Transportation Officials (AASHTO)
  - AASHTO M252                      Standard Specification for Corrugated Polyethylene Drainage Pipe
  - AASHTO M294                      Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter

**1.03 SUBMITTALS**

- A. Informational Submittals
  - 1. Certificates
    - a. Submit manufacturer's certification that materials delivered comply with the requirements of this section and the referenced standard.
  - 2. Manufacturers' Instructions
    - a. Submit recommendations for installation of pipe and fittings.

## **1.04 QUALITY ASSURANCE**

### **A. Certifications**

1. Provide manufacturer's certification that samples representing each lot have been tested and inspected in accordance with ASTM F667 and have been found to meet the requirements for material required per this Specification Section.

## **PART 2 - PRODUCTS**

### **2.01 DRAIN TILE**

- A. Provide drain tile pipe shall be in accordance to AASHTO M252, type CP, and AASHTO M294, type CP, with class 2 perforations.
- B. Drain tile shall be wrapped with geotextile fabric.
- C. Drain tile outlets shall be Mitered Drain Model Number 4MD3P-B or 4MD3P-G, manufactured by Mitered Drain, Inc., (Phone 707-620-0606, Fax 707-620-0607, [www.miteredrain.com](http://www.miteredrain.com)); or pre-approved equal.

## **PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 33 05 39.41**  
**REINFORCED CONCRETE PIPE FOR SEWERS AND CULVERTS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Circular culvert and storm sewer pipe.
  - 2. Perforated pipe.
  - 3. Elliptical culvert and storm sewer pipe.
  - 4. Arch culvert and storm sewer pipe.
  - 5. Box culvert and storm sewer sections.
  - 6. Apron endwalls

**1.02 REFERENCES**

- A. American Society for Testing and Materials (ASTM):
  - ASTM C76 Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
  - ASTM C443 Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
  - ASTM C444 Standard Specification for Perforated Concrete Pipe
  - ASTM C497 Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
  - ASTM C506 Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe.
  - ASTM C507 Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.
  - ASTM C877 Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
  - ASTM C990 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
  - ASTM C1433 Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers

**1.03 SUBMITTALS**

- A. Action Submittals

1. Shop Drawings
  - a. Provide detailed design of the pipe joints and gasket showing exact dimensions of the joints including permissible tolerances for each size pipe and size, type and locations of gasket materials.
- B. Informational Submittals
  1. Certificates
    - a. Manufacturer's certification that materials have been satisfactorily tested in accordance to ASTM C497.
    - b. Manufacturer's certification that culvert box sections and culvert box endwalls conform to ASTM C1433.
    - c. Manufacturer's certification that materials for sealing bands conform to ASTM C877.

## **1.02 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery and Acceptance Requirements
  1. Pipe shall be clearly marked with the following information:
    - a. Specification designation
    - b. Pipe class or strength designation
    - c. Date of manufacture
    - d. Name or trademark of manufacturer
    - e. Plant identification
    - f. Letters E or Q indicating elliptical or quadrant reinforcement
  2. Inspect and reject pipe for the following defects:
    - a. Improper marking.
    - b. Fractures or cracks passing through wall, except for a single end crack that does not exceed depth of joint.
    - c. Defects indicating non-compliance with proportioning, mixing and molding of the concrete.
    - d. Surface defects indicating honeycombed or open texture.

- e. Ends are not normal to the wall and center line of the pipe.
- f. Damaged or cracked ends.
- g. Any continuous crack having a width of 0.01 inch or more and extending for a length of 12 inches or more.

**B. Storage and Handling Requirements**

- 1. Deliver pipe materials to, unload, and distribute adjacent to or near the intended laying location.
- 2. Do not drop pipe materials.
- 3. Handle pipe materials in a manner intended to prevent damage to the pipe ends or to any coating or lining.
- 4. Pipe materials shall not be skidded or rolled against adjacent pipe materials.
- 5. Store material to protect from damage and do not stack in layers.
- 6. Store gasket materials in a cool place at a temperature less than seventy degrees Fahrenheit (70°F), and in no case stored in the open, or exposed to direct sun rays.

**PART 2 - PRODUCTS**

**2.01 USE OF REINFORCED CONCRETE PIPE**

- A. RCP shall only be used for storm sewer. All sanitary sewer shall be PVC.

**2.02 REINFORCED CONCRETE CIRCULAR PIPE (RCP)**

- A. Conform to ASTM C76 of the classification stated in the Engineered Plans.
- B. Class of pipe shall be per WisDOT Fill Height Tables in Facilities Development Manual Chapter 13.
- C. Provide bell and spigot joints conforming to ASTM C443 with flat rubber profile gaskets meeting standard gasket requirements.
- D. Branch fittings such as tees, wyes, etc. and fittings and specials shall be cast as integral parts of the pipe of the same strength class as the attached pipe.

**2.03 REINFORCED CONCRETE CIRCULAR PERFORATED PIPE**

- A. Conform to circular pipe requirements.

- B. Conform to the requirements of ASTM C444 Type 1.

#### **2.04 REINFORCED CONCRETE ELLIPTICAL PIPE (RCEP)**

- A. Conform to ASTM C507 of the classification stated on the Engineered Plans.
- B. Minimum Class HE III or Class VE III.
- C. Provide tongue and groove joints with flexible plastic Type B gaskets conforming to AASHTO M198 and joint sealants conforming to ASTM C990.

#### **2.05 REINFORCED CONCRETE ARCH PIPE (RCAP)**

- A. Conform to ASTM C506 of the classification stated on the Engineered Plans.
- B. Minimum Class A-III.
- C. Provide tongue and groove joints with flexible plastic Type B gaskets conforming to AASHTO M198 and joint sealants conforming to ASTM C990.

#### **2.06 BOX SECTIONS**

- A. Conform to ASTM C1433 of the Type identified in the standard.
- B. If the box section has less than 2' of cover, conform to ASTM C1433 of type identified in Table 1 of the standard.
- C. Provide tongue and groove joints with flexible plastic Type B gaskets conforming to AASHTO M198.
- D. Provide External Sealing Bands conforming to ASTM C-877.
- E. Provide reinforced concrete collars minimum 6 inch thickness at joints between box sections and box end sections. Reinforcement shall be 2 - #4(E) continuous bars.

#### **2.07 REINFORCED CONCRETE APRON ENDWALLS**

- A. Conform to the pipe standard and class same as specified for the connecting pipe.
- B. Conform to the specified joints same as specified for the connecting pipe.
- C. Joint ties shall be galvanized and installed on the last three joints in from the endwall.
- D. Provide trashguard for apron endwalls 18 inches diameter or greater.

1. Provide trashguard constructed of a minimum of 1 inch diameter steel bars for 42 inch and less diameter pipe and 1 ¼ inch diameter steel bars for greater than 42 inches diameter.
2. Space bars a minimum of 6 inches.
3. Connect trashguard with connector plates, bolts and nuts to the apron endwall at a minimum of three (3) locations.
4. Provide minimum ¾ inch diameter connection bolts and nuts for 42 inch or less diameter pipe and 1 inch diameter connection bolts for greater than 42 inch diameter pipe.
5. Trashguard, connection plates and fasteners shall be galvanized for corrosion resistance.

## **PART 3 - EXECUTION**

### **3.01 APPLICATION**

#### **A. Storm Sewer and Culverts**

1. Use circular pipe ASTM C76 "B" or "C" wall unless stated otherwise on Engineered Plans.
2. Use elliptical pipe, arch pipe and box sections only where shown on Engineered Plans.
3. Use perforated pipe only where shown on Engineered Plans.

#### **B. Box Sections**

1. Bed sections in a minimum of six (6) inches of Soil Class A-7 placed to 2 feet beyond the edge of the box section.
2. Seal all joints with a 13 inch wide sealing band centered on the joint.

**END OF SECTION**

**SECTION 33 05 62**  
**PRECAST CONCRETE MANHOLES AND STRUCTURES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Precast Reinforced Concrete Manholes
  - 2. Castings
  - 3. Sanitary Manhole Frame and Chimney Seals
  - 4. Manhole Joint Wrap
  - 5. Manhole Cover Removing Hook
  - 6. Precast Reinforced Concrete Rectangular and Square Structures
  - 7. Grade Adjusting Rings
  - 8. Fixed Aluminum Wall Ladder
  - 9. Hatches for Precast Concrete Structures

**1.02 REFERENCES**

- A. American Concrete Institute (ACI)
  - ACI 318 Building Code Requirements for Reinforced Concrete
- B. American Society for Testing and Materials (ASTM)
  - ASTM A48 Standard Specification for Gray Iron Castings
  - ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
  - ASTM A775 Standard Specification for Epoxy-Coated Steel Reinforcing Bars
  - ASTM C478 Standard Specification for Precast Reinforced Concrete Manhole Sections
  - ASTM C497 Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile
  - ASTM C877 Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
  - ASTM C890 Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures

- |            |   |
|------------|---|
| ASTM C990  | Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants |
| ASTM C913  | Standard Specification for Precast Concrete Water and Wastewater Structures   |
| ASTM C920  | Standard Specification for Elastomeric Joint Sealants   |
| ASTM C923  | Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals             |
| ASTM C1107 | Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)   |
| ASTM D4101 | Standard Specification for Polypropylene Injection and Extrusion Materials  |
| ASTM F593  | Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs   |
| ASTM F594  | Standard Specification for Stainless Steel Nuts   |
- C. American Association of State Highway and Transportation Officials (AASHTO)
- |             |  |
|-------------|--|
| AASHTO M198 | Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets |
| AASHTO M306 | Standard Specification for Drainage, Sewer, Utility, and Related Castings  |
- D. Federal Specifications (FS):
- FS SS-C-153C Cement, Bituminous, Plastic.

### 1.03 SUBMITTALS

- A. Action Submittals
1. Product Data
    - a. Manhole castings
    - b. Manhole steps
    - c. Access ladder
    - d. Joint sealants
    - e. Connections between structure and pipe
    - f. Non-shrink grout
    - g. Manhole frame and chimney seals
    - h. Grade adjusting rings

- i. Access hatches
- 2. Shop Drawings
  - a. Provide shop drawings of precast concrete structures and components.
  - b. Access ladder
- 1. Maintenance Material Submittals
  - a. Tools for frame and chimney seals
  - b. Manhole cover removing tools

## **1.02 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery and Acceptance Requirements
  - 1. Ship and handle precast sections in a manner that will prevent damage as recommended by the manufacturer.
  - 2. Units shall not be shipped until they have reached at least 75% of their specified 28-day design strength.
  - 3. Contractor shall take acceptance of all deliveries.
- B. Storage and Handling Requirements
  - 1. Store precast concrete units on relatively flat ground in a manner that will minimize potential damage.

## **PART 2 - PRODUCTS**

### **2.01 PRECAST REINFORCED CONCRETE MANHOLE COMPONENTS**

- A. Circular manhole components including base sections, risers sections, grade rings (adjusting rings), eccentric cone, flat slab top and manhole reducing bench shall meet ASTM C478.
- B. Provide precast concrete sections and related components conforming to ASTM C478, Type II with acid resistant cement.
- C. Provide base section with base riser section and integral monolithic bottom extending minimum of 6 inches beyond riser section.
- D. Provide riser sections with dimensions and orientation of pipe cut-outs as shown on the Engineered Plans.

- E. Joint design shall be in accordance with ASTM C990.
- F. Provide lifting inserts with base and riser sections. No through wall lifting holes.
- G. Mark date of manufacture and name or trademark of manufacturer on inside of barrel.
- H. Precast Concrete Base
  - 1. Base section shall include base riser section with integral monolithic bottom extending minimum of 6 inches beyond riser section.
  - 2. Provide cast in-place concrete base where shown on the Engineered Plans.
    - a. Provide Class AA Portland cement concrete mix design in accordance with the appropriate Specification Section.
    - b. Reinforcement
      - (1) Provide in accordance with ASTM A775.
      - (2) Provide bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place.
  - 3. Invert
    - a. Provide precast invert integrally with the base for sanitary sewer.
    - b. Provide cast in-place concrete inverts for storm sewer.
    - c. Invert shall be same diameter of largest adjoining sewer pipe and have depth 1/2 of diameter of largest adjoining sewer pipe. Invert bench shall slope towards invert at minimum of 2 inches per foot.
- I. Manhole Top
  - 1. Provide eccentric cone section for manholes unless flat slab top section is shown on the Engineered Plans.
  - 2. Provide flat slab top where shown on Engineered Plans.
  - 3. Provide eccentric cone section on sanitary sewer and storm sewer unless otherwise shown on the Engineered Plans.
  - 4. Manhole and structure top shall be capable of supporting HS-25 loading.
  - 5. Provide top opening of cone section or flat slab top of diameter shown on the Engineered Plans.

## 2.02 REINFORCED PRECAST CONCRETE RECTANGULAR AND SQUARE STRUCTURES

- A. Rectangular and square structure components including base sections, risers sections, grade rings (adjusting rings), flat slab top shall meet ASTM C913.
- B. Design in accordance with ACI 318 and ASTM C890.
- C. Provide riser sections with dimensions and orientation of pipe cut-outs as shown on the Engineered Plans.
- D. Provide lifting inserts with base and riser sections. No through wall lifting holes.
- E. Mark date of manufacture and name or trademark of manufacturer on inside of barrel.
- F. Precast Concrete Base
  - 1. Base section shall include base riser section with integral monolithic bottom extending minimum of 6 inches beyond riser section unless shown otherwise on the Engineered Plans.
  - 2. Provide cast in-place concrete base where shown on the Engineered Plans.
    - a. Provide Class AA Portland cement concrete mix design in accordance with the appropriate Specification Section.
    - b. Reinforcement
      - (1) Provide in accordance with ASTM A775.
      - (2) Provide bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place.
  - 3. Invert or Slopes
    - a. Provide cast in-place concrete inverts or slopes where shown on Engineered Plans.
    - b. Invert shall be same diameter of largest adjoining sewer pipe and have depth 1/2 of diameter of largest adjoining sewer pipe. Invert bench shall slope towards invert at minimum of 2 inches per foot.
    - c. Slopes shall be at configuration as shown on Engineered Plans.
- G. Structure Top
  - 1. Provide flat slab top as shown on Engineered Plans.

2. Manhole and structure top shall be capable of supporting HS-20 loading.
3. Provide top opening of configuration and size shown on Engineered Plans.
4. Integrally cast access hatches in flat slab top as shown on Engineered Plans.
5. Coat hatch frame in contact with concrete with a coal tar epoxy paint.

### **2.03 GRADE ADJUSTING RINGS**

- A. Provide grade adjusting rings with the inside dimension not less than the inside dimension of the manhole frame and not less than the inside dimension of the rectangular opening. Exterior dimensions shall not overhang the concrete sections.
- B. Grade rings shall be shaped for the application; e.g. circular for manhole castings and rectangular for rectangular castings.
- C. The grade adjusting rings shall be designed to allow final adjustment of the frame and cover or grate to the grade established on the Engineered Plans or established by the Engineer.
- D. Grade adjusting rings shall be capable of supporting the minimum requirements of AASHTO M-306, H-25 and HS-25.
- E. Precast Concrete Grade Adjusting Rings
  1. Provide precast reinforced concrete adjusting rings complying with ASTM C478.
    - a. Adjusting rings shall be free from cracks, voids, and other defects.
    - b. Provide minimum of two precast concrete rings with a maximum height of 10 inches total.
  2. Provide top 2 inches of adjusting rings height with rubber ring manufactured by Infra-Riser when in a traffic area.
    - a. Provide tapered rubber adjusting ring in sloped pavement.
    - b. Provide manufacturer recommended polyurethane sealant between rubber rings.

### **2.04 JOINT SEALANTS**

- A. Joint sealant gasket shall be rubber gasket joint meeting requirements of C-443.

- B. Outside edges of all joints shall have 1-1/4" thick butyl rubber material meeting requirements of AASHTO M-198 Type B flexible plastic gasket and ASTM C990 butyl rubber sealant. Shall be CS-102.
- C. Grade Adjusting Rings
  - 1. Provide polyurethane joint sealer/adhesive for attaching rubber grade adjusting rings.

## **2.05 NON-SHRINK GROUT**

- A. Provide cementitious premixed, non-shrink, non-metallic compound, conforming to ASTM C1107.
- B. Acceptable Products and Manufacturers
  - 1. Five Star Grout manufactured by Five Star Products, Inc.
  - 2. 588-10K manufactured by W.R Meadows, Inc.
  - 3. Euco Cable Grout PTX or Euco NS Grout manufactured by Euclid Chemical Company
  - 4. Sikagrout 212 manufactured by Sika Corporation

## **2.06 PIPE TO STRUCTURE CONNECTIONS FOR WATERTIGHTNESS**

- A. Connection between precast riser sections and pipes other than storm sewer:
  - 1. Provide resilient flexible connector meeting requirements of ASTM C923.
  - 2. Seal the flexible connector and the manhole by casting the connector integrally with the manhole wall.
  - 3. The seal between the connector and the pipe shall be by compression of the resilient material against the outside of the pipe.
  - 4. Factory made manholes shall use A-Lok or Z-Lok pipe connections.
  - 5. Where an existing manhole is core drilled in the field or the entering pipe is not perpendicular to the concrete riser section, provide one of the following flexible connectors: XPC Inc. Kor-N-Seal or Press-Seal Gasket Corporation PSX:Positive Seal.
- B. Connection between riser section and Storm Sewer Pipe:
  - 1. Provide a non-shrink grout between riser section opening and reinforced concrete storm sewer pipe.

2. For PVC pipe provide A-Lok or Z-Lok pipe connections.
  - a. Seal the flexible connector and the manhole by casting the connector integrally with the manhole wall.
- C. Connection between rectangular and square structures and pipe, other than storm sewer pipe.
  1. Provide flexible pipe to structure connector to produce a positive watertight seal for pipes entering precast concrete structures and the structure itself. Pipe seals shall be GPT Link-Seal Modular Seals.
  2. Precast concrete shall be core drilled perpendicular to the structure wall centered at the exact location of the pipe of size appropriate for the pipe plus the seal.
  3. Provide Link-Seal modular seals between the pipe and cored opening in the structure wall of size recommended by the manufacturer.
  4. The modular seals shall be suitable for direct ground burial, normal atmospheric conditions, and conditions with occasional or periodic water contact.
  5. Materials
    - a. Seal element: EPDM material.
    - b. Pressure Plates: Reinforced Nylon Polymer
    - c. Bolts and Nuts: Steel with 2-part Zinc Dichromate and corrosion inhibiting coating.

## **2.07 MANHOLE STEPS**

- A. Steel reinforced coated with copolymer polypropylene meeting ASTM C478.
- B. Copolymer polypropylene shall meet ASTM D4101.
- C. Steel reinforcement shall be ASTM A615, Grade 60, ½” minimum steel reinforcing rod.
- D. Step shall be 11”-12” wide center to center of anchors and project from the wall between 5” and 7”.
- E. Minimum design live load shall be a single concentrated load of 300 lbs. when in place.
- F. Uniformly space steps at 12 inches to 16 inches.

- G. Align steps with vertical side of eccentric top section.
- H. Place first step no more than 36 inches from top of casting.
- I. Do not place steps in lift station wet wells.

## **2.08 CASTINGS**

### **A. Manhole Castings**

1. Shall be ASTM A48, Class 35B, gray iron.
2. Manhole frame and covers shall be non-rocking.
3. Manhole covers for sanitary sewer shall be self-sealing with concealed pick hole.
4. Shall be of uniform quality free from blowholes, shrinkage, discoloration, and other defects.
5. Shall be heavy duty designed for HS-20 loadings.
6. Provide frame and covers of type shown on Engineered Plans.
7. Provide size and configuration as shown on Engineered Plans.

### **B. Inlet and Catch Basin Castings**

1. Shall be ASTM A48, Class 35B, gray iron.
2. Shall be of uniform quality free from blowholes, shrinkage, discoloration, and other defects.
3. Shall be heavy duty designed for HS-20 loadings.
4. Provide frame, box and grate of type shown on Engineered Plans.
5. Stamp the words “Dump No Waste – Drains to Fresh Water” on castings.
6. Provide size and configuration as shown on Engineered Plans.

## **2.09 HATCHES FOR PRECAST CONCRETE STRUCTURES**

- A. Provide frame and cover access hatches of the size opening shown on the Engineered Plans.
- B. Provide angle frame ¼” thick one-piece, mill finish, extruded aluminum frame, incorporating a continuous concrete anchor.

- C. The inside of the frame shall have a door-support ledge on two (2) sides.
- D. Support both frame and ledge by a full bed of concrete.
- E. Provide door panels ¼” thick aluminum diamond plate, reinforced to withstand a live load of the H-20, Uniform live load.
- F. Doors shall open to 90 degrees and automatically lock with T-316 stainless steel hold open arms with aluminum release handles.
- G. Door shall incorporate enclosed stainless steel compression spring assists, to provide ease of operation.
- H. Doors shall close flush with the frame.
- I. Hinges and all fastening hardware shall be T-316 stainless steel.
- J. Unit shall lock with a T-316 stainless steel slam lock with removable key and have a non-corrosive handle.
- K. Hatches shall be Halliday Products Series H-W Access Door.

## **2.10 FIXED ALUMINUM WALL LADDER**

- A. Ladder shall be constructed entirely of aluminum Series L1D as manufactured by Halliday Products Inc. of Orlando, Florida.
- B. Provide ½” x 1 ¾” aluminum extruded rails spaced 16” apart.
- C. Provide 3/8” x 1 ½” flat bar wall mounted standoffs welded to the rails at a maximum of 60” on center.
- D. The standoffs shall be a minimum of 7” manufactured to fit flush with the wall.
- E. Provide 1 3/8” diameter type “D” rungs with flat slip resistant surface spaced at 12” on center and welded to the outside of each rail.

## **2.11 SANITARY MANHOLE FRAME AND CHIMNEY SEALS**

- A. Internal Frame and Chimney Seals
  - 1. Provide and install internal flexible rubber frame seal and where necessary, an interlocking extension or extensions, sealing the entire chimney of sanitary manholes. The seal and extension or extensions shall extend from the casting down to the top of the manhole cone.
  - 2. Design the manhole frame seal to prevent leakage of water through the manhole chimney throughout a 50 year design life.

3. The seal shall be designed so that it can be installed in manholes where the frame and chimney diameters differ by up to 20%.
4. The frame seal shall be capable of repeated vertical movement of not less than 2 inches and/or repeated horizontal movement of not less than ½ inch after installation throughout the design life.
5. The frame and chimney seals and bands shall be sized for the casting diameter and the chimney diameter shown on the Engineered Plans.
6. Materials
  - a. Rubber sleeve and Extension
    - (1) Flexible rubber sleeve and extensions shall be extruded or molded from a high grade rubber compound conforming to the applicable material requirements of ASTM C923, with a minimum 1500 psi tensile strength, maximum 18% compression set and a hardness (durometer) of  $48 \pm 5$ .
    - (2) The rubber sleeve shall be double, triple or quadruple pleated with a minimum unexpanded vertical height of 8 inches, 10 inches or 13 inches respectively and a minimum thickness of 3/16 inches.
    - (3) Provide the top and bottom section of the sleeve with an integrally formed expansion band recess and a series of fins to facilitate a watertight seal.
    - (4) The top section of the extension shall have a minimum thickness of 3/32 inches shaped to fit into the bottom band recess of the sleeve under the bottom chimney seal band and the remainder of the extension shall have a minimum thickness of 3/16 inches. The bottom section of the expansion shall contain an integrally formed expansion band recess and a series of fins to facilitate a watertight seal.
  - b. Expansion Bands
    - (1) Provide minimum 1 ¾ inches wide expansion bands to compress the sleeve against the manhole integrally formed from 16 gauge stainless steel conforming to the applicable material requirements of ASTM C923, Type 304, with no welded attachments.

- (2) The bands shall have a minimum adjustment range of 2 ½ diameter inches with a mechanism used to expand the band necessary to develop the pressures to make a watertight seal.
- (3) The band shall be permanently held in place with a positive locking mechanism securing the band in its expanded position after tightening.
- (4) Provide at least two bands with one sealing at the frame and one sealing at the top of the precast manhole section.
- (5) Provide at least one and one per 20 chimney seals of expansion tools and all other equipment/tools necessary to prepare the surfaces of the manhole and install the frame seals.

7. Acceptable Manufacturers

- a. Cretex Specialty Products

## 2.12 GRANULAR FOUNDATION

- A. Structure bedding material below the concrete structure base shall be ¾-inch crushed rock chips gradation, Soil Class A-7, in accordance with appropriate Specification.

## PART 3 - EXECUTION

### 3.01 GENERAL ALL STRUCTURES

- A. Depths shown on Engineered Plans shall be considered approximate.
- B. Excavate for installation of the structure in accordance with the appropriate Specification Section.
- C. Install sheathing as required to protect the excavation and existing facilities and pavement around the structure.
- D. Install dewatering necessary to lower the water level to at least one foot below the bottom of the excavation.
- E. Concrete base bedding
  1. Place bases on a minimum of 6 inches of Soil Class A-7 bedding material:
  2. Place and work by hand to insure excavated voids are filled.

- F. Install precast concrete structures plumb and to line and grade shown on the Engineered Plans to within a tolerance of 1/8-inch in 4 feet.
- G. Unless indicated otherwise, provide precast concrete construction for all structures shown on the Engineered Plans.
- H. Provide precast risers in a combination of lengths to minimize the number of joints.
- I. Provide joint sealant between precast concrete structure components to compress sealant with subsequent precast concrete riser section.
- J. Fill interior holes with mortar and finish smooth.

### **3.02 PRECAST REINFORCED CONCRETE MANHOLES, CATCH BASINS AND INLETS**

#### **A. Structure Installation**

1. Establish flow lines and casting elevations from grade stakes and cut sheets.
2. Provide 6 feet minimum height from top of casting to flowline, unless otherwise shown on the Engineered Plans.
3. Fill annular space around pipes with non-shrink grout finished smooth, interior bottom half pipe opening only.
4. Provide manhole, catch basins and inlets of size shown on the Engineered Plans. Four foot diameter shall be considered standard for manholes.
5. Pitch casting to match street cross-slopes.
6. Use precast concrete flat top in lieu of a cone section when elevation is limited.
7. Contractor shall work with the inspector to provide elevations of all structures.

#### **B. Pipe Connections.**

1. For pipe other than storm sewer, the pipe shall enter the barrel through a flexible, watertight gasket or connector.
2. For storm sewer pipe, place non-shrink grout between pipe and precast concrete wall section inside and outside the storm structure providing a soil-tight seal.
3. Pipe penetrations shall not be through cone section.

- C. Cast manhole steps in place on each manhole unless otherwise shown on the Engineered Plans.
- D. Provide frame and cover castings on structure as shown on the Engineered Plans.
- E. Manhole Drops:
  - 1. Conform to the detail Engineered Plans.
  - 2. Furnish where designated on Engineered Plans.
  - 3. Drop pipe size shall be:
    - a. 8 inch diameter for sewers 8 inch diameter through 18 inch diameter.
    - b. 12 inch diameter for sewers 21 inch diameter through 30 inch diameter.
- F. Structure Base Concrete Inverts:
  - 1. Shape to the lower half diameter of the largest connecting pipe.
  - 2. Slope concrete bench upward to manhole wall.
  - 3. Maintain a uniform flow line slope through manhole which matches minimum pipe slope.
  - 4. Provide precast concrete manholes with a manufacturer installed invert.
- G. Provisions for Future Sewer Connections:
  - 1. Provide pipe stubs as shown on the Engineered Plans.
  - 2. Extend pipe stubs a maximum of 12 inches from outer wall of structure unless otherwise shown on Engineered Plans.
  - 3. Cap or bulkhead pipe stub to watertight condition.
- H. Grade Adjusting Rings
  - 1. Provide grade adjusting rings with a maximum height of 10 inches.
  - 2. Provide a minimum of 2 rings for grade adjustment.
  - 3. Provide grade adjusting rings such that the final casting grade is set to  $\frac{1}{4}$  inch to  $\frac{1}{2}$  inch below final paved surface.
  - 4. Precast Concrete Grade Adjusting Rings

- a. Provide concrete grade adjusting rings with the top 2 inches of rubber ring, tapered as necessary to match surface grade with casting.
- b. Provide 1/4 inch thick bituminous plastic cement between concrete grade rings; and between the precast concrete section and the concrete grade rings providing a watertight seal.
- c. Attach the rubber grade adjusting ring to concrete grade ring using polyurethane joint sealer/adhesive creating watertight seal.
- d. Remove all wooden wedges or other adjusting devices and mortar voids created by adjusting device.

I. Frame and Chimney Seal Installation

- 1. Inspect sealing surfaces to determine if reasonably smooth, clean and free from offsets.
- 2. Use a high strength, non-shrink grout to fill areas smooth in the sealing area of the precast manhole section.
- 3. Install rubber sleeve and the least number of extensions necessary to seal the area from the manhole frame to the cone section or flat top section of the precast manhole.
- 4. Install in accordance with the manufacturer's recommendations.

J. Manholes in the roadway shall be backfilled with Aggregate Base Course Gradation #3 from the top of the cone to the top of the casting.

**3.03 PRECAST REINFORCED CONCRETE RECTANGULAR AND SQUARE STRUCTURES**

- A. Provide precast reinforced concrete rectangular and square structures in accordance with Precast Reinforced Concrete Manholes, Catch Basins and Inlets specified above.
- B. Provide precast concrete structure top with provisions for manhole casting or hatch frames integrally cast with precast concrete top as shown on the Engineered Plans.
  - 1. Align manhole castings or access hatches over equipment or valves as shown on Engineered Plans such that entering structure to operate equipment or valves will be minimized.
- C. Grout floor and fillets in structure as shown on Engineered Plans.

- D. Provide openings for vents, electrical cable, etc. as shown on the Engineered Plans.
- E. Fixed Aluminum Wall Ladder
  - 1. Provide as shown on the Engineered Plans.
  - 2. Install ladder in accordance to manufacturer's installation instructions.
  - 3. Comply with OSHA Standard 1910.27 for fixed ladders.

**END OF SECTION**

**SECTION 33 05 97.26**  
**UNDERGROUND TRACE WIRE FOR LOCATING UTILITIES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Trace Wire
  - 2. Trace Wire Connectors
  - 3. Trace Wire Terminal Boxes

**1.02 SUBMITTALS**

- A. Action Submittals
  - 1. Product Data
    - a. Provide product data for trace wire, connectors and terminal boxes

**PART 2 - PRODUCTS**

**2.01 TRACE WIRE**

- A. Open Trench – Provide #12 AWG copper clad steel, high strength with minimum 450 lb. break load, with minimum 30 mil HDPE or high molecular weight polyethylene insulation thickness designed for direct bury.
- B. Directional Drilling/Boring – Provide #12 AWG copper clad steel, extreme strength with 1,150 lb. break load, with minimum 30 mil HDPE or high molecular weight polyethylene insulation thickness designed for direct bury.
- C. Pipe Bursting/Slip Lining – Provide 7x7 stranded copper clad steel, extreme strength with 4,700 lb. break load, with minimum 50 mil HDPE or high molecular weight polyethylene insulation thickness designed for direct bury.
- D. Insulation Color
  - 1. Non-metallic potable water main and water services – blue color
  - 2. Non-metallic non-potable water main – purple color
  - 3. Non-metallic sanitary sewer and sanitary sewer services – green color
  - 4. Non-metallic storm sewer and storm sewer services – brown color

## 2.02 TRACE WIRE CONNECTORS

- A. Direct Bury
  - 1. Provide main line splice to service line connection specifically manufactured for use in underground trace wire installation, dielectric silicon filled to seal out moisture and corrosion, and installed in a manner to prevent any uninsulated wire exposure.
    - a. Acceptable Manufacturers:
      - (1) Copperhead Industries Mainline to Service Connectors or approved equal.
  - 2. Interconnect mainline trace wires at intersections with tees and crosses.
    - a. At tee intersections, join the three wires using a single 3-way lockable connector.
    - b. At cross intersections, join the four wires using a 4-way connector. Using two 3-way connectors with a short jumper wire between the connectors is an acceptable alternative.
      - (1) Acceptable Manufacturers:
        - i) Copperhead Industries SnakeBite Locking Connector or approved equal.
- B. Directional Drilling and Pipe Bursting
  - 1. Do not splice wire for directional drilling and pipe bursting on the main line.
  - 2. Intersection splicing shall follow direct bury connector requirements.

## 2.03 TRACE WIRE TERMINATION/ACCESS

- A. Provide trace wire grade level/in-ground access box or above ground access post at trace wire termination points.
- B. Provide manually interruptible conductive/connective link between the terminal(s) for the trace wire connection and the terminal for the grounding anode wire connection.
- C. Connect grounding anode wire to bottom terminal on the access boxes/posts.
- D. Grade Level/In-Ground Access Boxes

1. Provide grade level/in-ground access boxes identified with “sewer” or “water” as appropriate cast into the cap and be color-coded blue for water, green for sanitary sewer and black for storm sewer.
  2. Provide access box with minimum of 2 feet of depth.
  3. Provide cast iron locking cap/cover on the access box.
  4. Acceptable Manufacturers
    - a. Test & Valve Products, Inc. Tracer Wire Access Box
    - b. Bingham & Taylor Cathodic Protection Test Boxes
    - c. Copperhead Snakepit Test Stations
- E. Above Ground Access Posts
1. Provide above ground access post covers boxes identified with “sewer” or “water” as appropriate and be color-coded blue for water, green for sanitary sewer and black for storm sewer.
  2. Provide post of polypropylene material extending 60 inches above ground.
  3. Acceptable Manufacturers
    - a. Copperhead Cobra T3 Test Stations
    - b. Rhino Marking & Protection Systems TriView Flex

## **2.04 GROUNDING**

- A. Ground trace wire at all dead ends/stubs.
- B. Provide a drive-in magnesium grounding anode rod with a minimum of 20 feet of #14 red HDPE insulated copper clad steel wire connected to anode (minimum 0.5 lbs.) specifically manufactured for this purpose and buried at the same elevation as the utility.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install trace wire on non-metallic pipe with trace wire access not more than 400-foot intervals.

- B. Perform trace wire installation in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512Hz) signal for distances in excess of 1,000 linear feet, and without distortion of signal caused by multiple wires being installed in close proximity to one another.
- C. Provide trace wire system as a continuous single wire without looping or coiling of wire.
- D. Immediately repair any damage occurring during installation of the trace wire in an approved waterproof method. Do not tape and/or spray coat.
- E. Terminate trace wire on all service laterals/stubs a trace wire access box directly above the utility, using color coded access boxes, located at the edge of the road right of-way, but out of the roadway.
- F. All mainline dead-ends shall go to ground using an approved waterproof connection to a drive-in magnesium grounding anode rod, buried at the same depth as the trace wire.
  - 1. Bury the anode on the opposite side of the utility at the furthest most point.
  - 2. Connect the anode wire in the trace wire access box to the trace wire utilizing the connection point in the access box.
- G. Do not connect mainline trace wire to existing conductive pipes. Treat as a mainline dead-end, ground using an approved waterproof connection to a grounding anode, buried at the same depth as the trace wire.
- H. Connect all service lateral trace wires to the mainline with a single wire, (no looping) using a mainline to lateral lug connector, installed without cutting/splicing the mainline trace wire.
- I. In occurrences where existing trace wire is encountered on an existing utility that is being extended or tied into, connect the new and existing trace wire using approved splice connectors, properly ground at the splice location as specified and be completely waterproof to prohibit corrosion and loss of conductivity.
- J. Installation - Sanitary Sewer System
  - 1. Provide mainline trace wire with all service lateral trace wires properly connected to the mainline trace wire, to ensure full tracing/locating capabilities from a single connection point.
  - 2. Provide trace wire at the 3 o'clock position of the pipe, taping or tying at 10-foot intervals.

3. Terminate trace wire on all sanitary laterals at an approved trace wire access box color coded green and located directly above the service lateral at the road right of way. Follow grounding specifications and connections.

K. Installation - Water System

1. Provide mainline trace wire with all service lateral and hydrant lead trace wires properly connected to the mainline trace wire, to ensure full tracing/locating capabilities from a single connection point.
2. Lay mainline trace wire continuously, bypassing around the outside of valves and fittings on the North or East side.
3. Provide trace wire at the 3 o'clock position of the pipe, taping or tying at 10-foot intervals.
4. Terminate trace wire on all water service laterals and hydrant leads at an approved trace wire access box color coded blue and located directly above the service lateral at the road right of way. Follow grounding specification and connections.
5. Provide tracer wire access boxes on all fire hydrants securely connected to the fire hydrant. Do not use straps or tape.
6. Provide tracer wire for all conductive and non-conductive service lines secured to pipe by taping or tying at 5 foot intervals.

L. Installation - Storm Sewer System

1. If the storm sewer system includes service laterals for connection of private drains and tile lines, provide trace wire the same as a sanitary sewer application.
2. Provide trace wire at the 3 o'clock position of the pipe, taping or tying at 10-foot intervals.
3. Terminate trace wire on all storm sewer laterals at an approved trace wire access box color coded black and located directly above the service lateral at the road right of way. Follow grounding specification and connections

M. Prohibited Methods and Materials

1. Uninsulated trace wire
2. Twist-on wire connectors
3. Brass or copper ground rods
4. Wire connections utilizing taping or spray-on waterproofing

5. Looped wire or continuous wire installations, that has multiple wires laid side-by-side or in close proximity to one another
6. Brass fittings with trace wire connection lugs
7. Wire terminations within the roadway, i.e. in valve boxes, cleanouts, manholes, etc.
8. Connecting trace wire to existing conductive utilities. To prevent corrosion at existing grounding options on corps or curb stops or splices. Anode grounding will prevent the wire from corroding.

### **3.02 FIELD QUALITY CONTROL**

#### **A. Field Tests and Inspections**

1. Locate all new trace wire installations using typical low frequency (512Hz) line tracing equipment, witnessed by the Contractor, Engineer and Owner.
2. Perform this verification upon completion of rough grading and again prior to Substantial Completion.
3. Continuity testing in lieu of actual line tracing is not acceptable.

#### **B. Non-Conforming Work**

1. Correct any areas where trace wire installations cannot be traced with line tracing equipment.

**END OF SECTION**

**SECTION 33 14 00**  
**WATER UTILITY TRANSMISSION AND DISTRIBUTION**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
1. Water Utility Transmission and Distribution Piping Installation
  2. Water Utility Transmission and Distribution Fittings Installation
  3. Water Utility Transmission and Distribution Pipeline Accessories
  4. Water Service Pipe, Valves and Appurtenances
  5. Water Utility Service Valves
  6. Water Utility Service Hydrants
  7. Insulation Board for Frost Shield
  8. Disinfection

**1.02 REFERENCES**

- A. American Water Works Association (AWWA)
- |           |  |
|-----------|--|
| AWWA C105 | Polyethylene Encasement of Ductile-Iron Pipe Systems   |
| AWWA C116 | Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service |
| AWWA C219 | Bolted, Sleeve-Type Couplings for Plain-End Pipe   |
| AWWA C502 | Dry-Barrel Fire Hydrants   |
| AWWA C504 | Rubber-Seated Butterfly Valves   |
| AWWA C509 | Resilient-Seated Gate Valves for Water Supply Service  |
| AWWA C512 | Air-Release, Air/Vacuum and Combination Air Valves for Waterworks Service  |
| AWWA C515 | Reduced Wall, Resilient Seated Gate Valves for Water Supply Services   |
| AWWA C550 | Protective Epoxy Interior Coatings for Valves and Hydrants   |
| AWWA C600 | Installation of Ductile-Iron Water Mains and Their Appurtenances   |
| AWWA C605 | Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water  |
| AWWA C800 | Underground Service Line Valves and Fittings   |

- B. American Society for Testing and Materials (ASTM)
- |            |   |
|------------|---|
| ASTM A307  | Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength |
| ASTM C578  | Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation                         |
| ASTM D2774 | Standard Practice for Underground Installation of Thermoplastic Pressure Piping                   |
| ASTM D3139 | Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.    |
| ASTM F1668 | Standard Guide for Construction Procedures for Buried Plastic Pipe                                |
| ASTM F1674 | Standard Test Method for Joint Restraint Products for Use with PVC Pipe                           |

### 1.03 SUBMITTALS

- A. Action Submittals
1. Product Data
    - a. Provide manufacturer's product data and installation instructions for valves, hydrants, water service valves, valve boxes, and joint restraints.
    - b. Restrained fittings and required length of restrained joint pipe.
  2. Shop Drawings
    - a. Provide shop drawings of layout and installation details for control valves in manholes.
    - b. Manufacturer's calculations and recommendations for joint restraint.
- B. Informational Submittals
1. Closeout Submittals
    - a. Record Documentation
      - (1) Provide record drawings for tees, bends, crosses, and plugs showing distance to adjacent valve.
      - (2) Pipe location records.

## **PART 2 - PRODUCTS**

### **2.01 WATER UTILITY TRANSMISSION AND DISTRIBUTION PIPING**

- A. Do not use more than one material brand of pipe and manufacturer.
- B. Provide pipe and joints as shown on the Engineered Plans and stated in the Bid Form.
- C. Provide pipe in accordance with the appropriate Specification Section.

### **2.02 COUPLINGS AND ADAPTERS**

- A. Flanged Coupling Adapters
  - 1. Used for connecting plain end pipe to flanged equipment and fittings.
  - 2. Body and end rings (follower rings): Ductile iron complying to ASTM A536
  - 3. Body and end rings coating: epoxy coated.
  - 4. Gaskets: New rubber compounded for water service and resistant to permanent set. Full face flange gasket.
  - 5. Provide with anchor studs.
  - 6. Bolts and Nuts: 304 stainless steel with an anti-seize mechanism.
- B. Plain End to Plain End Couplings
  - 1. Meet applicable requirements of AWWA C219.
  - 2. Used for connecting DIP to DIP or PVC pipe or HDPE pipe
  - 3. Body and end rings (follower rings): Minimum of 65-45-12 ductile iron meeting the requirements of ASTM A536.
  - 4. Provide stainless steel stiffener rings for connecting to HDPE pipe.
  - 5. Joint Restraint to prevent axial separation: multiple gripping surfaces actuated with torque limiting twist off nuts.
  - 6. Coating:
    - a. Body: electrostatically applied and heat cured polyester based powder providing corrosion, impact, and UV resistance.

- b. Wedge assembly: Minimum two coats of liquid thermoset epoxy heat cured following each coat.
  - 7. Bolts and Nuts: 304 stainless steel with an anti-seize mechanism.
  - 8. Gaskets: New rubber compounded for water service and resistant to permanent set.
- C. Tapping Sleeves
  - 1. Rated at 200 psi working pressure up to 12" diameter and 150 psi working pressure above 12" diameter.
  - 2. Outlet Joint: Mechanical joint allowing use of standard MJ x MJ valve.
  - 3. Sleeve and outlet flange: 304 stainless steel.
  - 4. Gasket: Full-length waffle style 360 degrees around the pipe.
  - 5. Manufacturer: Waterous or Municipal Engineer approved equal.
- D. Acceptable coupling and adapter Manufacturers: EBAA Iron Megalugs.

## **2.03 WATER UTILITY TRANSMISSION AND DISTRIBUTION PIPELINE ACCESSORIES**

- A. Trust Restraints
  - 1. Mechanical Restraints
    - a. Polyvinyl Chloride (PVC) Pipe:
      - (1) Megalug Series 2000 PV restraint gland or equal for mechanical joint restraint.
      - (2) EBAA Iron, Inc. Series 1600 for AWWA C-900 pipe push-on joint restraint and EBAA Iron, Inc. Series 2800 for AWWA C-905 pipe push-on joint restraint, or equal.
  - 2. Concrete Thrust Blocks
    - a. Ready-mixed concrete conforming to the following:
      - (1) 28-day Comp. Str.: 3000 (PSI)
      - (2) Max. Size Coarse Aggregate: 1 ½"
      - (3) Min. Cement Content: 4.75 (Bags/C.Y.)

- (4) Air Content: 6+/-1 (%)
- (5) Slump: 3 inch - 4 inch
- (6) Job-mixed concrete is permitted for amounts one cubic yard or less and shall meet the same material and strength requirements as ready-mixed concrete.

3. Tie Rods

- a. Rods and straps shall meet ASTM A-575, Grade M 1020.
- b. Rods shall be minimum ¾" diameter to 16" pipe diameter.
- c. Clamps, nuts, washers, and other components shall be of corrosion-resistant material.

B. Polyethylene Encasement for Ductile Iron Fittings, Valves, Valve Boxes, and Curb Boxes

1. Conform to requirements of AWWA C105.
2. Type: I
3. Class: "A" (natural color) or "C" (black).
4. Grade: "E-1"

## 2.04 WATER SERVICE PIPE, VALVES AND APPURTENANCES

A. Pipe and Tubing

1. Pipe and/or tubing material and size shall be as stated in the Bid Form and as shown on the Engineered Plans.
2. Polyethylene (PE) tubing: Conform to the requirements of AWWA C901, PE 3408, DR 9, for sizes up to 2 inches.
3. Polyethylene (PE) pipe: Conform to the requirements of AWWA C901, PE 3408, DR 11, for sizes greater than 2 inches up to 3 inches.

B. Tapping or Service Saddles

1. Required for PVC service taps.
2. Acceptable Manufacturers: Cascade CSC-2 Double Bolt Stainless Steel.

C. Corporation Stops/Valves

1. Conform to the requirements of AWWA C800.
2. Ball type valve with double O-ring seals.
3. Outlet shall include a copper flare or compression connection for copper tubing or compression connection with stiffeners for polyethylene tubing.
4. Acceptable Manufacturers: A.Y. McDonald A4701B-22.

D. Curb Stops/Valves

1. Conform to the requirements of AWWA C800.
2. Minneapolis pattern ball type valve with double O-ring seals.
3. Inlet and outlet shall include copper flare or compression connection for copper tubing or compression connection with stiffeners for polyethylene tubing.
4. Acceptable Manufacturers: A.Y. McDonald 6100-22 with Saddle Type Adapter.

E. Curb Boxes

1. Minneapolis pattern.
2. Cast iron lid with 1¾" threaded brass pentagon plug and the word "Water" on top in raised letters.
3. Upper section shall be minimum 1¾" I.D. steel pipe.
4. Base section shall be minimum 1¾" I.D. cast iron.
5. Provide shut-off rod extension for curb stop.
6. Length shall be 6.5 feet when extended.
7. Acceptable Manufacturers: A.Y. McDonald 5607 with 48" stainless steel rod.

## 2.05 WATER UTILITY SERVICE VALVES

A. General

1. Valves shall be for buried service.
2. Provide mechanical joint valve end connections unless in a manhole structure, then provide flanged joint.

3. Mechanical joints to conform with AWWA C111 and as follows:
  - a. Ductile or gray iron follower gland.
  - b. Tee-head bolts and hexagonal nuts shall be 304 stainless steel with an anti-seize mechanism
  - c. Gaskets
    - (1) Plain rubber gasket for sewer and water to temperatures not exceeding 150°F.
    - (2) Buna-N Nitrile (NBR) in petroleum contaminated soils.
  - d. Operating stem shall turn counterclockwise to open.
  - e. Seal shaft or stem using O-ring seals.
4. Flanged Joints
  - a. Conform with AWWA C115.
  - b. Joints shall include:
    - (1) Ductile iron flanges.
    - (2) Bolts with nuts.
    - (3) Gaskets
    - (4) Sheet rubber gaskets, full face, minimum 1/8 inch thick for sewer and water to temperatures not exceeding 150°F.
  - c. Use above grade, in manholes, in structures and other areas where the joint is exposed.
5. Provide and install valve extension stems on all valves.

**B. Butterfly Valves**

1. Conform to requirements of AWWA C504 mechanical joint end valves, Class 150B.
2. Use where water main is larger than 12 inches diameter.
3. Equip with traveling nut or worm gear operators.
4. Valve Body: Cast iron ASTM A126, Class B

5. Valve Shaft: Stainless steel 304
6. Valve Disc: Ductile iron ASTM A536 with 304 stainless steel disc edge.
7. Acceptable Manufacturers: Dresser "M&H", Clow / Kennedy, and Mueller / Pratt.

C. Resilient Wedge Gate Valves

1. Conform to requirements of AWWA C509 or AWWA C515 mechanical joint connectors.
2. Use where water main is 12 inches diameter or smaller.
3. Stem shall be non-rising.
4. Tapping valves shall have one end flanged with alignment lip to attach tapping sleeve, and the other end with a special flange to attach the drilling machine and adaptor.
5. Acceptable Manufacturers: Mueller, Clow, or Waterous.

D. Valve Boxes

1. Cast iron, three-piece screw type, 5¼ inch shaft, round or oval base sized for valve.
2. Threads shall be cast into top and bottom sections.
3. Cover shall be anti-rattle type mark with the word "water" on top.
4. Valve boxes shall be North American made.
5. Valve box adaptor shall be provided to ensure valve box is centered on control valves. Shall be manufactured by Adaptor, Inc. or approved equal
6. Acceptable Manufacturers: Tyler, Bingham and Taylor, and Bibby-Ste. Croix.

E. Air Release, Vacuum Relief Valves

1. Conform to AWWA C512, combination air valve.
2. Body inlet shall be threaded connection and piped to discharge down.
3. Threaded cover outlet.
4. Valve body and cover shall be cast iron with other metal parts stainless steel.

5. Maximum working pressure of 300 psi.
- F. Acceptable Manufacturers: Mueller / Pratt and Val-Matic.

## **2.06 WATER UTILITY SERVICE HYDRANTS**

- A. Conform to requirements of AWWA C502.
- B. Compression type shutoff with bronze by bronze seating design opening against the pressure and closing with the pressure.
- C. Main Valve Opening: 5¼"
- D. Minimum Barrel Diameter: 7"
- E. Provide traffic model with upper and lower barrels joined at the ground line by a separate, breakable, and replaceable flange joint and providing 360 degrees rotation of upper barrel.
- F. Design hydrant to accept barrel extensions.
- G. Nozzles
  1. Provide three-way design with one 4 ½" NST pumper nozzle and two 2½" NST hose nozzles.
  2. Provide nozzle caps with nut the same size as the operating nut and chain.
- H. Bury depth shall be as shown on the Engineered Plans.
- I. Inlet connection shall be 6 inch mechanical joint conforming with AWWA C111 and as follows:
  1. Ductile or gray iron follower gland.
  2. Tee-head bolts and hexagonal nuts shall be 304 stainless steel with an anti-seize mechanism
  3. Gaskets
  4. Plain rubber gasket for sewer and water to temperatures not exceeding 150°F.
  5. Buna-N Nitrile (NBR) in petroleum contaminated soils.
- J. Paint hydrant top section the color yellow.
- K. Hydrant to have 16" break-off section.

- L. 1½" pentagon operating nut to open left.
- M. Hydrant Markers
  - 1. Stainless steel 53" long shaft, bracket and wound spring wire spring cell in one piece.
  - 2. Staff topped with a steel flag.
  - 3. 5/8" x 4½" flange bolt for bolting to hydrant.
  - 4. Manufactured by Nordic Fiberglass, Inc., Warren, MN.
- N. Acceptable Hydrant Manufacturer: Waterous PacerWB-67.

## **2.07 HYDROSTATIC PRESSURE AND LEAKAGE TESTS EQUIPMENT**

- A. Provide the pump, pipe connections, and all necessary apparatus for the pressure and leakage tests including gauges and metering devices.
- B. Pressure gauges used for testing shall have no greater than 5 psi increment markings.

## **2.08 INSULATION BOARD**

- A. Extruded polystyrene conforming to ASTM C578, Type IV.
  - 1. Compressive strength of at least 40 PSI.
  - 2. Minimum R-value of 5.
  - 3. Maximum water absorption of 0.17% by volume
- B. Each board shall be 2 inches thick x 4 feet wide x 8 feet long.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Protection of In-Place Conditions
  - 1. Protection of Work, Public, and Property
    - a. Provide safe passage for local vehicular and pedestrian traffic.
    - b. Provide vehicular and pedestrian access to properties abutting street where utilities are being constructed.

- c. Provide all necessary barricades, warning lights, and signs, signals, flagmen, etc. in accordance with federal, state, and local regulations.
- d. Provide and maintain safety equipment for confined entry at the project site at all times for use by the Contractor's personnel and Owner's Representative.
- e. Organize and perform construction activities to minimize the creation of airborne dust and the tracking of mud and dirt into public streets.
- f. If dust is generated, implement control measures such as:
  - (1) Street sweeping with use of water and vacuum, and cleaning.
  - (2) Water sprinkling or application of chemical dust suppressant.
  - (3) Cover dusty materials in piles or in transit.
  - (4) Protect buildings that may be adversely affected.
  - (5) Protect new and existing machinery, motors, instrument panels or similar equipment with suitable dust screens.
    - i) Provide proper ventilation with dust screens.

2. Protection of Utilities and Structures

- a. The existing utilities and structures are shown on the Engineered Plans may not be all inclusive.
- b. The locations of existing utilities and structures are shown on the Engineered Plans for information to the Contractor, but should not be construed as representative of the exact location.
- c. Maintain or provide:
  - (1) Service of water, sewers, gas, culverts, drains, electricity, or other utilities encountered.
  - (2) Temporary connections and outlets for all private and public utilities that are interrupting construction.

- (3) Disposal for all drainage and sewage resulting from relocations and/or interruptions in accordance with regulations and permits of the controlling governmental agency(s).
- (4) Correct any damage to below or above ground utilities and structures encountered during construction.

d. Separation of Water Mains and Sewers

- (1) Provide minimum separations between sewers and water mains:
  - i) Parallel - 8 feet, measured center to center.
  - ii) Vertical (when pipelines cross or when horizontal clearance is impossible)
    - a) Water Main Below a Sewer: 18 inches clear. (Both pipes shall be constructed of water main quality pipe and joints for ten feet either side of the crossing)
    - b) Water Main Above a Sewer: 6 inches clear.
- (2) When crossing a sewer, center a full length of water main or sewer to position joints as far as possible from sewer.

3. Protection of Established Property Markers

- a. Protect all property markers (iron pipe, concrete, or wood posts, etc.) from movement from original position.
- b. Pay costs of replacement of property markers moved during construction.

B. Demolition / Removal

- 1. Provide demolition and/or removal of paved surfaces.
  - a. Minimize the removal area and protect paved surfaces outside trench area.
  - b. Provide in accordance to appropriate Specification Section.

**3.02 WATER UTILITY PIPING INSTALLATION**

A. General

1. Vertical and Horizontal Alignment:
  - a. Install pipe to maintain vertical and horizontal alignment as shown on the Engineered Plans.
  - b. Place pipe to required line and grade with a tolerance of plus or minus 0.1 feet.
  - c. Install pipe without unplanned high points in the line, and a minimum cover over the top of pipe of 6.5 feet with a maximum of 7.0 feet.
    - (1) In areas with no proposed finish grade provided, the minimum shall be 6.5 feet below existing grade.
  - d. Provide fittings, valves and hydrants at the required locations with joints centered, spigots bottomed and valve and hydrant stems plumb.
  - e. Commence pipe installation only after the trench has been dewatered below the trench bottom and all necessary sheeting and bracing is in place.
  - f. Use full length pipe except where necessary at valves and fittings.
  - g. Cut pipe to provide a smooth end at a right angle to the longitudinal axis of the pipe.
  - h. Assemble pipe in accordance with the written recommendations of the manufacturer.
  - i. When the interruption or operation of an existing pressure pipeline system is necessary to complete construction, conform to the following:
    - (1) Owner will operate system at Contractor's request.
    - (2) Confine requests to Owner's normal working schedule.
    - (3) Do not operate controls or appurtenances.

B. Open Cut Installation Method

1. Pipe construction of any pipe material shall follow the recommended procedures of ASTM F1668.
2. Trench requirements shall conform to the appropriate Specification Section.

3. Keep pipe clean during and after laying.
4. Do not roll, drop or dump pipe appurtenances into the trench.
5. When laying operations are interrupted or terminated, temporarily seal pipe ends to prevent entry of water, debris, small animals, or other types of contamination. Prevent flotation of the sealed pipe.

C. Trenchless Excavation Method

1. Boring and Jacking:
  - a. Provide casing pipe bored and jacked in-place in accordance to the appropriate Specification Section, at line and grade to accommodate the carrier pipe.
2. Horizontal Directional Drilling:
  - a. Install pipe directly by horizontal directional drilling in accordance to the appropriate Specification Section at the line and grade shown on the Engineered Plans.
  - b. Design pipe as required above that specified to accommodate tensile stress during the installation process.

D. Polyvinyl Chloride (PVC) Pipe Installation

1. Install pipe and appurtenances in accordance with AWWA C605.
2. Do not bend pipe.

E. Polyethylene (PE) Pipe Installation

1. Install pipe in accordance with ASTM D2774.

F. Pipe Embedment

1. Plastic Pipe - Class "B" Embedment:
  - a. Bedding, Haunching and Initial Backfill:
    - (1) 4" below pipe to 12" above the pipe, place Soil Class A-7 material work by hand to insure all excavated voids are filled.
    - (2) If in rock, place Soil Class A-7 material 6" below pipe to 12" above the pipe and work by hand to insure all excavated voids are filled.

- (3) Block pipe installed through steel casing so as not to touch steel casing and fill the annular space between steel casing and carrier pipe.

G. Thrust Restraints

1. Provide at mechanical joint and push-on joint connections including valves, hydrants, and fittings including plugs, caps, tees, reducers and bends.
2. Provide thrust restraint with mechanical restraints or tie rods which physically prevent joint separation; or poured in place concrete thrust blocks constructed to transfer the thrust load from the pipe to the undisturbed soil of the trench wall.
3. When using mechanical restraints or tie rods, restrain the fitting joints within the following minimum pipe length on each side of the fitting unless manufacturer's submitted calculations and recommendations indicate otherwise:

RESTRAINED/TIED PIPE LENGTH CHART								
Minimum Length Requiring Restraint in Feet (Bare Pipe)								
Fitting Type	6"	8"	10"	12"	16"	20"	24"	30"
11.25 degree bend	10	10	10	10	20	20	20	20
22.5 degree bend	10	10	10	15	20	20	35	40
45 degree bend	15	20	25	30	40	45	50	65
90 degree bend	20	20	25	40	60	80	80	120
Tee (side tied)	15	20	30	35	50	65	80	110
Stubs or dead ends	25	35	45	50	65	80	95	120
Cross with plugged	15	20	30	35	50	65	80	110
Valves at end of line	25	35	45	50	65	80	95	120
The above lengths (given in feet) represent the minimum length of pipe to be tied together in each required direction from the fitting described.								

4. Where grade changes are made in the line by means of bends, secure the top bends by tie rods and secure the bottom bends by means of poured in-place concrete thrust blocks or provide mechanical restraints within a pipe length of 30' of the joint.
5. Install mechanical restraints in accordance with the manufacturer's recommendations. Use a torque limiting twist off nut without the need for a torque wrench to insure proper actuation of the restraint wedge.
6. Encase tie rods, associated materials, and the restrained pipe with polyethylene.
7. Restrain hydrants with mechanical restraints or with tie rods connecting all joints between the hydrant and the main line.

#### H. Connections to Existing Water Main

1. Verify material composition of existing main or lateral, as applicable.
2. Provide adaptors and sleeves necessary to make connection to main or lateral.
3. Provide a leak-free connection.
4. Wet Taps to Existing Water Main
  - a. Schedule tap with Owner and Engineer a minimum of two (2) working days in advance.
  - b. Use approved tapping machine designed specifically for tapping under pressure.
  - c. Disinfect sleeves, valve, and tapping machine with chlorine solution prior to assembly.
  - d. Install tapping sleeve and valve in accordance with manufacturer's instructions.
    - (1) Maintain separation from ends of sleeve to adjacent joints or fittings.
    - (2) Install a solid concrete block beneath valve for support.
  - e. Perform a leakage test on the installed tapping sleeve and valve and provide for inspection by the Engineer and Owner. No leakage will be allowed.

- f. When tapping sleeve or tapping valve leaks, remove, reinstall, and replace, if necessary, tapping sleeve and tapping valve. Retest reinstalled or replaced sleeves and valves until they achieve satisfactory test results.

I. Maintain Water Service

- 1. Maintain water service to the greatest extent reasonably possible using temporary water systems, appropriate staging of construction operations, and other Owner and Engineer approved methods.
- 2. Coordinate water shut-offs with the Owner providing a minimum of 24 hours' notice to residents prior to shutting off their water.
- 3. Unless pre-approved by the Owner and Engineer, the maximum allowable duration of water service interruption to water utility customers shall be 4 hours. Customers to whom water service is critical (as determined by Owner), shall have service interruption limitations and accommodation needs determined on a case by case basis.
- 4. If a temporary water system is employed to maintain water service during construction, it shall meet the following requirements:
  - a. The temporary water system shall be suitably sized to provide sufficient flow rate and adequate pressure, shall be thoroughly cleaned and disinfected in accordance with the specifications immediately prior to its installation, and shall be free of leakage.
  - b. Provide backflow preventers on temporary water system connections to source water.
  - c. Adequately anchor or strap fittings and bends to prevent blow-off.
  - d. Install the system so it is protected from damage during use and does not create a hazard for vehicular and pedestrian traffic.
  - e. Attachments to fire hydrants shall be made in a manner that will allow removal with minimum effort in case of emergency.
  - f. Obtain Engineer's approval of the temporary water system prior to interrupting any water service.

- J. Once the water is complete the Contractor shall schedule a walk through with the Sanitary District, the Municipal Engineer, and the Developer's Engineer. The Contractor shall correct all deficiencies prior to proceeding with roadway construction.

### **3.03 WATER SERVICE VALVES INSTALLATION**

- A. Corporation stops
  - 1. Install at 2 o'clock and 10 o'clock position on the pipe circumference.
  - 2. Do not install taps closer than 2 feet from end of pipe and not closer than 18" between taps.
  - 3. Pipe shall be tapped with a service saddle.
  - 4. Tap ductile iron pipe in accordance with AWWA C600.
  - 5. Install service connections to PVC pipe in accordance with AWWA C605 using service saddles.
  - 6. Install corporation stops with the pipeline at normal working pressure while observing any leaks.
  - 7. Tap the service with use of manual feed equipment using a cutter designed specifically for the material tapped.
- B. Curb Stops
  - 1. Install at the property line or as shown on the Engineered Plans.
  - 2. Provide curb box centered over operating nut of the valve.
  - 3. Provide shut-off extension rod on curb stop valve operator.
  - 4. Adjust top of the curb box flush with finished grade.
- C. Water services to be installed to right of sanitary sewer lateral when looking at the lot.

### **3.04 WATER UTILITY DISTRIBUTION VALVES INSTALLATION**

- A. Install in accordance with AWWA C600.
- B. Provide gate valves for sizes up to and including 12 inches.
- C. Provide butterfly valves for sizes over 12 inches.
- D. Support valves on 6 inches of soil class A-7 crushed rock pipe bedding material.
- E. Provide a valve box centered plumb over the operating nut of the valve and placed such that the box will not transmit shock or stress to the valve. Adjust the top of the valve box flush with finished grade.

- F. Provide and connect air release, vacuum relief valves to the main with a tee fitting and isolation valve. Install per manufacturer's recommendations.

### **3.05 WATER UTILITY DISTRIBUTION HYDRANT INSTALLATION**

- A. Install where shown on the Engineered Plans in accordance with AWWA C600.
- B. Install hydrants plumb with the nozzles parallel with or at right angles to the road as determined by the Owner.
- C. Set to grade with the breakaway flange not less than 2 inches nor more than 6 inches above established grade.
- D. Provide a drainage pit at the base of the hydrant placing soil class A-7 crushed rock pipe bedding material from 3 feet below the hydrant to a minimum of 6 inches above the drain - port opening in the hydrant and at least 1 foot around the elbow.
- E. If groundwater is above the drain port, or the drain port is within 8 feet of a sanitary sewer or storm inlet, or if there are contaminated soil, then plug the port. Install tag on hydrant which reads "Pump After Each Use". Notify Owner in writing of port plugged hydrant.
- F. Provide hydrant marker by removing one bolt from top flange and bolting bracket to top flange of hydrant.
- G. Place 8.0 mil polyethylene sheets over hydrants until acceptance by the Greenville Sanitary District #1.
- H. Pump hydrant barrels dry prior to acceptance of project.

### **3.06 INSULATION BOARD FOR PIPE FROST SHIELD**

- A. Provide where shown on the Engineered Plans or as directed by the Municipal Engineer or Director of Public Works.
- B. Install insulation board in an inverted U around the pipe.
  - 1. The top width of the insulation board frost shield shall be the same as the trench width centered over the pipe.
  - 2. The sides of the U shall be 2' high with the bottom of the legs at least to the springline of the pipe.
- C. Install the insulation board in layers to provide a minimum thickness of 4" or the thickness stated on the Engineered Plans.
- D. Install such that there are no voids under the insulation.

### **3.07 FIELD QUALITY CONTROL**

- A. Demonstrate that all valves, hydrants, curb stops operate fully open and closed.
- B. Demonstrate that all valves are in open position.
- C. Provide Hydrostatic Pressure and Leakage Tests

### **3.08 DISINFECTION OF WATER MAINS**

- A. Method: Use Calcium Hypochlorite Tablet Method in accordance with requirements of AWWA C651.
- B. One pound of commercial (70%) Calcium Hypochlorite to 1,680 gallons of water may be used in lieu of tablets.
- C. Section being tested shall be isolated from remainder of system.
- D. Flushing
  - 1. Disposing of chlorinated water flushed from mains shall flow into sanitary sewers. Discharge to trout streams, or lakes will not be allowed unless water is dechlorinated prior to discharge and discharge is approved by WDNR.
  - 2. Discharge into Owner's sanitary sewer system after dechlorination must have Owner's approval.
- E. Testing
  - 1. Two samples are required to test for presence coliform bacteria for every 1,200 feet of new water main, at end of lines, and at each branch.
  - 2. Take one sample and test for coliform bacteria prior to the pressure and leakage test and take one sample and test for coliform bacteria after pressure and leakage test before services are activated.
  - 3. Provide sampling tap and collect samples.
  - 4. Provide coliform bacteria analysis testing.
  - 5. Provide results of tests to Engineer prior to making service connections.

### **3.09 CLEANING**

- A. Pipelines
  - 1. Interiors of utility pipelines (including existing) affected by construction procedures shall be free of all extraneous materials.

2. Pipelines shall be clean at the completion of work.
- B. Final Cleanup and Inspection
1. Remove the following:
    - a. Temporary offices and storage structures.
    - b. Temporary fencing and roads.
    - c. Surplus material and rubbish.
    - d. Material (liquid or solid) resulting from cleaning operations.
  2. The Engineer and Owner may make a final inspection of the work during the progress of the final cleaning and repairing. Any portion of the work accepted by the Owner shall be kept clean by the Contractor until final acceptance of the entire project.
  3. During construction, clean up as the Work proceeds. Keep the premises free of accumulations of waste materials and earth, rubbish and other debris resulting from the work.
  4. All debris, waste materials and salvaged materials, unless required by the Specifications to be reused or delivered to the Owner, shall become the property of the Contractor and shall be removed from the construction site.
  5. Sidewalks shall be kept free from all spilled earth and grading materials and shall be maintained in a passable condition for foot traffic.
  6. Generally, the transportation of materials to and from the sites shall be over regular streets. When the Contractor's operations or that of its shippers, haulers, or subcontractors are such that dirt, mud, or debris is spilled or otherwise deposited on streets, driveways, sidewalks, or other thoroughfares, clean up the large chunks before the close of every day's operations or before it is broken up or becomes impacted on the surface. In case of dispute or Contractor's failure to perform this cleanup work, the Owner may clean the streets and walks, remove the rubbish, etc., and will charge the cost to the Contractor, by withholding monies due to cover all charged work.
  7. After completion of work in any of the site work areas, remove all waste materials, rubbish and debris from and about the premises as well as all tools and surplus materials, and leave the sites clean and ready for occupancy by the Owner. Restore to original condition any roads, utilities, walks, buildings, etc. disturbed or damaged by the Contractor's operations.

8. Open burning of debris will not be permitted unless specifically authorized in writing by the Owner, and then only following state, municipal or other local codes, ordinances, rules or regulations.

**END OF SECTION**

**SECTION 33 31 00**  
**SANITARY SEWERAGE PIPING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Sanitary Sewer Gravity Mains Installation
  - 2. Sanitary Sewer Force Mains Installation
  - 3. Sanitary Sewer Services Installation
  - 4. Force Main Valves
  
- B. Products Installed but not Furnished or Supplied Under this Section
  - 1. Sanitary Sewer Gravity Pipe
  - 2. Sanitary Sewer Force Main Pipe
  - 3. Sanitary Sewer Services Pipe

**1.02 REFERENCES**

- A. American Society for Testing and Materials (ASTM):
  - ASTM A575 Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
  - ASTM C578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
  - ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity - Flow Applications
  - ASTM D2774 Standard Practice for Underground Installation of Thermoplastic Pressure Piping
  - ASTM F1668 Standard Guide for Construction Procedures for Buried Plastic Pipe
  
- B. American Water Works Association (AWWA)
  - AWWA C105 Polyethylene Encasement for Ductile-Iron Pipe Systems
  - AWWA C600 Installation of Ductile-Iron Mains and Their Appurtenances
  - AWWA C605 Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings

### **1.03 ALLOWANCES**

- A. If so stated in specification “Allowances”, installation testing will be paid as an allowance. All other testing shall be incidental to the work.
- B. If there is no reference in the specification section “Allowances” to sewer collection system testing, then testing costs shall be included in the cost for sewer collection system.

### **1.04 SUBMITTALS**

- A. Action Submittals
  - 1. Product Data
    - a. Provide product data sheet.
- B. Informational Submittals
  - 1. Certificates
    - a. Certification of production date of all materials.
    - b. Manufacturer's certification that the materials were manufactured, sampled, tested, and inspected in accordance with this specification and appropriate referenced standards.
  - 2. Manufacturers’ Instructions
    - a. Manufacturer's recommendations for assembly.

### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery and Acceptance Requirements
  - 1. Inspect the pipe shipment to identify shifted loads, broken packaging or rough treatment, which could be an indication of damage.
  - 2. Pipe and fittings shall be marked as follows:
    - a. Manufacturer's name, trademark or logo.
    - b. Nominal size.
    - c. PVC cell classification.
    - d. Pipe stiffness designation, dimension ratio or schedule size and pressure class.

- e. ASTM or AWWA specification designation.
  - f. Production date.
- B. Storage and Handling Requirements
- 1. Unload the pipe in a manner that will not put stress on the pipe or strike anything causing damage.
  - 2. Place and store the pipe package units on level ground stacked no more than 8 feet high. Do not store close to heat sources.
  - 3. Store gaskets away from excessive exposure to heat, direct sunlight, ozone, oil or grease.
  - 4. Store solvent cement in tightly sealed containers away from excessive heat.
  - 5. Handle pipe in a manner to prevent impact blows, abrasion damage, gouging or cutting.
  - 6. When handling pipe in cold weather, provide additional care to prevent damage due to impact.

## **PART 2 - PRODUCTS**

### **2.01 SANITARY SEWERAGE GRAVITY PIPING**

- A. Provide type of pipe shown on Engineered Plans or stated in Bid Form.
- B. Do not use more than one material brand and manufacturer.
- C. Provide sanitary sewerage gravity pipe in accordance to the appropriate Specification Section.

### **2.02 SANITARY SEWER FORCE MAIN PIPING**

- A. Provide type of pipe shown on Engineered Plans or stated in Bid Form.
- B. Do not use more than one material brand and manufacturer.
- C. Provide sanitary sewer force main pipe in accordance to the appropriate Specification Section.

### **2.03 FORCE MAIN VALVES**

- A. Check Valves
  - 1. Iron bodied, bronze mounted, clearway or full opening type.

2. Adjustable weighted arm to reduce slam in closing.
3. Disk shall have brass or bronze faces.
4. End connection shall be flanged, faced and drilled to ANSI 125/150 lbs.
5. Clow.

B. Plug Valves

1. Non-lubricated, eccentric type with resilient faced plugs.
2. End connections shall be flanged.
3. Port areas shall be at least 80% of full pipe area.
4. Valve bodies shall be cast iron.
5. All exposed nuts, bolts, springs, washers, etc. shall be stainless steel plated.
6. Resilient plug facings shall be of neoprene suitable for use with raw sewage.
7. Valves shall be furnished with corrosion resistant seats having a welded overlay of high nickel content on all surfaces containing the piping face.
8. Bearings and Seals:
  - a. Valves shall be furnished with replaceable, sleeve-type bearings in the upper and lower journals.
  - b. Bearings shall comply with AWWA Standard C507-73, paragraphs 8.1, 8.3 and 8.4 and with AWWA Standard C504-74 Section 9.
  - c. Valves through 20" shall have permanently lubricated, stainless steel bearings in the upper and lower plug stem journals, valves 24" and larger shall have bronze bearings and stainless steel sleeves in the upper and lower plug stem journals.
  - d. Valve shaft seals shall comply with AWWA Standard C507-73 Section 10 and with AWWA C504-74 Section 10. Split V-type packing with multiple rings and adjustable packing gland which will allow replacement of packing under pressure without valve disassembly shall be standard for all plug valves in use for raw sewage.
9. Actuators for Plug Valves:

- a. Manual valves shall have lever or gear actuators and tee wrenches.
- b. All valves 6" and larger shall be equipped with gear actuators.

10. Acceptable Manufacturers: Clow.

C. Combination Air Release and Vacuum Break Valve

1. Combination air valve, single body, double orifice. Designed for wastewater service.
2. Vent-O-Mat, or equal.
3. Designed to allow large volumes of air to escape out of large orifice when filling the pipeline and allow large volumes of air to enter the large orifice when draining the pipeline to break the vacuum.
4. Trapped pockets of air shall automatically exit the pipeline through a small orifice when the pipeline is operating under pressure.
5. Provide watertight shutoff to prevent discharge of water.
6. Provide a compact tubular all stainless steel fabricated body, hollow direct acting float and solid large orifice float in HDPE - stainless steel nozzle and woven dirt inhibitor screen, nitrile rubber seals and natural rubber seat.
7. An integral "anti-surge" orifice mechanism shall operate automatically to limit transient pressure rise or shock induced by closure to less than 2 x valve rated working pressure. The intake orifice area shall be equal to the nominal size of the valve.
8. Large orifice sealing shall be affected by the flat face of the control float seating against a nitrile rubber "O" ring housed in a dovetail groove circumferentially surrounding the orifice.
9. Discharge of pressurized air shall be controlled by the seating and unseating of a small orifice nozzle on a natural rubber seal affixed into the control float. The nozzle shall have a flat seating land surrounding the orifice so that damage to the rubber seal is prevented.
10. The valve construction shall be proportioned with regard to material strength characteristics, so that deformation, leaking or damage of any kind does not occur by submission to twice the designed working pressure.
11. Connection to the valve inlet shall be facilitated by flanged ends conforming to ANSI B16.1 Class 125 Standards.

12. Flanged ends shall be supplied with the requisite number of stainless steel screwed studs inserted for alignment to the specified standard. Nuts, washers or jointing gaskets shall be excluded.
13. Valve shall operate to a maximum operating pressure of 150 psi and minimum pressure of 0 psi.
14. Provided with an isolation valve.
15. Perform the following factory tests in the order represented.
  - a. Hydrostatic test to 2X maximum rated working pressure.
  - b. Low head leak test to 7 psi.
  - c. Small orifice function test at maximum rated working pressure.
16. Size shall be as shown on Engineered Plans.

#### **2.04 MANHOLES**

- A. Provide manholes in accordance with the appropriate Specification Section.

#### **2.05 PIPE EMBEDMENT MATERIAL**

- A. Soil Class A-7, ¾" crushed rock in accordance with the appropriate Specification Section.

#### **2.06 ACCESSORIES**

- A. Thrust Restraints
  1. Mechanical Restraints
    - a. Ductile Iron Pipe and Fittings:
      - (1) Megalug Series 1100 follower gland or equal for mechanical joint restraints.
    - b. Polyvinyl Chloride (PVC) Pipe:
      - (1) Megalug Series 2000 PV restraint gland or equal for mechanical joint restraint.
  2. Concrete Thrust Blocks
    - a. Ready-mixed concrete conforming to the following:

- (1) 28-day Comp. Str.: 3000 (PSI)
- (2) Max. Size Coarse Aggregate: 1 ½"
- (3) Min. Cement Content: 4.75 (Bags/C.Y.)
- (4) Air Content: 6+/-1 (%)
- (5) Slump: 3 inch - 4 inch
- (6) Job-mixed concrete is permitted for amounts one cubic yard or less and shall meet the same material and strength requirements as ready-mixed concrete.

3. Tie Rods

- a. Rods and straps shall meet ASTM A-575, Grade M 1020.
- b. Rods shall be minimum ¾" diameter to 16" pipe diameter.
- c. Clamps, nuts, washers, and other components shall be of corrosion-resistant material.

B. Geotextile Fabric for Filtration and Separation

1. Fabric shall be non-woven polyester, polypropylene or polyethylene conforming to the following minimums:
2. Grab Tensile Strength: 180 lbs.
3. Puncture strength: 68 lbs.
4. Apparent Breaking Elongation: 30%
5. Apparent Opening Size (Sieve Size): 50
6. Permittivity

C. Insulation Board

1. Extruded polystyrene conforming to ASTM C578, Type IV.
2. Each board shall be 2 inches thick x 4 feet wide x 8 feet long

D. Tracer Wire

1. Provide in accordance to the appropriate Specification Section.

E. Polyethylene Encasement for Ductile Iron Pipe and Fittings

1. Conform to requirements of AWWA C105.
2. Type: I
3. Class: "A" (natural color) or "C" (black).
4. Grade: "E-1"

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Clean pipe interior and joints prior to installation. Keep pipe clean during construction.
- B. Install watertight plug to prevent water from entering the existing sewer system.
- C. Provide bypass pumping of existing connecting sewer in accordance to the appropriate Specification Section.

### **3.02 SANITARY SEWER GRAVITY MAINS INSTALLATION**

- A. Separation of Water Mains and Sewers
  1. The following separations shall be minimum:
    - a. Parallel.
      - (1) 8 feet, measured center to center.
      - (2) Vertical (when pipelines cross or when horizontal clearance is impossible).
      - (3) Water Main Below a Sewer: 18 inches clear. (Both pipes shall be constructed of water main quality pipe and joints for ten feet either side of the crossing)
    - b. Water Main Above a Sewer: 6 inches clear.
  2. When crossing a sewer, center a full length of water main or sewer to position joints as far as possible from sewer.
  3. Coordinate relocation of any utilities within the work schedule.
- B. General
  1. Begin pipe installation at the lowest point in the line proceeding upstream with the bell end of the pipe pointing upstream.

2. Utilize full length pipe except at manholes or service branches.
  - a. Minimum pipe length entering and exiting manholes shall be 10 feet.
3. Use a saw to cut ends of pipe flush with inside wall of manholes and structures.
4. Provide cap, plug, or bulkhead at exposed ends of pipe upon completion of construction or whenever pipe installation is not in progress.
5. Vertical and Horizontal Alignment:
  - a. Install sewer pipe to maintain vertical and horizontal alignment as shown on the Engineered Plans.
  - b. Use laser equipment mounted in a manner to permit beam to shine through pipe.
  - c. Use a target to check each pipe installed.
  - d. Check laser beam alignment and grade a minimum of every 100 feet.
  - e. Use a fan to control air temperature variations in pipe and reduce bending of laser beam.
6. Install PVC pipe in accordance with requirements of ASTM D 2321.
7. Commence pipe installation only after dewatering the trench below the trench bottom and necessary sheathing is in place.
8. Once the sanitary sewer is complete the Contractor shall schedule a walk through with the Sanitary District, the Municipal Engineer, and the Developer's Engineer. The Contractor shall correct all deficiencies prior to proceeding with roadway construction.

C. Trenched Installation

1. Excavate trench and provide pipe bedding and backfill material in accordance to the appropriate Specification Section.
2. Prepare trench bottom to design line and grade so that only minor movement of the pipe is necessary after installation.
3. Lay pipe to design line and grade with set field grades to invert of pipe.

- a. Do not allow horizontal and vertical alignment to vary from design line and grade at any structure by more than 1% of the inside diameter of the pipe or 1/4 inch, whichever is larger.
- b. Do not allow the horizontal alignment of the pipe to vary from design line at any point along the pipe by more than 1% of the inside diameter of the pipe.
- c. Low spots holding water exceeding the following depths for each pipe size are unacceptable and shall be removed and reinstalled to proper grade.

Pipe Diameter	Maximum Low Spot Depth
8"	1/2"
10"	1/2"
12"	3/4"
15"	3/4"
18" and Larger	5% of Pipe Diameter*

\*Measured to the nearest 1/2"

- 4. Provide uniform bearing for full pipe barrel length. Excavate bell holes as necessary for uniform support of pipe barrel on bedding material.
- 5. Do not lay pipe in water or on saturated soil or bedding, or allow water to rise in trench around pipe prior to placing backfill material.
- 6. Do not disturb installed pipe and bedding when using movable trench boxes and shields. Block or anchor pipe as necessary to prevent joint displacement.
- 7. Install wye or tee service fitting at each location shown on the Engineered Plans.
  - a. Insert Tee fittings may be used for lateral connections on existing sanitary sewer.
- 8. Assemble pipe joints in accordance with manufacturer's recommendations.
- 9. Push "home" the spigot end of the pipe joint in the socket before proceeding to install the next pipe.

10. When connecting to an existing sewer not terminating in a manhole, uncover the end of the existing sewer prior to laying sewer to allow horizontal and vertical adjustments.
11. Install pipe such that pipe joints are located far enough from the manhole outside wall to permit future pipe repair without damaging the manhole and the joints do not fall within manhole walls.
12. Provide pipe embedment as shown on the Engineered Plans.

D. Trenchless Installation

1. Provide trenchless installation where shown on the Engineered Plans in accordance with the appropriate Specification Section.

E. Manholes and Other Structures

1. Provide manholes where shown on the Engineered Plans and make pipe connections in accordance to the appropriate Specification Section.
2. Provide flow lines and casting elevations from grade stakes and cut sheets provided by Engineer. Depths shown on Engineered Plans are approximate.

F. Connecting to Existing Sanitary Sewer Structure

1. Excavate to verify location and depth of existing structure. Notify Engineer immediately if location and/or depth conflict with the Engineered Plans.
2. Core drill a hole in the structure large enough to accommodate the pipe and a watertight flexible pipe gasket to manhole connection seal.
3. Provide a watertight flexible pipe gasket to manhole connection seal and commence pipe installation.

### **3.03 SANITARY SEWER SERVICES INSTALLATION**

- A. Depth of services at the property line shall be determined by the Utility District Manager or representative prior to installation.
- B. Provide sanitary sewer services at locations shown on the Engineered Plans.
- C. Unless otherwise specified, terminate laterals (service connections) at the property line.
- D. Connect sanitary sewer services to new sewer pipe using in-line wyes.

- E. Sanitary sewer services installed following installation of sewer pipe or in existing pipe shall use pipe saddles in order to avoid damage to pipe and to insure proper joint.
- F. All connections installed in concrete pipe shall use pipe saddles fitted over core drilled hole same size as lateral.
- G. Bends used at wye and where necessary in lateral shall be no greater than 45 degrees.
- H. Install sanitary sewer services as nearly as possible at right angles to sewer pipe and extended to property line.
- I. Minimum grade shall be 1/8 inch per foot.
- J. Plug sanitary sewer services to withstand low pressure air testing.
- K. Ends of laterals not being connected to existing laterals shall be marked with a 2" x 6" or 4" x 4" composite wood post positioned directly over end of lateral with top of post being 3' above finish grade in new developments.
- L. Install laterals in conformance with all plumbing codes and ordinances.
- M. Provide cleanouts required by plumbing codes and ordinances as part of the lateral installation.
- N. When a lateral is not connected for immediate use mark location in accordance with the appropriate Specification Sections.
- O. Risers:
  - 1. Provide at the property line for all mains deeper than 12' to facilitate a depth at the property line of 10'.
  - 2. Provide risers to terminate at the property line.
  - 3. Provide 45° bends.
  - 4. Place riser pipe on a minimum of 6" of bedding material on undisturbed soil.
- P. Connecting New Pipe to Existing Pipe
  - 1. If pipes are of the same material and size, then use coupling of the same pipe material designed for coupling pipe of the same material and size.

2. If pipes are of dissimilar material or dissimilar size or there is no coupling made of the same material, then provide a transition coupling with stainless steel shear ring. Provide bushings or inserts to maintain the flow line through the connection.

### **3.04 SANITARY SEWER FORCE MAINS INSTALLATION**

#### **A. General**

1. Vertical and Horizontal Alignment:
  - a. Install pipe to maintain vertical and horizontal alignment as shown on the Engineered Plans.
  - b. Place pipe to required line and grade with a tolerance of plus or minus 0.1 feet.
  - c. Install pipe without unplanned high points in the line, and a minimum cover over the top of pipe of 6.5 feet.
  - d. Provide fittings at the required locations with joints centered, spigots bottomed.
  - e. Commence pipe installation only after the trench has been dewatered below the trench bottom and all necessary sheeting and bracing is in place.
  - f. Use full length pipe except where necessary at fittings.
  - g. Cut pipe to provide a smooth end at a right angle to the longitudinal axis of the pipe.
  - h. Assemble pipe in accordance with the written recommendations of the manufacturer.

#### **B. Open Cut Installation Method**

1. Pipe construction of any pipe material shall follow the recommended procedures of ASTM F1668.
2. Trench requirements shall conform to the appropriate Specification Section.
3. Keep pipe clean during and after laying.
4. Do not roll, drop or dump pipe appurtenances into the trench.

5. When laying operations are interrupted or terminated, temporarily seal pipe ends to prevent entry of water, debris, small animals, or other types of contamination. Prevent flotation of the sealed pipe.

C. Trenchless Excavation Method

1. Boring and Jacking:
  - a. Provide casing pipe bored and jacked in-place in accordance to the appropriate Specification Section, at line and grade to accommodate the carrier pipe.
2. Horizontal Directional Drilling:
  - a. Install pipe directly by horizontal directional drilling in accordance to the appropriate Specification Section at the line and grade shown on the Engineered Plans.
  - b. Design pipe as required above that specified to accommodate tensile stress during the installation process.

D. Polyvinyl Chloride (PVC) Pipe Installation

1. Install pipe and appurtenances in accordance with AWWA C605.
2. Do not bend pipe.
3. Shall be used for open cut force mains.

E. Polyethylene (PE) Pipe Installation

1. Install pipe in accordance with ASTM D2774.
2. Shall be used for directionally drilled force mains.

F. Pipe Embedment

1. Plastic Pipe - Class "B" Embedment:
  - a. Bedding, Haunching and Initial Backfill:
    - (1) 4" below pipe to 12" above the pipe, place Soil Class A-7 material work by hand to insure all excavated voids are filled.
    - (2) If in rock, place Soil Class A-7 material 6" below pipe to 12" above the pipe and work by hand to insure all excavated voids are filled.

- (3) Block pipe installed through steel casing so as not to touch steel casing and fill the annular space between steel casing and carrier pipe.

G. Thrust Restraints

1. Provide at mechanical joint and push-on joint connections including plugs, caps, tees, reducers and bends.
2. Provide thrust restraint with mechanical restraints or tie rods which physically prevent joint separation; or poured in place concrete thrust blocks constructed to transfer the thrust load from the pipe to the undisturbed soil of the trench wall.
3. When using mechanical restraints or tie rods, restrain the fitting joints within the following minimum pipe length on each side of the fitting unless manufacturer's submitted calculations and recommendations indicate otherwise:

RESTRAINED/TIED PIPE LENGTH CHART								
Minimum Length Requiring Restraint in Feet (Bare Pipe)								
Fitting Type	6"	8"	10"	12"	16"	20"	24"	30"
11.25 degree bend	10	10	10	10	20	20	20	20
22.5 degree bend	10	10	10	15	20	20	35	40
45 degree bend	15	20	25	30	40	45	50	65
90 degree bend	20	20	25	40	60	80	80	120
Tee (side tied)	15	20	30	35	50	65	80	110
Stubs or dead ends	25	35	45	50	65	80	95	120
Cross with plugged	15	20	30	35	50	65	80	110
Valves at end of line	25	35	45	50	65	80	95	120
The above lengths (given in feet) represent the minimum length of pipe to be tied together in each required direction from the fitting described.								

4. Where grade changes are made in the line by means of bends, secure the top bends by tie rods and secure the bottom bends by means of poured in-place concrete thrust blocks or provide mechanical restraints within a pipe length of 30' of the joint.
5. Install mechanical restraints in accordance with the manufacturer's recommendations. Use a torque limiting twist off nut without the need for a torque wrench to insure proper actuation of the restraint wedge.
6. Encase tie rods, associated materials, and the restrained pipe with polyethylene.

H. Valves

1. Install in accordance with AWWA C600.
2. Valves shall be supported on 6 inches of crushed rock pipe bedding material.
3. Install valves in the closed position.
4. Air release, vacuum relief valves shall be provided and connected to the main with a tee fitting and isolation valve. Installation shall be per manufacturer's recommendations.

**3.05 INSULATION FOR PIPE FROST SHIELD**

- A. Provide where shown on the Engineered Plans.
- B. Install insulation board in an inverted "U" around the pipe.
- C. Install insulation board with the top insulation board the same width as the trench centered over the pipe.
- D. Install the sides of the U-shape 2 feet high with the bottom of the legs at least to the springline of the pipe.
- E. Install the insulation board in layers to provide a minimum thickness of 4" or the thickness stated on the Engineered Plans.
- F. Install such that there are no voids under the insulation.

**3.06 BULKHEADS**

- A. Bulkhead new construction to protect existing sewers from water, dirt, and debris.
- B. Do not remove bulkheads until new construction is accepted for use.

- C. Prior to removal of bulkhead, remove all material (liquid or solid) which accumulated behind bulkheads.

### **3.07 CLEANING AND REPAIRING SEWER LINES**

- A. Clean new sewer lines installed under this contract.
- B. Clean any existing sewer lines which are affected by construction.
- C. Furnish water and jetting equipment for cleaning operation.
- D. Repair all visible leaks and defects, whether or not the sewer lines have been subject to all required tests.
- E. Remove any stuck cleaning, inspection or testing equipment from sewer lines.

### **3.08 TRACER WIRE**

- A. Provide for all non-metallic sewer mains and for all non-metallic service laterals within public right-of-way.
- B. Provide in accordance to appropriate Specification Section.

### **3.09 FIELD QUALITY CONTROL**

- A. Televise sanitary sewer gravity mains in accordance to the appropriate Specification Section.
- B. Provide leakage testing of sanitary sewer gravity mains in accordance to the appropriate Specification Section.
- C. Provide deflection testing of sanitary sewer gravity mains in accordance to the appropriate Specification Section.
- D. Provide alignment testing of sanitary sewer gravity main in accordance to the appropriate Specification Section.
- E. Provide tracer wire continuity testing in accordance to appropriate Specification Section.

### **3.10 RECORD KEEPING**

- A. Measure and record the following for future location:
  - 1. Service branch locations.
  - 2. Sanitary sewer service locations at the termination point.

3. Riser lengths and location.

**END OF SECTION**

**SECTION 33 42 00**  
**STORMWATER CONVEYANCE**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Storm Sewer Pipe Installation
  - 2. Apron Endwalls Installation
  - 3. Outlet Structure Trash Rack
  - 4. Connect to Existing Storm Sewer
  - 5. Connect to Existing Storm Sewer Manhole
  - 6. Culvert Pipe Installation
  - 7. Drain Tile
- B. Products Installed but not Furnished or Supplied Under this Section.

**1.02 REFERENCES**

- A. American Concrete Pipe Association (ACPA)  
Concrete Pipe and Box Culvert Installation Manual
- B. American Society for Testing and Materials (ASTM):
  - ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity - Flow Applications
  - ASTM D3212 Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
  - ASTM F667 Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings
- C. American Association of State Highway and Transportation Officials (AASHTO)
  - AASHTO M36 Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
  - AASHTO M170 Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
  - AASHTO M252 Standard Specification for Corrugated Polyethylene Drainage Pipe

AASHTO M294 Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter

D. National Corrugated Steel Pipe Association (NCSPA)

Installation Manual for Corrugated Steel Pipe and Structural Plate

### **1.03 ALLOWANCES**

- A. If so stated in the specification “Allowances”, installation testing will be paid as an allowance. All other testing will be incidental to the Work.
- B. If there is no reference in the specification section to “Allowances”, then testing costs will be incidental to other Work items.

### **1.04 SUBMITTALS**

A. Action Submittals

1. Product Data

- a. Provide product data sheet(s).

B. Informational Submittals

1. Certificates

- a. Certification of production date of all materials.
- b. Manufacturer's certification that the materials were manufactured, sampled, tested, and inspected in accordance with this specification and appropriate referenced standards.

2. Manufacturers' recommendations for assembly.

## **PART 2 - PRODUCTS**

### **2.01 STORM SEWER PIPING**

- A. Provide type of pipe shown on Engineered Plans or stated in Bid Form.
- B. Do not use more than one material brand and manufacturer.
- C. Provide storm sewer pipe in accordance to the appropriate Specification Section.
- D. Pipes larger than 15” shall be reinforced concrete pipe. Less than 15” may be PVC if depth of cover is over 2 feet.

1. All pipes exposed to sunlight shall be reinforced concrete pipe unless otherwise approved by Municipal Engineer or the Director of Public Works

**2.02 CULVERT PIPE**

- A. Provide culvert pipe in accordance to the appropriate Specification Section.

**2.03 DRAIN TILE**

- A. Provide in accordance to the appropriate Specification Section.

**2.04 MANHOLES, INLETS AND CATCH BASINS**

- A. Provide manholes, inlets, and catch basins in accordance with the appropriate Specification Section.

**2.05 PIPE EMBEDMENT MATERIAL**

- A. Soil Class A-7, ¾" crushed rock in accordance with the appropriate Specification Section.
- B. Culvert Pipe:

Sieve Size	% Passing by Weight
1 1/4-inch	100
No. 4	25 - 100
No. 40	---
No. 100	0 - 30
No. 200	0 - 15

**2.06 ACCESSORIES**

- A. Apron End Walls and Trash Screen Materials
  1. For CMP pipes, provide apron end walls conforming to AASHTO M36.
  2. For RCP pipes, provide apron end walls conforming to AASHTO M170.
  3. Apron End Wall Trashguard
    - a. Provided for all apron end wall installations of 18" or greater diameter pipe.

- b. Provide a minimum of 1" diameter steel bar for 42" or less diameter pipe, 1-1/4" diameter steel bar for greater than 42" diameter pipe.
  - c. Provide minimum of 6" spacing between bars.
  - d. Connect to end walls with connector plates and bolts at a minimum of three (3) locations. Bolts shall be minimum of 3/4" diameter for 42" or less diameter pipe, 1" diameter for greater than 42" diameter pipe.
  - e. Provide galvanized bars and fasteners to provide corrosion resistance.
4. Outlet Structure Trashrack:
- a. Provide for all outlet structures.
  - b. Provide with a minimum of 1-1/4" diameter steel bar.
  - c. Provide minimum of 6" spacing between bars.
  - d. Connect to outlet structure with connector plates, brackets, and bolts to the outlet structure at a minimum of three (3) locations. Bolts shall be minimum of 1" diameter.
  - e. Provide galvanized bars and fasteners to provide corrosion resistance.

B. Geotextile Fabric for Filtration and Separation

- 1. Fabric shall be non-woven polyester, polypropylene or polyethylene conforming to the following minimums:
- 2. Grab Tensile Strength: 180 lbs.
- 3. Puncture strength: 68 lbs.
- 4. Apparent Breaking Elongation: 30%
- 5. Apparent Opening Size (Sieve Size): 50
- 6. Permittivity

C. Geotextile Fabric for Wrapping Drain Tile

- 1. Provide a geotextile of knitted, woven, or non-woven fibers of polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride. Do not use slit film woven fabrics.

2. The fabric shall conform to the following requirements:
    - a. Minimum Grab Tensile Strength: 35 lbs.
    - b. Apparent Opening Size (Sieve Size): No. 30 - 200
    - c. Minimum Permittivity:  $1.35 \text{ s}^{-1}$
  3. Fabrics
    - a. Provide knitted fabrics constructed from continuous yarn.
    - b. Non-woven fabrics may be needle-punched, heat-bonded, resin-bonded, or combinations of these three types.
    - c. Provide woven fabrics constructed from monofilament or multifilament yarns.
  4. Provide geotextile wraps of knitted construction that form a seamless sleeve and fit tightly over the pipe. If using geotextile wraps constructed from woven or non-woven fabric, then tightly wrap and securely fix to the pipe.
  5. Clearly mark the geotextile rolls to identify the type of fabric.
- D. Insulation Board
1. Extruded polystyrene conforming to ASTM C578, Type IV.
  2. Each board shall be 2 inches thick x 4 feet wide x 8 feet long.
- E. Tracer Wire - Provide in accordance to the appropriate Specification Section.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Clean pipe interior and joints prior to installation. Keep pipe clean during construction.
- B. Install watertight plug to prevent water from entering the existing sewer system.
- C. Provide bypass pumping of existing connecting sewer in accordance to the appropriate Specification Section.

### 3.02 STORMWATER CONVEYANCE INSTALLATION

#### A. Separation of Water Mains and Sewers

1. The following separations shall be minimum:
  - a. Parallel.
    - (1) 8 feet, measured center to center.
    - (2) Vertical (when pipelines cross or when horizontal clearance is impossible).
    - (3) Water Main Below a Sewer: 18 inches clear. (Both pipes shall be constructed of water main quality pipe and joints for ten feet either side of the crossing.)
  - b. Water Main Above a Sewer: 6 inches clear.
2. When crossing a sewer, center a full length of water main or sewer to position joints as far as possible from sewer.
3. Coordinate relocation of any utilities within the work schedule.

#### B. General

1. Begin pipe installation at the lowest point in the line proceeding upstream with the bell end of the pipe pointing upstream.
2. Utilize full-length pipe except at manholes or service branches.
  - a. Minimum pipe length entering and exiting manholes shall be a full pipe length.
3. Use a saw to cut ends of pipe flush with inside wall of manholes and structures.
4. Provide cap, plug, or bulkhead at exposed ends of pipe upon completion of construction or whenever pipe installation is not in progress.
5. Vertical and Horizontal Alignment:
  - a. Install storm sewer pipe to maintain vertical and horizontal alignment as shown on the Engineered Plans.
  - b. Use laser equipment mounted in a manner to permit beam to shine through pipe.
  - c. Use a target to check each pipe installed.

- d. Check laser beam alignment and grade a minimum of every 100 feet.
  - e. Use a fan to control air temperature variations in pipe and reduce bending of laser beam.
- 6. Install PVC pipe in accordance with requirements of ASTM D 2321.
  - 7. Commence pipe installation only after dewatering the trench below the trench bottom and necessary sheathing is in place.
  - 8. Once the storm sewer is complete the Contractor shall schedule a walk through with the Sanitary District, the Municipal Engineer, and the Developer's Engineer. The Contractor shall correct all deficiencies prior to proceeding with roadway construction.

C. Trenched Installation

- 1. Excavate trench and provide pipe bedding and backfill material in accordance to the appropriate Specification Section.
- 2. Prepare trench bottom to design line and grade so that only minor movement of the pipe is necessary after installation.
- 3. Lay pipe to design line and grade with set field grades to invert of pipe.
  - a. Do not allow horizontal and vertical alignment to vary from design line and grade at any structure by more than 1% of the inside diameter of the pipe or 1/4 inch, whichever is larger.
  - b. Do not allow the horizontal alignment of the pipe to vary from design line at any point along the pipe by more than 1% of the inside diameter of the pipe.
- 4. Provide uniform bearing for full pipe barrel length. Excavate bell holes as necessary for uniform support of pipe barrel on bedding material.
- 5. Do not lay pipe in water or on saturated soil or bedding, or allow water to rise in trench around pipe prior to placing backfill material.
- 6. Do not disturb installed pipe and bedding when using movable trench boxes and shields. Block or anchor pipe as necessary to prevent joint displacement.
- 7. Install wye or tee service fitting at each location shown on the Engineered Plans.

8. Assemble pipe joints in accordance with manufacturer's recommendations.
9. Push "home" the spigot end of the pipe joint in the socket before proceeding to install the next pipe.
10. When connecting to an existing sewer not terminating in a manhole, uncover the end of the existing sewer prior to laying sewer to allow horizontal and vertical adjustments.
11. Install pipe such that pipe joints are located far enough from the manhole outside wall to permit future pipe repair without damaging the manhole and the joints do not fall within manhole walls.
12. Provide pipe embedment as shown on the Engineered Plans.

D. Concrete Pipe

1. Install in accordance to American Concrete Pipe Association "Concrete Pipe and Box Culvert Installation Manual" and WisDot Standard Specification Section 522.
2. Circular concrete pipe with elliptical reinforcing shall be placed so reference lines indicating top of pipe are not more than 5 degrees from vertical plane through longitudinal axis of pipe.
3. Install RCP apron endwall at all culvert inlet and outlet locations.
4. Last three joints shall be tied at all culvert inlet and outlet locations with two pipe connections per joint.
5. All joints shall be tied where the pipe slope exceeds 20%.

E. Corrugated Metal Pipe

1. Install in accordance to National Corrugated Steel Pipe Association "Installation Manual for Corrugated Steel Pipe and Structural Plate" and WisDOT Standard Specification Section 521.
2. Install corrugated metal pipe apron endwall at all culvert inlet and outlet locations with two pipe connections per joint.

F. Drain Tile

1. Wrapping Pipe
  - a. Wrap the geotextile securely around the pipe underdrain along its entire length such that no water enters the underdrain without first passing through the fabric.

- b. Do not expose the fabric to the direct rays of the sun for more than 48 hours before covering.
  - c. Cover torn or punctured fabric with suitable geotextile extending at least 12 inches in all directions from the edge of the damaged fabric.
  - d. Overlap all joints or splices in the fabric a minimum of 18 inches.
2. Laying Pipe
- a. Lay pipe in the trench starting at the outlet end and proceed toward the upper end, true to line and grade.
  - b. Securely connect sections of corrugated polyethylene pipe with fittings conforming to AASHTO M252 or M 294.
  - c. Secure corrugated polyethylene pipe as necessary to prevent displacement during laying and backfilling.
  - d. Lay perforated drainage pipe with the perforations on the underside of the pipe.
  - e. Close the dead ends of pipe securely with concrete plugs, or watertight caps, or plugs fabricated from the same material used in the pipe.
  - f. Protect discharge ends of pipes with securely fastened gratings or screens.
3. A 4" perforated drain tile shall extend upslope 50' in both directions at inlets parallel to the road line. The drain tile shall be installed two feet below the proposed finished road elevation and shall connect to the inlet.
4. Drain tile discharging into storm structures shall be extended into the structure by approximately 6". Mortar space between pipe and existing structure so area is watertight and uniform with inside and outside of structure.
5. Provide drain tile outlets at each point of discharge other than storm structures.

### **3.03 CONNECT TO EXISTING STORM PIPE**

- A. Excavate to verify location, direction, and depth of existing pipe stubs. Notify Engineer immediately if actual location, direction, and/or depth conflict with the Engineered Plans.

- B. Remove any plugs or partial sections and commence pipe installation at nearest existing bell.

#### **3.04 CONNECT TO EXISTING STORM STRUCTURE**

- A. Excavate to verify location and depth of existing structure. Notify Engineer immediately if location and/or depth conflict with the Engineered Plans.
- B. Create opening in existing structure and commence pipe installation.
- C. Grout space between pipe and existing structure so area is watertight and uniform with inside and outside of structure.

#### **3.05 CLEANING**

- A. Clean existing culverts by jetting method where shown in the Engineered Plans.

**END OF SECTION**

**SECTION 33 46 11**  
**STORM WATER PONDS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Wet Detention Basin Liner
  - 2. Wet Detention Basin
  - 3. Soil Amendment

**1.02 REFERENCES**

- A. American Society for Testing and Materials (ASTM)
  - ASTM D422 Standard Test Method for Particle-Size-Analysis
  - ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>))
  - ASTM D1556 Test for Density of Soil in Place by the Sand-Cone Method
  - ASTM D1557 Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Lb (4.54 kg) Rammer and 18 in. (457 mm) Drop
  - ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
  - ASTM D2487 Standard Test Method for Classification of Soils for Engineering Purposes
  - ASTM 2937 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
  - ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
  - ASTM D5084 Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.
  
- B. American Association of State Highway and Transportation Officials (AASHTO)
  - AASHTO T99 Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305mm (12-in.) Drop
  - AASHTO T191 Standard Method of Test for Density of Soil In-Place by the Sand-Cone Method

AASHTO T310 Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

**1.03 ALLOWANCES**

- A. If so stated in the specification “Allowances”, installation testing will be paid as an allowance. All other testing will be incidental to the Work.
- B. If there is no reference in the specification section to “Allowances”, then testing costs will be incidental to other Work items.

**1.04 SUBMITTALS**

- A. Informational Submittals
  - 1. Field or Site Quality Control Submittals –Submit two (2) copies of the results of quality control testing (include location where tests were performed).

**1.05 QUALITY ASSURANCE**

- A. Clay Liner: An independent testing laboratory approved by the Owner shall be obtained by the Contractor and provide quality control testing.
  - 1. Compaction
    - a. The clay liner shall be compacted to a minimum of standard proctor dry density (ASTM D698) or to a minimum of 90% of modified proctor dry density (ASTM D1557), at a moisture content above optimum moisture.
  - 2. Control of Moisture
    - a. During placement and compaction of the clay liner, the moisture content of the clay being placed shall be maintained above optimum moisture as determined by Standard Proctor Test (ASTM D698) or Modified Proctor Test (ASTM D1557).
    - b. The application of water to the clay shall be accomplished at the borrow areas insofar as practicable. Water may be applied by sprinkling the clay after placement and before compaction of the liner, if necessary. Uniform moisture distribution shall be obtained by diskings.
  - 3. Testing and Documentation Requirements

- a. Liner construction shall be tested and documented as specified below. Copies of the documentation report, including test locations and test results, shall be provided to the Engineer.
- b. Field and laboratory soil test shall be completed on the clay liner, by an independent testing firm retained by the Contractor, to document compliance with this specification. Testing shall be completed as the liner is being placed. The following test shall be completed at the specified frequency.

Testing Category and Standards:	Number of Acceptable Tests:
Standard Proctor Test (ASTM D698) OR Modified Proctor Test (ASTM D1557)	1 test per 5,000 cubic yards of clay liner
Field Density Tests (D2937, or D2167, or D1556)	1 test per 100-foot grid per 1 foot thickness of clay liner
Atterberg Limit Tests (ASTM D4318)	1 test per 1,500 cubic yards of clay liner
Grain Size Distribution (ASTM D422)	1 test per 1,500 cubic yards of clay liner
Permeability (ASTM D5084)	1 test per 5,000 cubic yards of clay liner (2 minimum per facility)

- c. Atterberg limits, grain size distribution, and permeability tests shall be completed on undisturbed samples obtained from the constructed clay liner. A minimum of one of each of the laboratory tests specified above shall be completed per clay liner.
  - d. All test holes shall be backfilled using powdered bentonite mixed with clay soil used in liner construction and compacted by hand tamping. The clay shall be broken down into clods less than ½ inch in diameter. A minimum of 25% of the backfilled test hole volume shall be occupied by powdered bentonite after backfilling.
4. Provide Additional Density and Gradation Testing:
- a. Change in method of compaction.
  - b. Change in source or quality of soil or aggregate.
  - c. Disturbed cut areas.

- B. When the testing results show that the Work is of an acceptable nature, the acceptance of the work shall not relieve the Contractor from making corrections to the tested work during the warranty period.

## **PART 2 - PRODUCTS**

### **2.01 MATERIALS**

- A. General
  - 1. Stripped and/or excavated soils shall be segregated and stockpiled for use on the site as intended and indicated by the Engineered Plans.
- B. Topsoil
  - 1. Material shall be natural on-site upper layer of soil consisting of loam, sandy loam, silt loam, silty clay loam, or clay loam humus-bearing soils able to sustain plant life.
- C. Wetland Topsoil
  - 1. Material shall consist of moist organic soil, including any existing wetland vegetation and seeds. Material shall be excavated from areas shown on the Engineered Plans, stockpiled and protected from contamination of other soils. Handling of material shall be in compliance with associated permits / permitting authorities / regulatory agencies.
- D. Fill and Borrow
  - 1. Material shall consist of satisfactory soil or a mixture of satisfactory soil, stone, gravel or other acceptable materials, of a character and quality satisfactory for the purpose intended. Use material free from sod, stumps, logs, and other perishable and deleterious matter.
  - 2. As a minimum, all soil shall meet the requirements of Soil Class G-1 as specified in appropriate Specification Section.
- E. Embankments
  - 1. For embankments that will function as temporary or permanent water impoundments for ponds or small dams, the following shall apply:
    - a. Satisfactory soil materials are those complying with ASTM D2487 soil classification groups GC, GM, SC, SM, CL, ML, CH, and MH or as determined by Engineer.

- b. Unsatisfactory soil materials are those complying with ASTM D2487 soil classification groups GW, GP, SW, SP, OL, OH and PT or as determined by Engineer.
- F. Pond Liner
  - 1. Clay Basin Liner
    - a. Soils used in construction of the clay liner shall have a minimum plasticity index of 12 as tested in accordance with ASTM D4318, a minimum percentage passing the number 200 sieve.
    - b. Clay materials shall contain no sod, brush, roots, frozen soil, or other perishable materials. Rock particles larger than 3 inches shall be removed prior to compaction of the clay.
    - c. In situ clay material shall be scarified and recompacted if sand seams are observed as a result of inspecting the clay material after pond construction has been completed to the elevations indicated on the Engineered Plans. Verify that in situ clay material is consistently at the thickness specified for clay liner.
  - 2. Geo Membrane Containment Barrier
    - a. Provide membrane liner as specified in the appropriate Specification Section.

## **PART 3 - EXECUTION**

### **3.01 GENERAL**

- A. Prior to the start of soil disturbing activities, perform the following:
  - 1. Install erosion control devices and measures as specified in the appropriate Specification Section and as indicated on the Engineered Plans.
  - 2. Clear and grub as specified in the appropriate Specification Section and as indicated on the Engineered Plans.
  - 3. Remove and dispose of site debris. All debris materials removed from the project site shall be disposed of at a legally approved site. No burning of materials is permitted onsite
- B. Perform topsoil stripping, excavation, fill, grading, compaction and topsoil placement in accordance to the appropriate Specification Section.

### **3.02 WET DETENTION BASIN**

- A. In addition to items of work specified elsewhere, the following procedures shall apply to construction of wet detention basins.
  - 1. Contractor shall partially excavate wet detention basin to act as a sediment trap during construction.
  - 2. Contractor shall complete excavation and shaping of wet detention basin upon establishment of upstream restoration.
  - 3. Contractor shall finish areas to receive topsoil to within not more than 0.10 feet above or below required subgrade elevations.

### **3.03 CLAY BASIN LINER**

- A. Foundation Preparation
  - 1. Foundation surfaces shall be graded to remove surface irregularities and shall be scarified or otherwise acceptably scored or loosened to a minimum depth of 2 inches.
  - 2. The moisture content of the loosened material shall be controlled as specified for the clay liner, and the surface materials of the foundation shall be compacted and bonded with the first layer of the clay liner as specified for subsequent layers of clay liner.
  - 3. Over-excavation and/or under filling of soil to allow placement of the specified liner thickness in accordance with finish grades as shown on Engineered Plans shall be considered incidental to wet detention basin liner.
  - 4. Liner Thickness
    - a. Provide a 12” thick layer (in-place) of material on the sides and base of the wet detention basin below the permanent pool elevation to act as a liner to ensure retention of water.
    - b. Provide an 18” thick layer (in-place) on roadway embankments facing both the wet detention basin and infiltration basin up to the 100-year storm event maximum water storage elevation.
  - 5. Placement

- a. The clay liner shall not be placed until the required foundation preparation has been completed and the foundation has been inspected and approved. The clay liner shall not be placed upon frozen surface, nor shall snow, ice, or frozen material be incorporated in the clay liner.
- b. The clay liner shall be placed in lifts. The thickness of each lift before compaction shall not exceed the smaller of 6 inches or the length of the teeth of the footed compactor used.
- c. The distribution of materials throughout the clay liner shall be essentially uniform, and the clay liner shall be free from pockets, streaks, or layers of material differing substantially in texture, moisture content, or gradation from the surrounding material.
- d. If the surface of any layer becomes too hard and smooth for proper bond with the succeeding layer, it shall be scarified to a depth of not less than 2 inches before the next layer is placed.

### **3.04 GEO MEMBRANE CONTAINMENT BARRIER**

- A. Install the liner material in accordance to the appropriate Specification Section.

### **3.05 SOIL AMENDMENT**

- A. Consists of blending suitable soil material with native soils to create a 3 foot depth soil layer with 20% - 30% fines below the infiltrative surface of an infiltration basin.
  1. Coordinate with Engineer to obtain suitable material from on-site excavations with which to amend the soil within three vertical feet below the proposed infiltrative basin bottom. Segregate acceptable soil material of sufficient quantity during excavation operations to meet the required depth of amendment.
  2. Remove native soils from below the infiltrative surface (bottom of infiltration basin) to the specified depth for incorporation of fine-grained material. Removal depth shall be equal to depth of material to be added, and such excavation shall be considered incidental to soil amendment.
- B. Uniformly incorporate the specified depth of Engineer approved soil amendment material into the remaining native soils that are within three vertical feet below the infiltration basin bottom.
  1. Compaction of soils shall be avoided to the maximum extent practical.

2. If Engineer determines that unacceptable compaction has occurred, Provide compaction mitigation to acceptable requirements.

**END OF SECTION**

# Municipality of Greenville

## Standard Details

October 2019

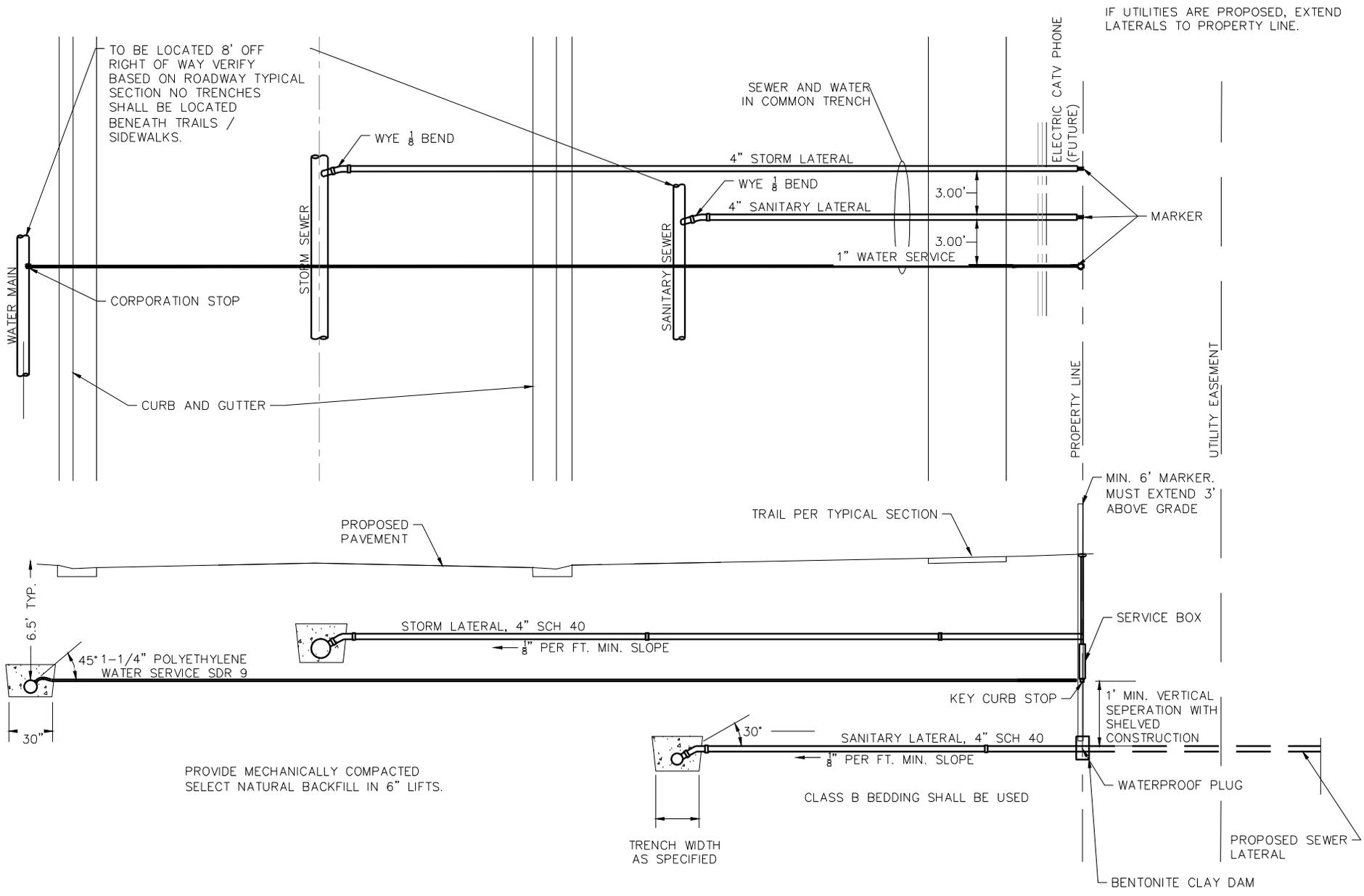
Municipality of Greenville  
Outagamie County, WI

Summary of Revisions	
Revision Date	Comments



**REUSE OF DOCUMENTS**

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IF UTILITIES ARE PROPOSED, EXTEND  
LATERALS TO PROPERTY LINE.

TO BE LOCATED 8' OFF  
RIGHT OF WAY VERIFY  
BASED ON ROADWAY TYPICAL  
SECTION NO TRENCHES  
SHALL BE LOCATED  
BENEATH TRAILS /  
SIDEWALKS.

SEWER AND WATER  
IN COMMON TRENCH

ELECTRIC CATV PHONE  
(FUTURE)

MARKER

PROPERTY LINE

UTILITY EASEMENT

TRAIL PER TYPICAL SECTION

MIN. 6" MARKER.  
MUST EXTEND 3'  
ABOVE GRADE

SERVICE BOX

KEY CURB STOP

1' MIN. VERTICAL  
SEPERATION WITH  
SHELVED  
CONSTRUCTION

WATERPROOF PLUG

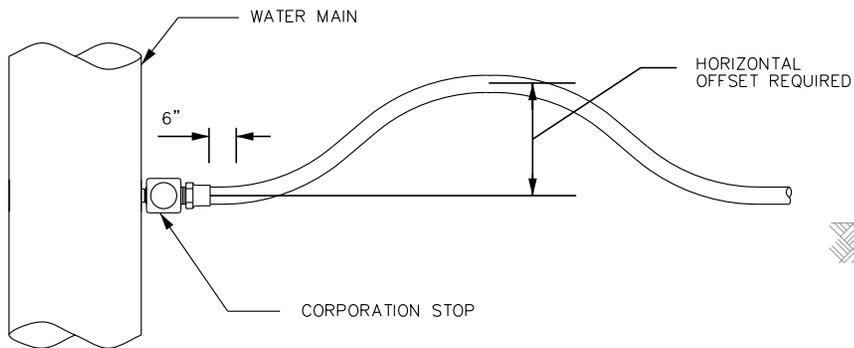
PROPOSED SEWER  
LATERAL

BENTONITE CLAY DAM

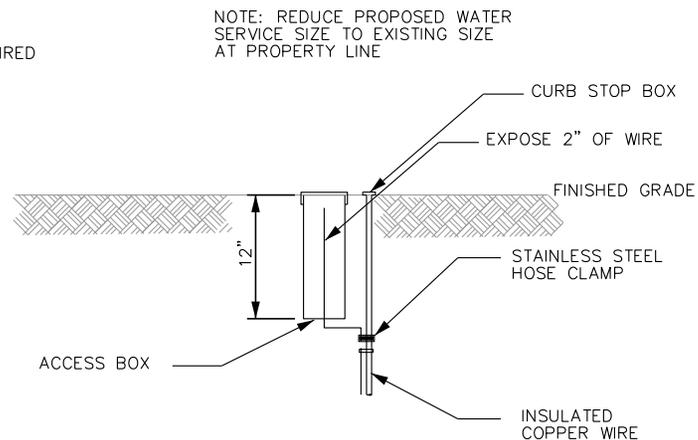
PROVIDE MECHANICALLY COMPACTED  
SELECT NATURAL BACKFILL IN 6" LIFTS.

TRENCH WIDTH  
AS SPECIFIED

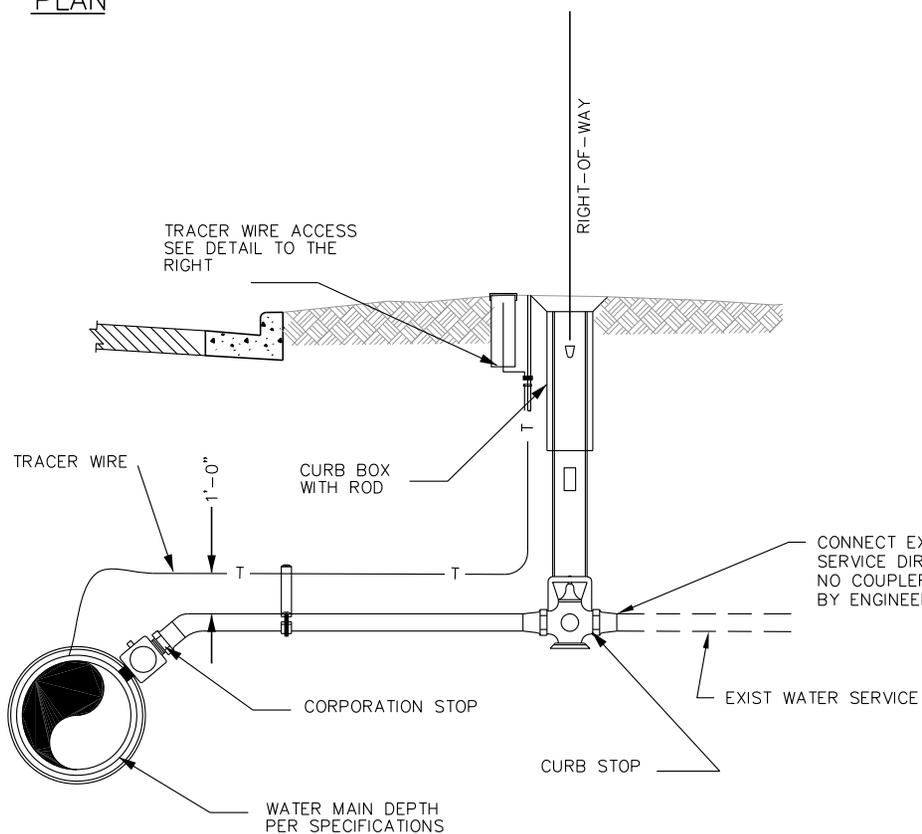
TYPICAL CONNECTION SEWER AND WATER	
MUNICIPALITY OF GREENVILLE	
	<small>engineers • architects • planners • environmental specialists land surveyors • landscape architects • interior designers</small> 800-472-7372    www.cedarcorp.com
DETAIL No.	



PLAN



TRACER WIRE ACCESS DETAIL



PROFILE

NOTES:

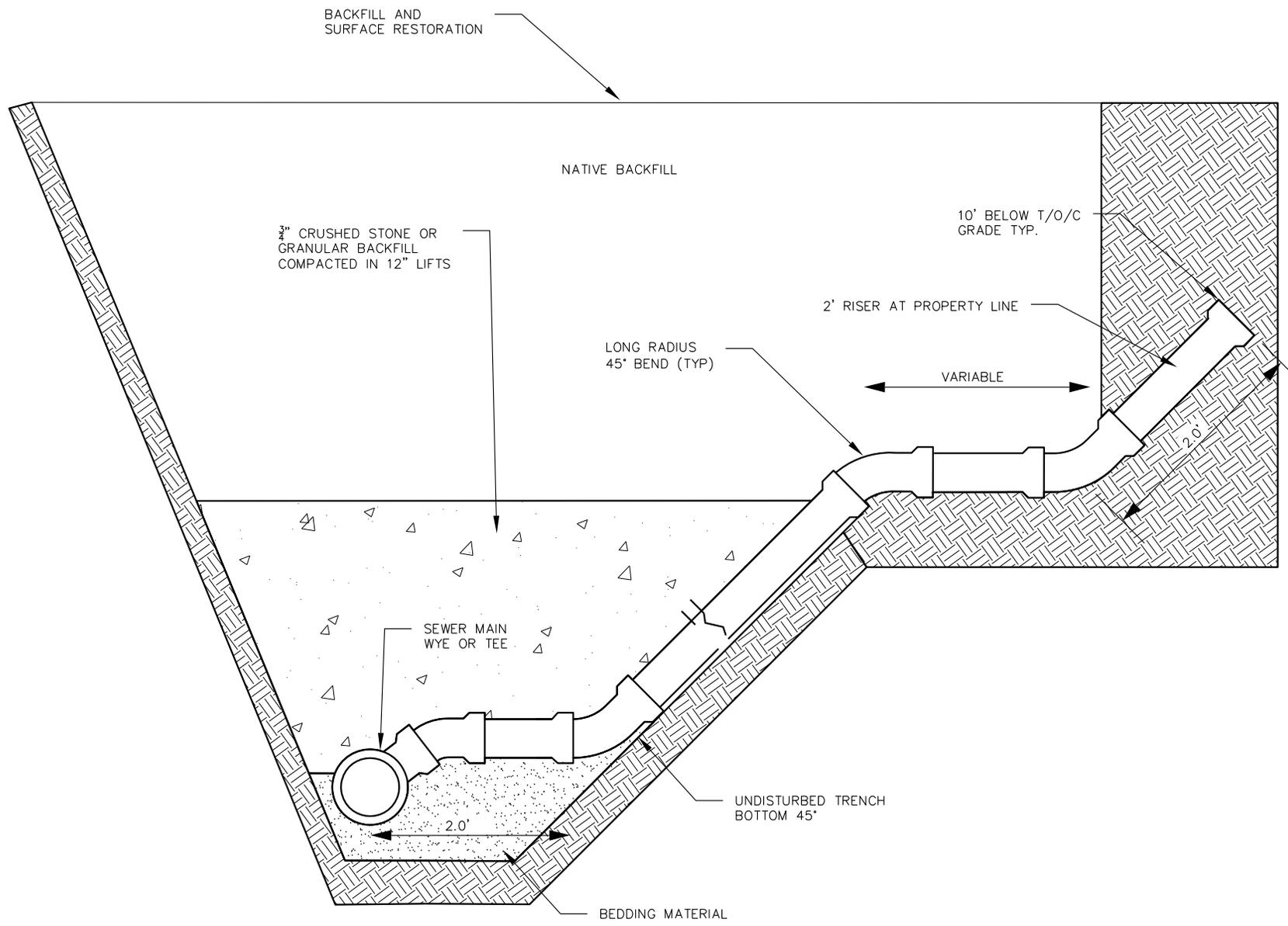
SPIRAL WRAP CORPORATION VALVE THREADS WITH A MINIMUM OF TWO LAYERS OF TEFLON PIPE THREAD TAPE.

DIRECT TAP ON ALL SERVICES UNDER 2". USE A SERVICE SADDLE ON ALL SERVICES OVER 2".

WHERE CURB BOX WILL BE IN CONCRETE SIDEWALK OR DRIVEWAY, SLIDE 6" CAST IRON WATER VALVE BOX TOP AROUND TOP OF CURB BOX AND TRACER WIRE FOR PROTECTION.

TYPICAL WATER SERVICE CONNECTION

MUNICIPALITY OF GREENVILLE



STANDARD RISER FOR SEWER SERVICE CONNECTION

MUNICIPALITY OF GREENVILLE

FINISHED RIM GRADE SHALL BE:  
 -1/2" TO 1" ABOVE FINISHED GRADE IN LANDSCAPED AREAS.  
 -1/4" TO 1/2" BELOW PAVED SURFACES.

CASTING: R-1550 TYPE B LID W/ CONCEALED PICK HOLE AND SELF SEALING APPLICATION

TAPERED 1"-2" RUBBER RING TO MATCH SLOPE OF ROAD

BUTYL JOINT SEALANT AND INTERNAL CHIMNEY SEAL REQUIRED

ECCENTRIC CONE SECTION

MANHOLE STEPS  
 16" O.C.  
 N.F. R-1981-C  
 OR EQUAL

CLASS "B" CONCRETE

5" MIN.

8" MIN.

6" MIN.

8' MAXIMUM

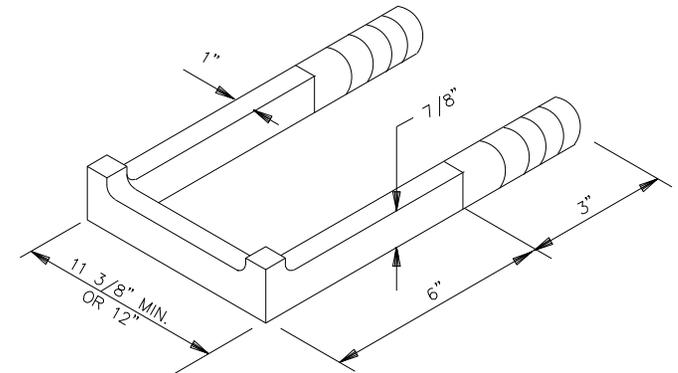
8" MIN.

4'

4' DIAMETER PRECAST CONCRETE MANHOLE

LARGE DIAMETER PRECAST CONCRETE MANHOLE

	MAX. PIPE I.D. STRAIGHT THROUGH TO 45° DEFLECTION	MAX. PIPE I.D. 90° DEFLECTION
4' MANHOLE	18"	18"
5' MANHOLE	30"	27"
6' MANHOLE	42"	30"
8' MANHOLE	54"	42"



TYPICAL MANHOLE STEP

NOTES:

BASE SLAB OVERHANG DESIGNED FOR 25' MAXIMUM DEPTH.

PRECAST CONCRETE BASE SHALL BE CAST MONOLITHIC WITH BARREL SECTION.

12" MAX HEIGHT ADJUSTING RINGS W/ MIN. ADJ. RING THICKNESS OF 2" W/ WATERSTOP (PREMOLDED) PLASTIC MASTIC-KENT SEAL NO. 2 OR EQUAL (TYP.)

SMALL ADJUSTMENT RING IS RUBBER.

NO MORE THAN 3 RINGS.

PIPES ENTERING AND EXITING MH'S SHALL BE FULL PIPE LENGTH.

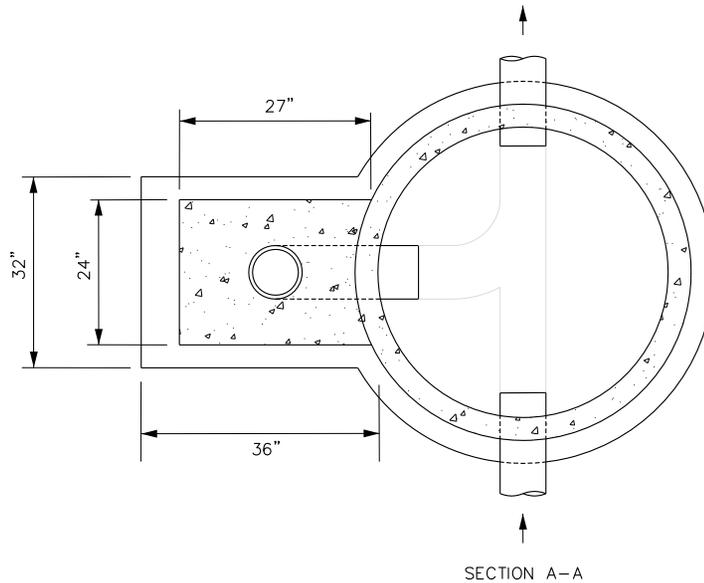
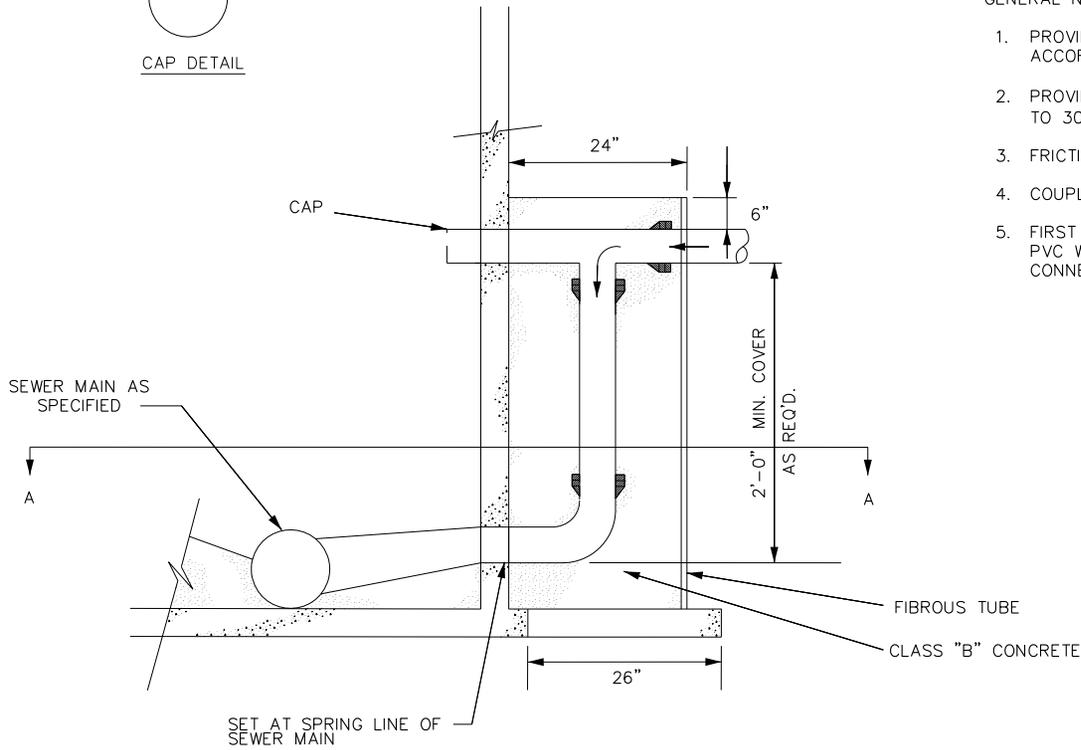
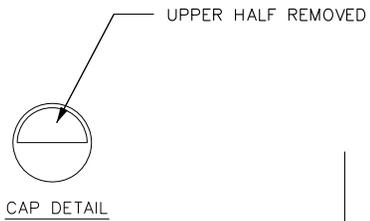
STANDARD PRECAST MANHOLE

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GENERAL NOTES

1. PROVIDE FLEXIBLE WATER TIGHT GASKET OR CONNECTOR MANUFACTURED IN ACCORDANCE TO ASTM C443 OR C923 AT PIPE AND BARREL.
2. PROVIDE 8" DIA. DROP FOR SEWERS 8" TO 18" DIA. 12" DIA. DROP FOR SEWERS 21" TO 30" DIA.
3. FRICTION FIT CAP IN PLACE.
4. COUPLER TO BE HELD IN PLACE WITH STAINLESS STEEL CLAMP.
5. FIRST 15 FOOT PIPE SECTION OUT OF DROP TO BE CLASS 52 D.I. PIPE. CONNECT TO PVC WITH SOLID BODY COUPLING. ALL PIPE WITHIN DROP TO BE PVC WITH FITTING TO CONNECT TO CLASS 52 D.I. CAST INTO DROP.

STANDARD DROP MANHOLE

MUNICIPALITY OF GREENVILLE

FINISHED RIM GRADE SHALL BE:  
 -1/2" TO 1" ABOVE FINISHED GRADE IN LANDSCAPED  
 AREAS.  
 -1/4" TO 1/2" BELOW PAVED SURFACES.

CASTING: R-1550 TYPE B LID WITH  
 CONCEALED PICK HOLE AND SELF  
 SEALING APPLICATION

INTERNAL MANHOLE CHIMNEY SEAL,  
 CRETEX OR EQUAL. SEAL SHALL  
 OVERLAP ONTO TOP OF CONE AND  
 BOTTOM OF CASTING 2"

TAPERED RUBBER RING TO  
 MATCH SLOPE OF ROAD

BUTYL JOINT SEALANT  
 REQUIRED

12" MAX. HEIGHT ADJUSTING RINGS WITH  
 MIN. ADJUSTMENT RING THICKNESS OF 2"  
 WITH WATERSTOP (PREMOLDED) PLASTIC  
 MASTIC-KENT SEAL NO. 2 OR EQUAL  
 (TYP.) SET AT 2" BELOW FINISHED GRADE.

M.H. STEPS 16" O/C M.A.  
 INDUSTRIES PSI, NF  
 R-1981-C OR EQUAL

ECCENTRIC CONE

PRECAST MANHOLE SECTIONS

BUTYL JOINT SEALANT REQUIRED

5"

48" ID

INSIDE DROP (WHERE INDICATED), ALL PIPE  
 MATERIALS TO MATCH SANITARY MAIN

INVERT

1/2"x6" STAINLESS  
 STEEL LAG SCREW WITH  
 EXPANSION SHIELDS

PVC PIPE

1/2"x6" STAINLESS STEEL  
 STRAP (AT 2' INTERVALS)

4" POLYETHYLENE  
 SADDLE BLOCK

SHORT 90° BEND

FLEXIBLE RUBBER BOOT PIPE TO  
 MANHOLE CONNECTION

5" MIN.

8" MONOLITHIC BASE

INSIDE DROP DISTANCE

### INSIDE DROP MANHOLE DETAIL

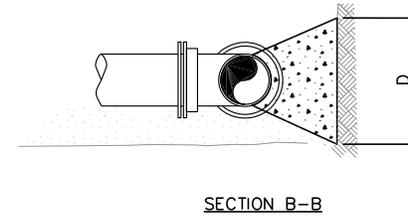
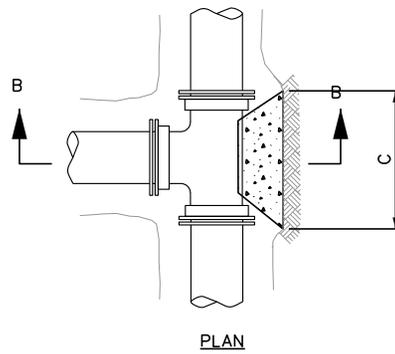
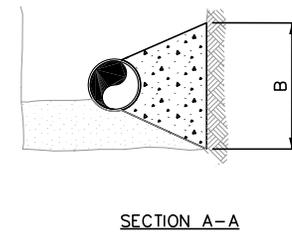
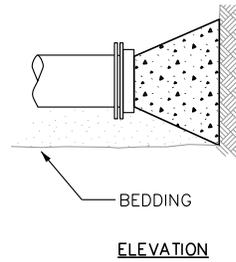
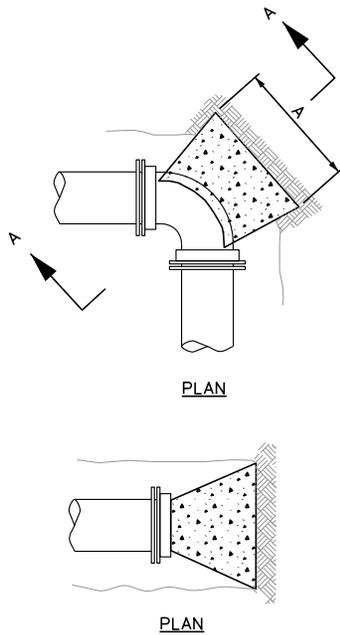
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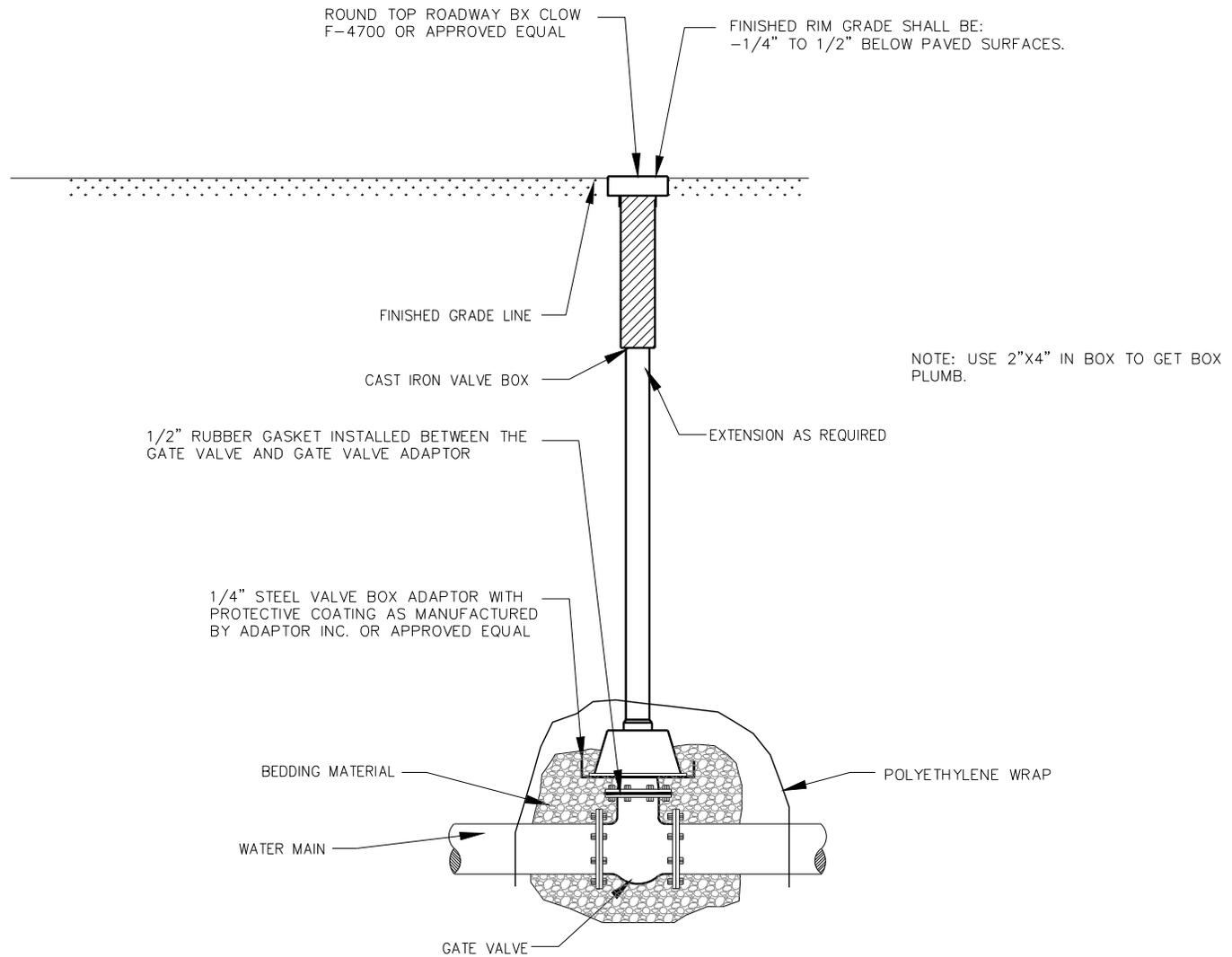


NOTES:  
 REACTION BLOCKING WILL CONTACT FITTING FROM BELL TO BELL AND THE FULL DIAMETER OF FITTING AS SHOWN  
 CAST BLOCKING AGAINST UNDISTURBED EARTH  
 USE CLASS "B" CONCRETE BLOCKING  
 DIMENSIONS IN TABLES ARE BASED ON WATER PRESSURE OF 150 PSI AND EARTH RESISTANCE OF 4000 POUNDS

DIA	BENDS					
	22 12		45		90	
	A	B	A	B	A	B
6" & 8"	1'-0"	1'-0"	1'-2"	1'-2"	1'-10"	1'-6"
10" & 12"	1'-4"	1'-4"	1'-10"	1'-10"	2'-8"	2'-3"
14" & 16"	1'-10"	1'-8"	2'-6"	2'-4"	3'-10"	2'-10"
18" & 20"	2'-4"	2'-0"	3'-3"	2'-10"	5'-0"	3'-4"
24"	2'-10"	2'-4"	4'-0"	3'-5"	5'-4"	3'-10"
30"	3'-6"	3'-0"	5'-4"	3'-10"	8'-0"	4'-8"

DIA	TEES	
	C	D
6" & 8"	1'-6"	1'-4"
10" & 12"	2'-3"	2'-0"
14" & 16"	3'-2"	2'-6"
18" & 20"	4'-0"	3'-0"
24"	5'-3"	3'-4"
30"	6'-3"	4'-3"

STANDARD BLOCKING	
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STANDARD VALVE BOX

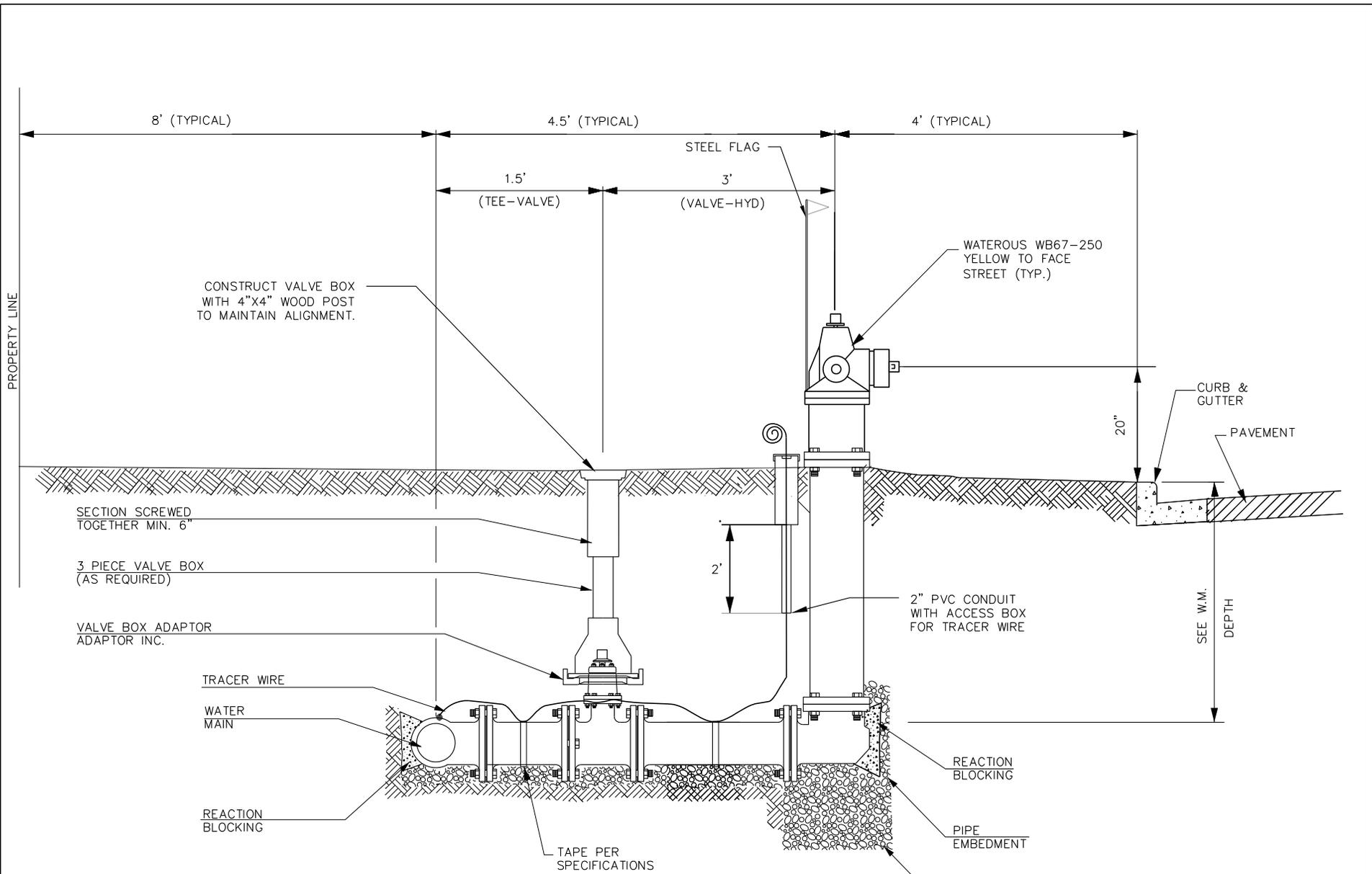
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DETAIL No.





SECTION SCREWED TOGETHER MIN. 6"

3 PIECE VALVE BOX (AS REQUIRED)

VALVE BOX ADAPTOR ADAPTOR INC.

TRACER WIRE

WATER MAIN

REACTION BLOCKING

TAPE PER SPECIFICATIONS

2'

2" PVC CONDUIT WITH ACCESS BOX FOR TRACER WIRE

REACTION BLOCKING

PIPE EMBEDMENT

DRAINAGE PIT (2" DIA., 3" DEEP)

SEE W.M. DEPTH

CURB & GUTTER

PAVEMENT

20"

8' (TYPICAL)

4.5' (TYPICAL)

4' (TYPICAL)

1.5' (TEE-VALVE)

3' (VALVE-HYD)

STEEL FLAG

CONSTRUCT VALVE BOX WITH 4"X4" WOOD POST TO MAINTAIN ALIGNMENT.

WATEROUS WB67-250 YELLOW TO FACE STREET (TYP.)

PROPERTY LINE

NOTE:

1. SEE WATER DISTRIBUTION TRACER WIRE DETAIL FOR LOCATION/TERMINATION
2. USE ANCHOR TEES IF NECESSARY TO MAINTAIN SEPARATION.
3. HYDRANT LEAD RESTRAINT PER SPECIFICATIONS.
4. HYDRANTS TO BE PLUGGED TO BE APPROVED BY MUNICIPALITY.

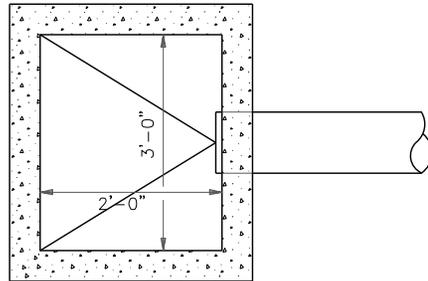
STANDARD HYDRANT WITH TRACER WIRE

MUNICIPALITY OF GREENVILLE

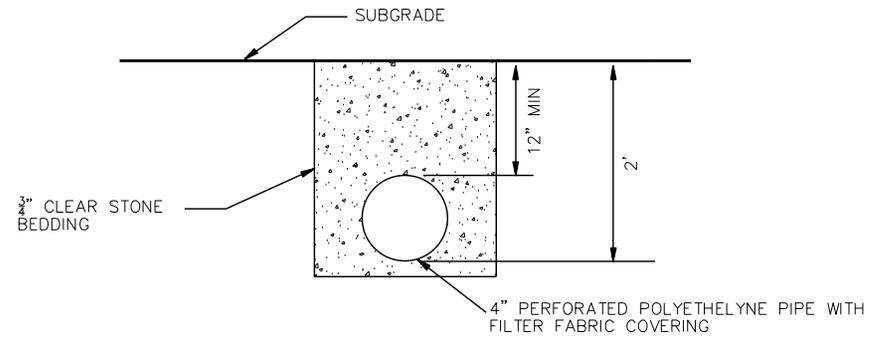


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DETAIL No.

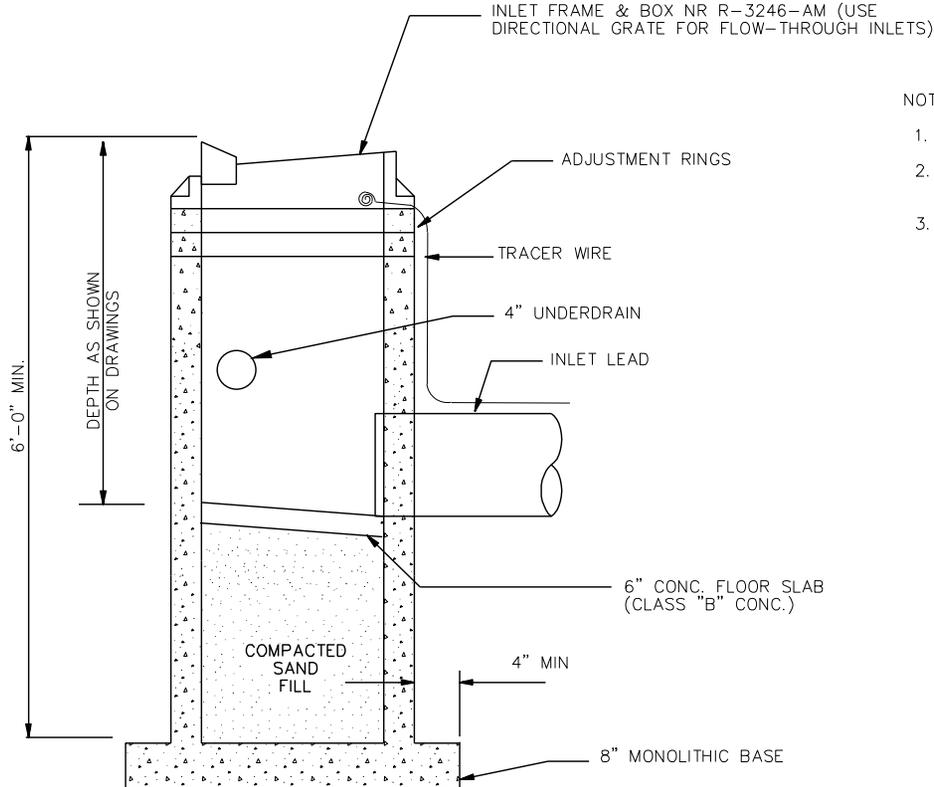


PLAN



UNDERDRAIN DETAIL

NOTE: UNDERDRAIN SHALL EXTEND 50' EACH WAY OF THE INLET OR AS DIRECTED BY THE ENGINEER.



ELEVATION

NOTES:

1. EXCEPT FOR FLOOR SLAB, ALL CONCRETE SHALL BE PRECAST.
2. COMPACTED GRANULAR BACKFILL SOILS REQUIRED AROUND INLET ON ROADWAY SIDE & UNDER CURB & GUTTER SECTION.
3. SEE MANHOLE TRACER WIRE DETAIL FOR LOCATION/TERMINATION

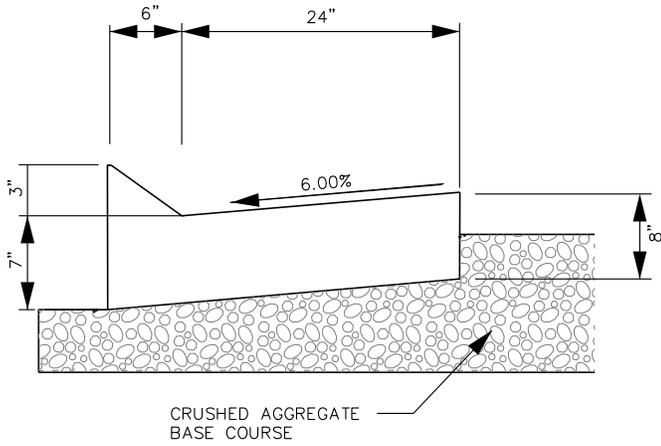
STANDARD 2'X3' INLET

MUNICIPALITY OF GREENVILLE

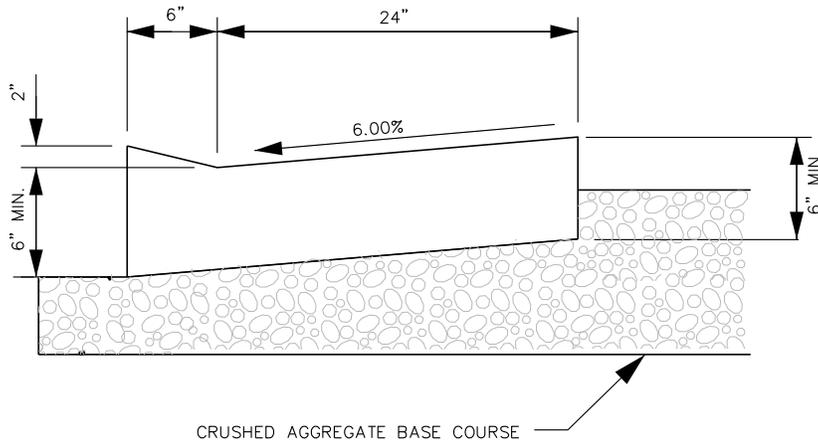


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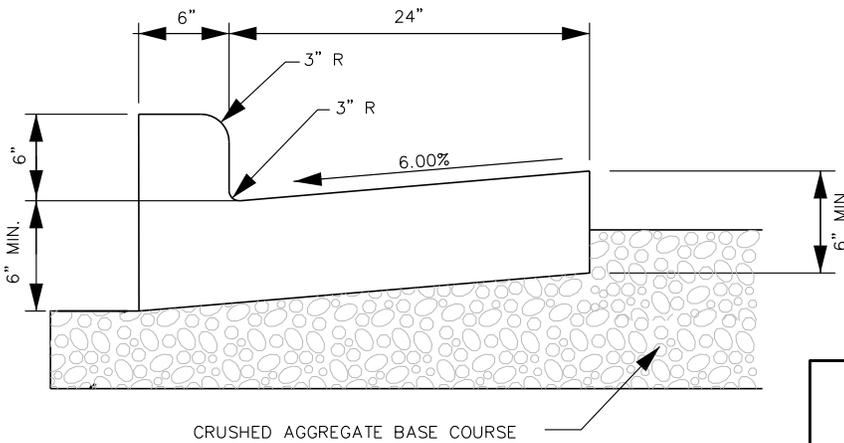
DETAIL No.



STANDARD MOUNTABLE CURB & GUTTER



DRIVEWAY ENTRANCE CURB



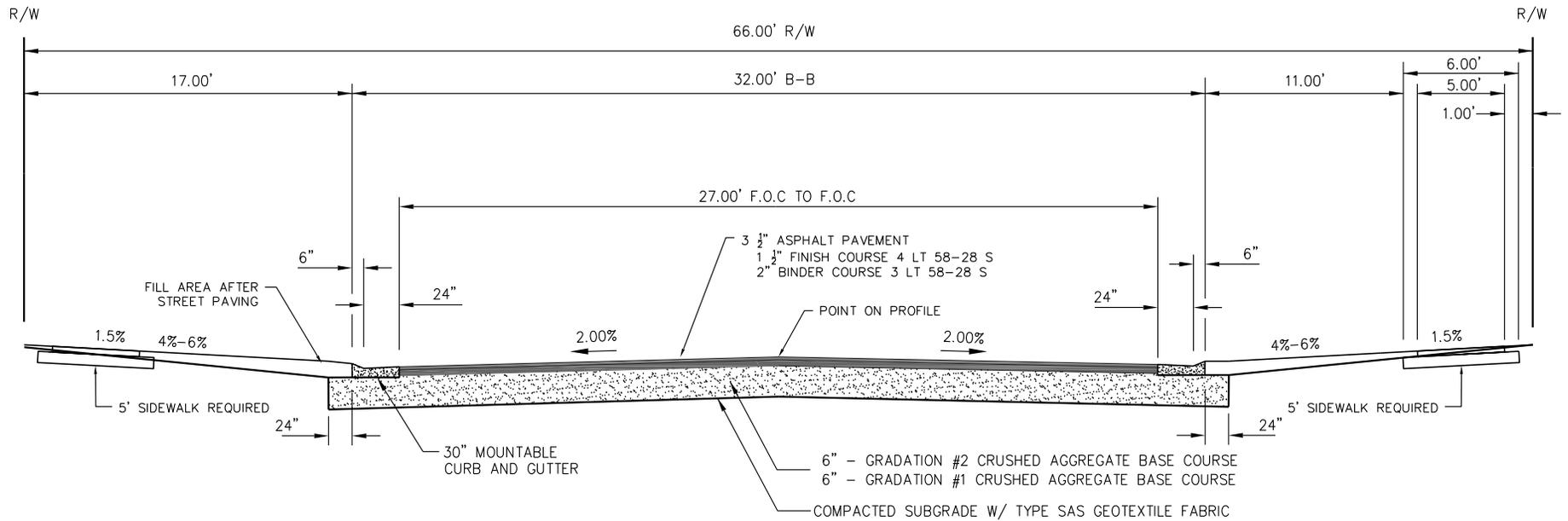
BARRIER CURB & GUTTER

NOTE: ONLY AS REQUIRED BY MUNICIPALITY

NOTES

1. REINFORCEMENT REQUIRED AT ALL LATERAL TRENCHES (20' LENGTH) AND 10' EACH WAY OF INLETS.
2. AT TIE-INS TO EXISTING CURB AND GUTTER, DOWEL 2 NO. 3 REBARS INTO THE EXISTING.
3. WHEN REINFORCING IS REQUIRED, PLACE 2-NO. 3 REBARS AS FOLLOWS:  
A) 3" FROM EACH FACE.  
B) 3" FROM BOTTOM.
4. THE BOTTOM OF CURB AND GUTTER MAY BE CONSTRUCTED EITHER LEVEL OR PARALLEL TO THE SLOPE OF THE SUBGRADE OR BASE COURSE PROVIDED A 6" MIN. GUTTER THICKNESS IS MAINTAINED.

CURB & GUTTER DETAILS	
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NOTE:

1. OTHER TYPICAL SECTIONS MAY BE REQUIRED BY MUNICIPALITY.

TYP. STREET SECTION (66' R/W) URBAN  
LOCAL ROADWAY

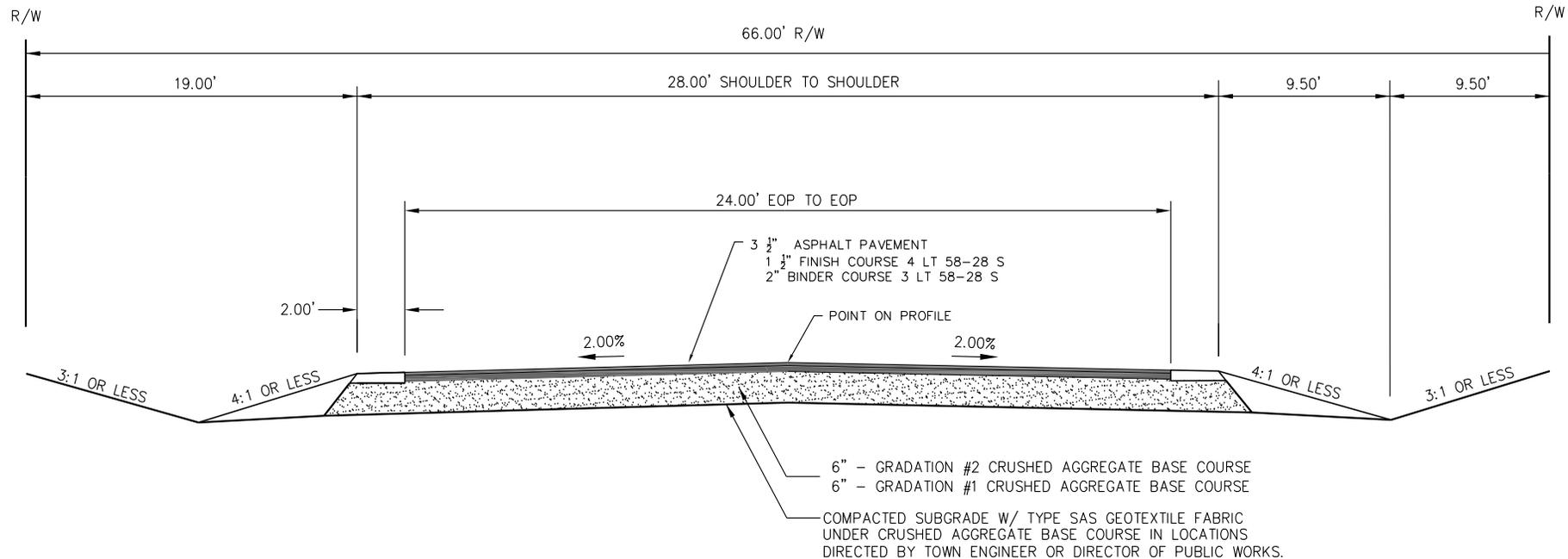
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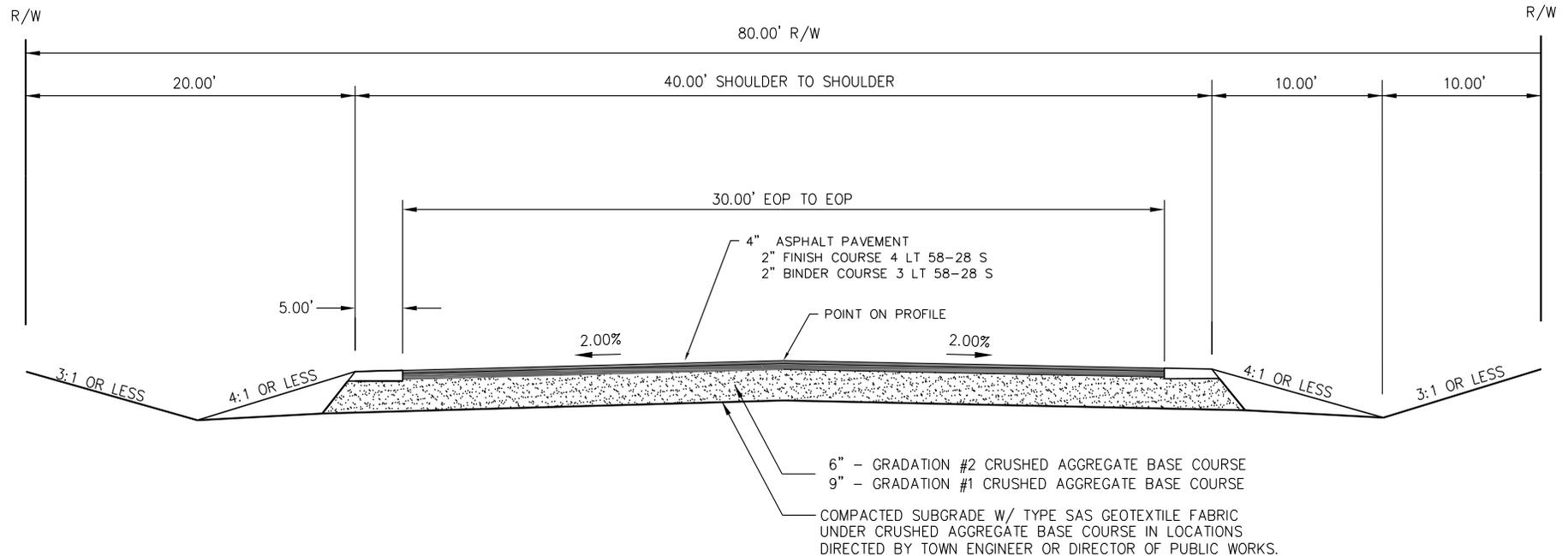


NOTE:

1. OTHER TYPICAL SECTIONS MAY BE REQUIRED BY MUNICIPALITY.

TYP. STREET SECTION (66' R/W) RURAL  
 LOCAL ROADWAY

MUNICIPALITY OF GREENVILLE



NOTE:

1. OTHER TYPICAL SECTIONS MAY BE REQUIRED BY MUNICIPALITY.
2. PAVEMENT MARKINGS AND / OR BIKE LANE MAY BE REQUIRED BY MUNICIPALITY.

TYP. STREET SECTION (80' R/W) RURAL  
COLLECTOR ROADWAY

MUNICIPALITY OF GREENVILLE



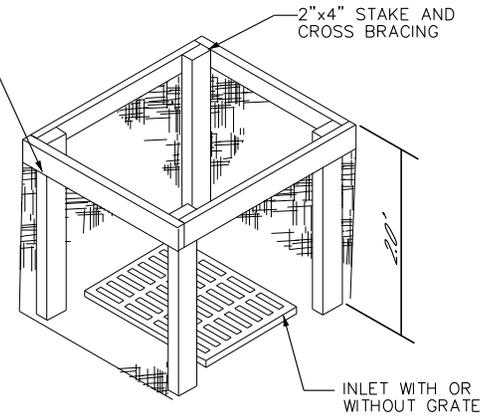
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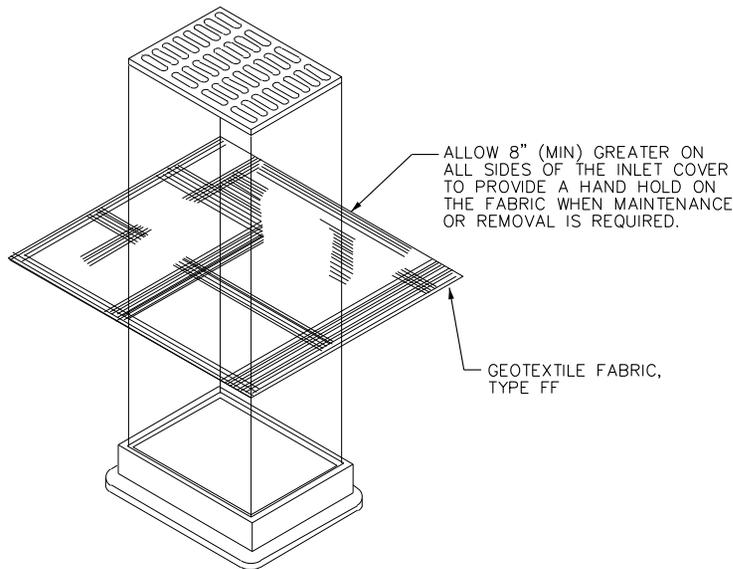
ATTACH GEOTEXTILE FABRIC, TYPE FF TO THE TOP OF STAKES AND CROSS BRACINGS

NOTE:

WHEN REMOVING OR MAINTAINING INLET PROTECTION, TAKE CARE SO THAT THE SEDIMENT TRAPPED ON THE GEOTEXTILE FABRIC DOES NOT FALL INTO THE INLET. REMOVE ANY MATERIAL FALLING INTO THE INLET IMMEDIATELY.



INLET PROTECTION, TYPE A



ALLOW 6" (MIN) GREATER ON ALL SIDES OF THE INLET COVER TO PROVIDE A HAND HOLD ON THE FABRIC WHEN MAINTENANCE OR REMOVAL IS REQUIRED.

GEOTEXTILE FABRIC, TYPE FF

INLET PROTECTION, TYPE B (WITHOUT CURB BOX)  
(CAN BE INSTALLED ON ANY INLET TYPE)

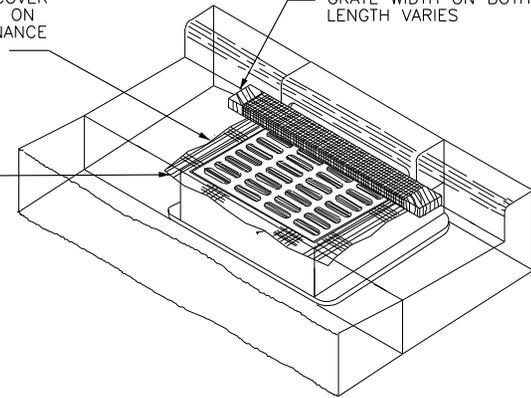
STANDARD INLET PROTECTION

MUNICIPALITY OF GREENVILLE

ALLOW 8" (MIN) GREATER ON ALL SIDES OF THE INLET COVER TO PROVIDE A HAND HOLD ON THE FABRIC WHEN MAINTENANCE OR REMOVAL IS REQUIRED.

WOOD 2"x4" EXTENDS 8" BEYOND GRATE WIDTH ON BOTH SIDES, LENGTH VARIES

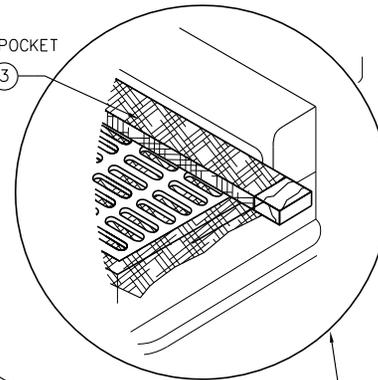
GEOTEXTILE FABRIC, TYPE FF



INLET SPECIFICATIONS AS PER THE THE PLAN DIMENSION LENGTH AND WIDTH TO MATCH

FLAP POCKET

③



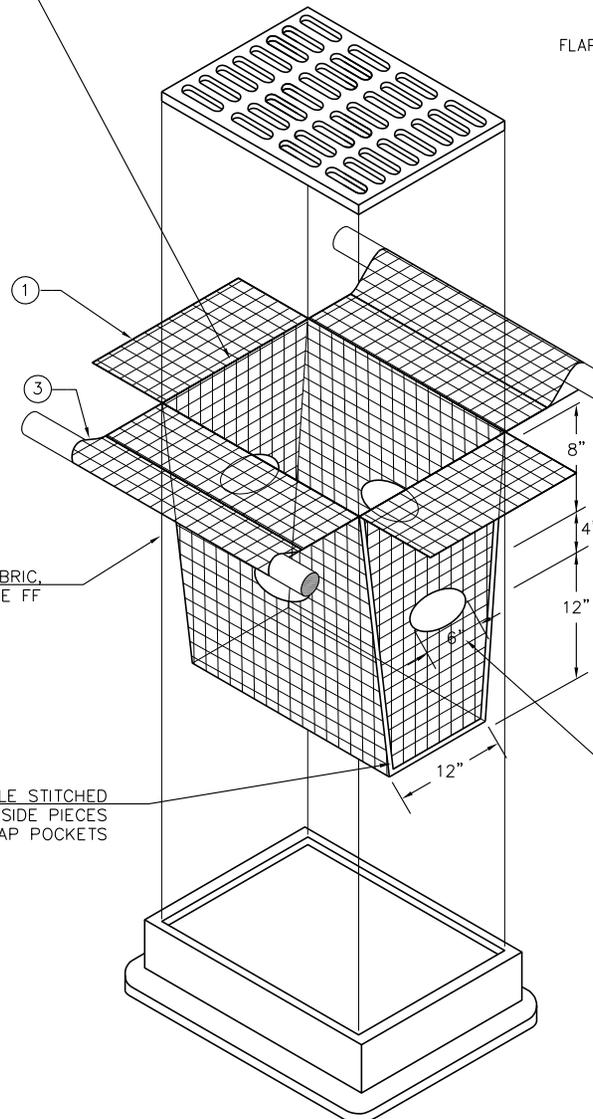
USE REBAR OR STEEL ROD FOR REMOVAL OR

FOR INLETS WITH CAST CURB BOX USE WOOD 2" X 4". EXTEND 10" BEYOND GRATE WIDTH ON BOTH SIDES, LENGTH VARIES. SECURE TO GRATE WITH WIRE OR PLASTIC TIES

4" X 6" OVAL HOLE SHALL BE HEAT CUT INTO ALL FOUR SIDE PANELS

GEOTEXTILE FABRIC, TYPE FF

MINIMUM DOUBLE STITCHED SEAMS ALL AROUND SIDE PIECES AND ON FLAP POCKETS



**INLET PROTECTION, TYPE C (WITH CURB BOX)**

**INSTALLATION NOTES**

DO NOT INSTALL INLET PROTECTION TYPE D IN INLETS SHALLOWER THAN 30", MEASURED FROM THE BOTTOM OF THE INLET TO THE TOP OF THE GRATE.

TRIM EXCESS FABRIC IN THE FLOW LINE TO WITHIN 3" OF THE GRATE.

THE INSTALLED BAG SHALL HAVE A MINIMUM SIDE CLEARANCE, BETWEEN THE INLET WALL AND THE BAG, MEASURED AT THE BOTTOM OF THE OVERFLOW HOLES, OF 3". WHERE NECESSARY THE CONTRACTOR SHALL CINCH THE BAG, USING PLASTIC ZIP TIES, TO ACHIEVE THE 3" CLEARANCE. THE TIES SHALL BE PLACED AT A MAXIMUM OF 4" FROM THE BOTTOM OF THE BAG.

**GENERAL NOTES**

- ① FINISHED SIZE, INCLUDING FLAP POCKETS WHERE REQUIRED, SHALL EXTEND A MINIMUM OF 10" AROUND THE PERIMETER TO FACILITATE MAINTENANCE OR REMOVAL.
- ② FOR INLET PROTECTION, TYPE C (WITH CURB BOX), AN ADDITIONAL 18" OF FABRIC IS WRAPPED AROUND THE WOOD AND SECURED WITH STAPLES. THE WOOD SHALL NOT BLOCK THE ENTIRE HEIGHT OF THE CURB BOX OPENING.
- ③ FLAP POCKETS SHALL BE LARGE ENOUGH TO ACCEPT WOOD 2X4.

**INLET PROTECTION, TYPE D**

(CAN BE INSTALLED IN ANY INLET TYPE WITH OR WITHOUT A CURB BOX AS PER NOTE ②)

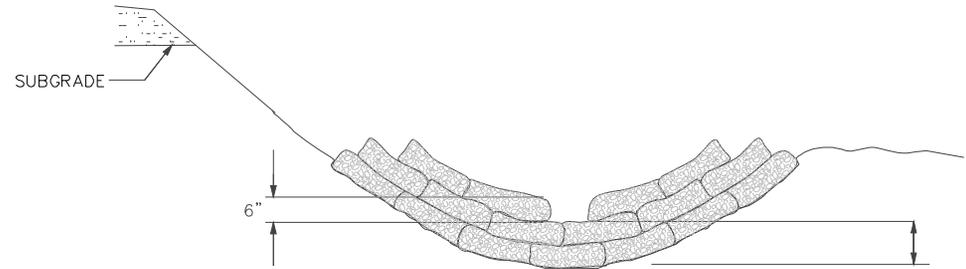
STANDARD INLET PROTECTION

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NOTES:

- 12" X 18" ROCK FILLED FILTER BAG SHALL BE COMPRISED OF THE FOLLOWING:
- HDPE HIGH DENSITY POLYETHYLENE
- HDPE HIGH DENSITY POLYETHYLENE DRAW STRING KNITTED DIRECTLY INTO BAG OPENING.
- 80% FABRIC CLOSURE WITH APPARENT OPENING SIZE NO LARGER THAN \*" X \*"
- ROLLED SEAM USING A MINIMUM OF 480 DENIER POLYESTER SEWING YARN FOR STRENGTH AND DURABILITY.

USE WELL GRADED COURSE AGGREGATE CONFORMING TO THE FOLLOWING GRADATION REQUIREMENTS

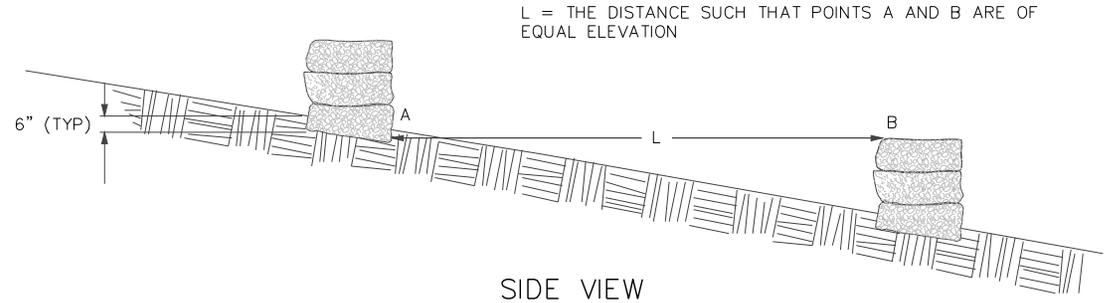


CROSS SECTIONAL VIEW

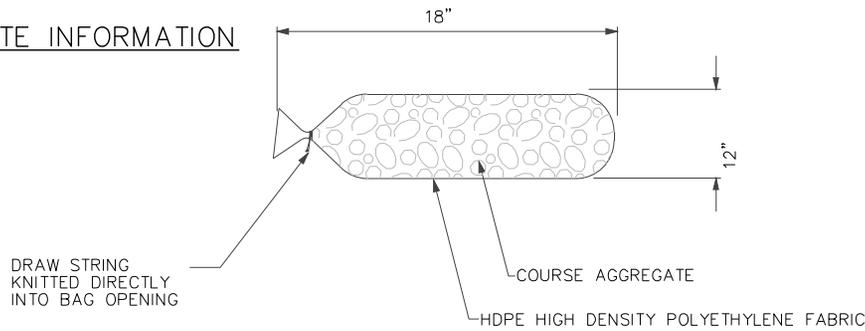
SIEVE SIZE	SIZE NO. AASHTO No. 67
2 INCH (50 mm)	-
1 1/2 INCH (37.5mm)	-
1 INCH (25.0 mm)	100
3/4 INCH (19.0mm)	90-100
3/8 INCH (9.5mm)	20-55
No. 4 (4.75mm)	0-10
No. 8 (2.36mm)	0-5

(1) SIZE No. ACCORDING TO AASHTO M 43

COURSE AGGREGATE INFORMATION



SIDE VIEW

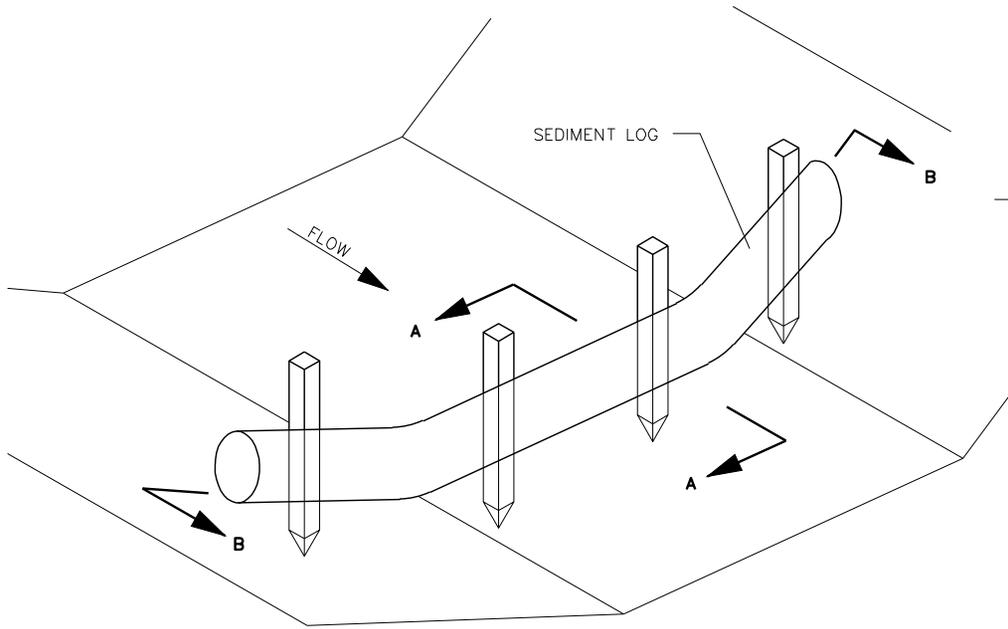


FILTER BAG DETAIL (PRIOR TO INSTALLATION)

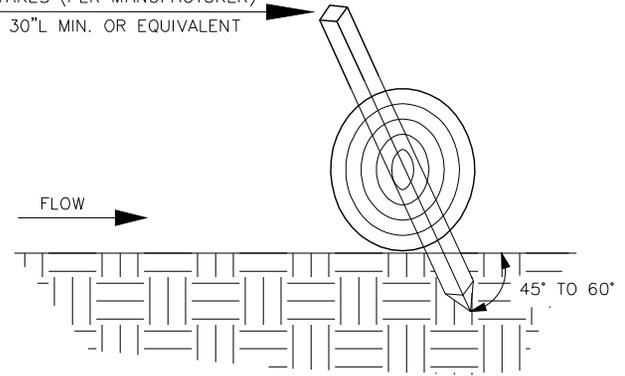
DITCH CHECK DETAIL

STANDARD STONE FILLED DITCH CHECK

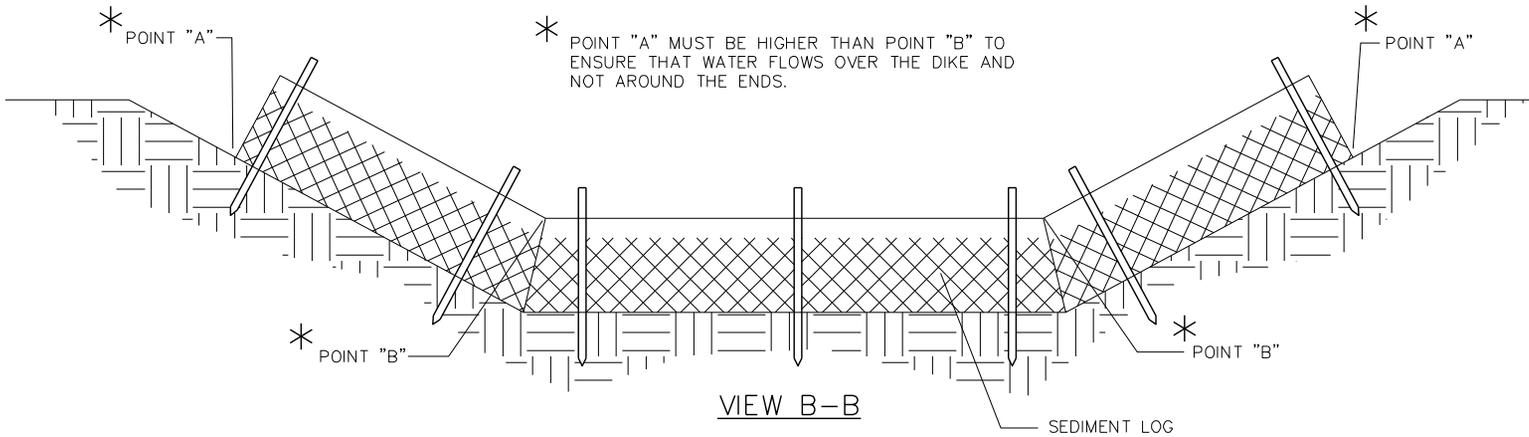
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FLOOD STAKES (PER MANUFACTURER)  
2"x2" x 30"L MIN. OR EQUIVALENT



VIEW A-A



VIEW B-B

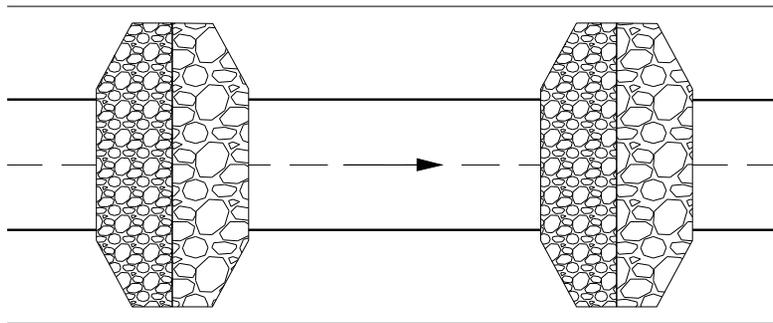
STANDARD SEDIMENT LOG DITCH CHECK

MUNICIPALITY OF GREENVILLE

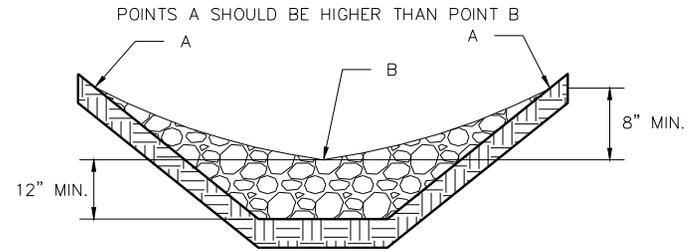


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DETAIL No.

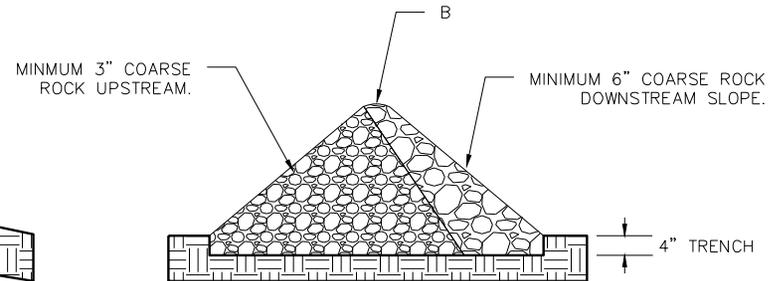
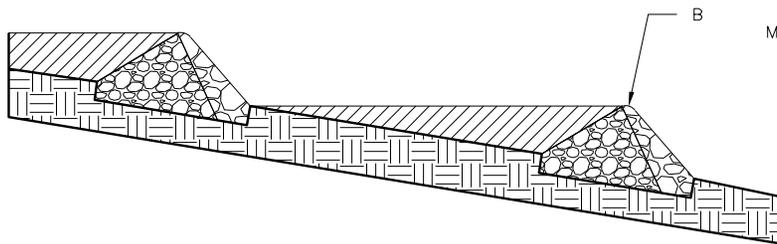


PLAN



FRONT

PLACE DOWNSTREAM STRUCTURE SUCH THAT POINT "B" IS APPROXIMATELY LEVEL WITH THE LOWEST GROUND ELEVATION OF THE UPSTREAM STRUCTURE.



STONE DITCH CHECK DETAIL

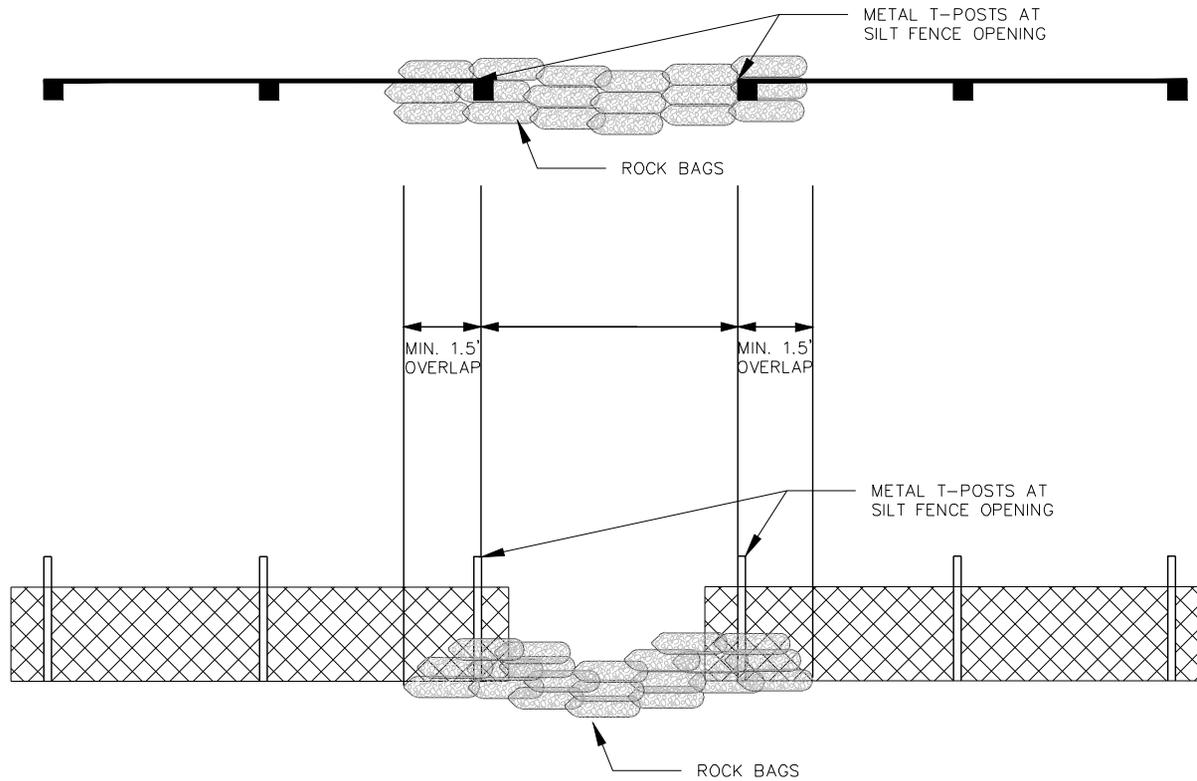
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DETAIL No.

TOP VIEW



FRONT VIEW

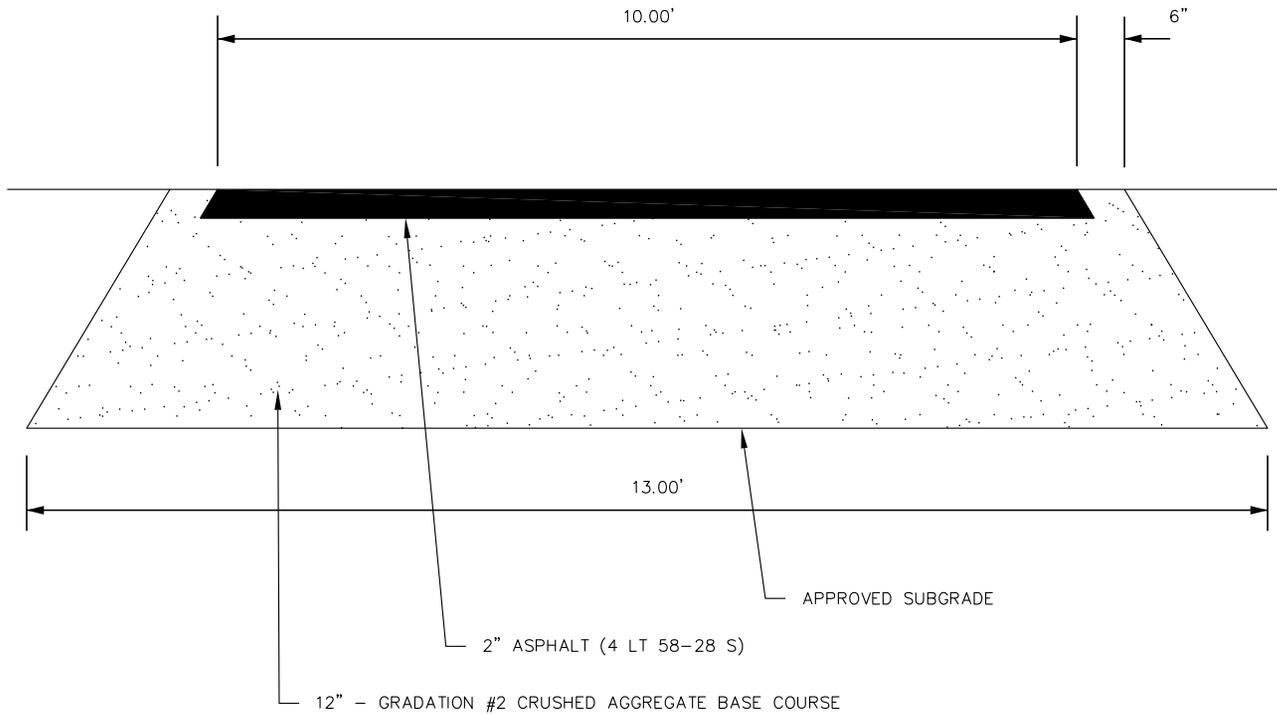
STANDARD ROCK BAGS FOR SILT FENCE  
RELIEF

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DETAIL No.



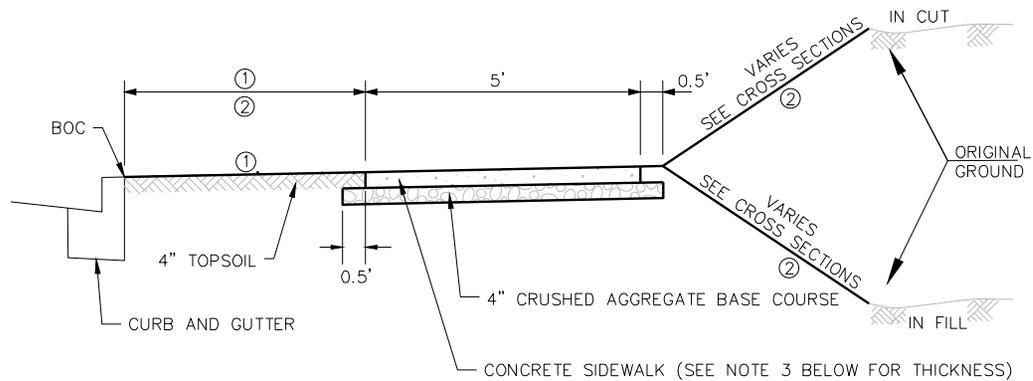
SHARED USE PATH TYPICAL SECTION

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DETAIL No.



NOTES:

1. SLOPE AND WIDTH OF TERRACE VARIES PER CROSS SECTION.
2. RESTORATION LIMITS SHALL BE FROM THE BACK OF CURB TO FACE OF SIDEWALK AND FROM BACK OF SIDEWALK TO SLOPE INTERCEPT.
3. SIDEWALK THICKNESS SHALL BE AS FOLLOWS:
  - A. STANDARD SIDEWALK: 4 INCHES  
(SIDEWALKS WITHIN DRIVEWAYS SHALL MATCH THE DRIVEWAY THICKNESS)
  - B. CURB RAMPS: 6 INCHES
  - C. RESIDENTIAL DRIVEWAY: 6 INCHES, OR MATCH EXISTING, WHICHEVER IS GREATER
  - D. COMMERCIAL AND INDUSTRIAL DRIVEWAY: 7 INCHES, OR MATCH EXISTING, WHICHEVER IS GREATER
  - E. HEAVY INDUSTRIAL DRIVEWAY: 9 INCHES, OR MATCH EXISTING, WHICHEVER IS GREATER

SIDEWALK TYPICAL SECTION

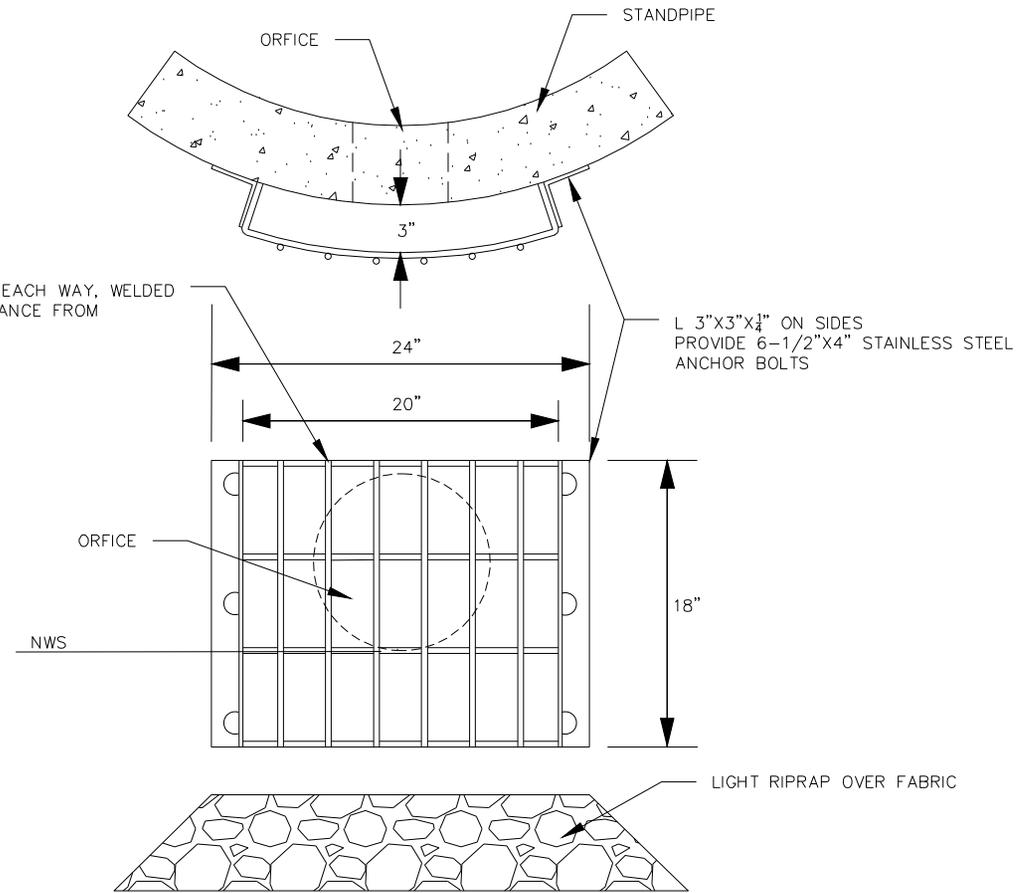
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DETAIL No.

$\frac{3}{8}$ " GALVANIZED BARS @ 3" O.C. EACH WAY, WELDED BEND TO MATCH WITH 3" CLEARANCE FROM STRUCTURE.

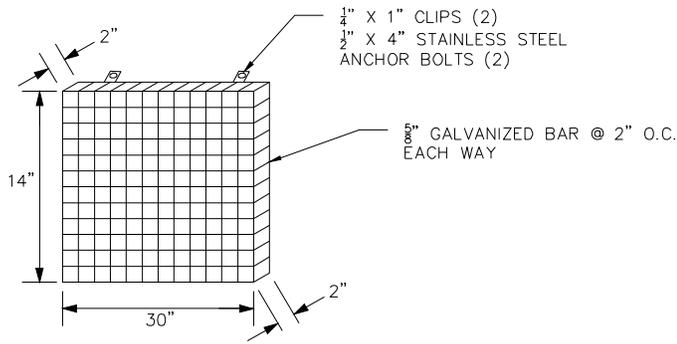


NOTE:  
BAR SPACING & DIMENSION CAN VARY  
DEPENDING ON OUTLET DESIGN.

TRASH RACK 1 DETAIL

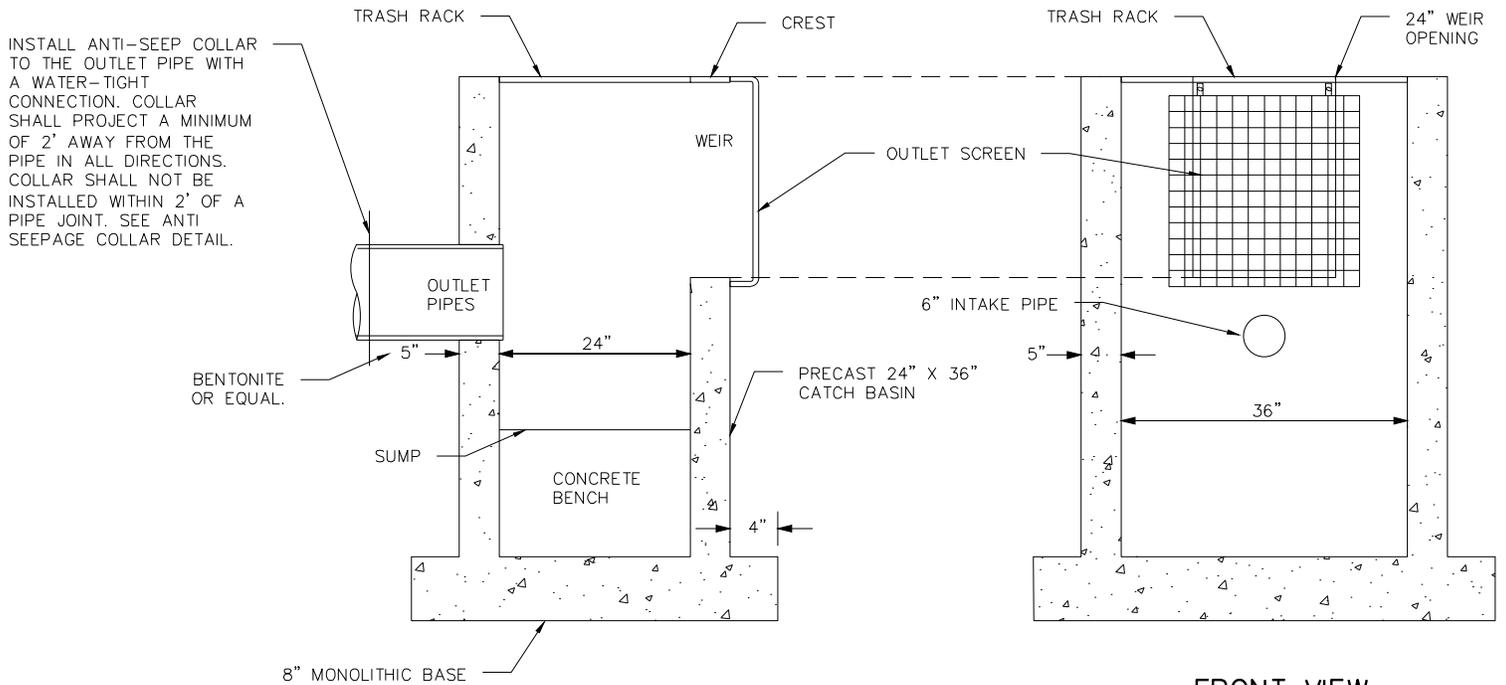
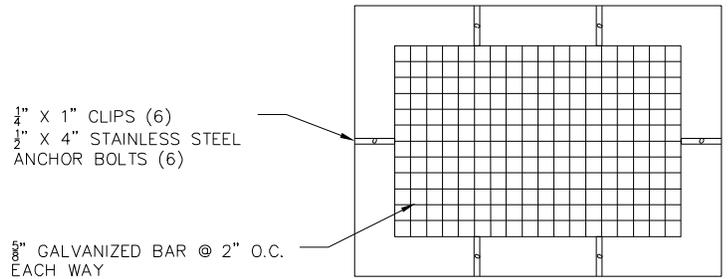
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NOTE: BAR SPACING & DIMENSION CAN VARY DEPENDING ON OUTLET DESIGN.

**TYPICAL SCREEN FOR  
OUTLET STRUCTURE**



**SECTION VIEW**

**FRONT VIEW  
TRASH RACK REMOVED**

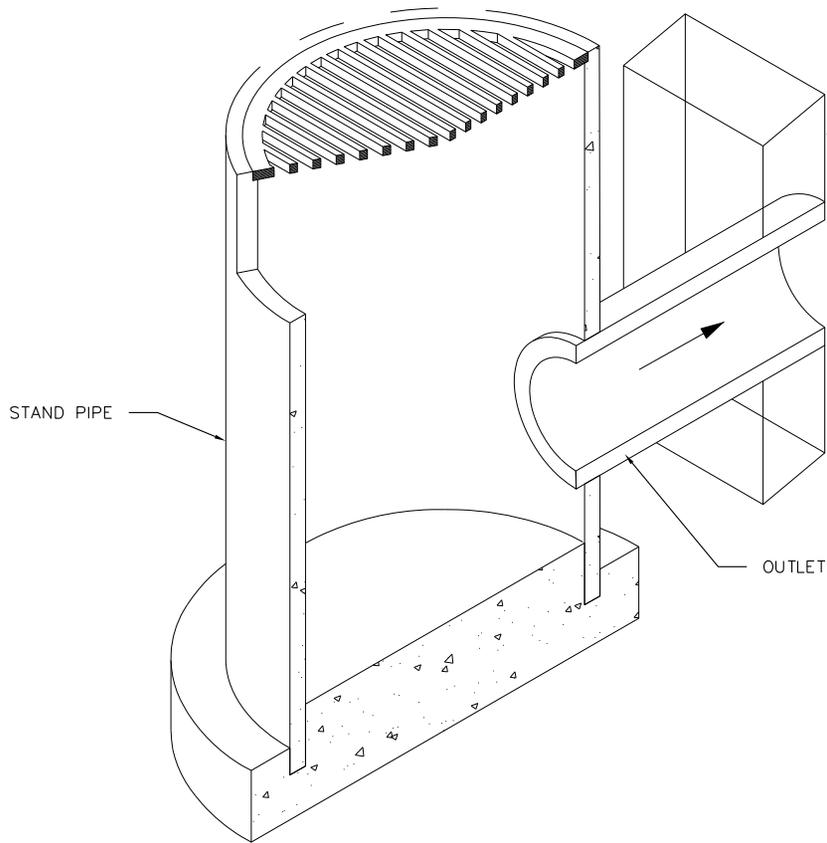
TRASH RACK 2 DETAIL

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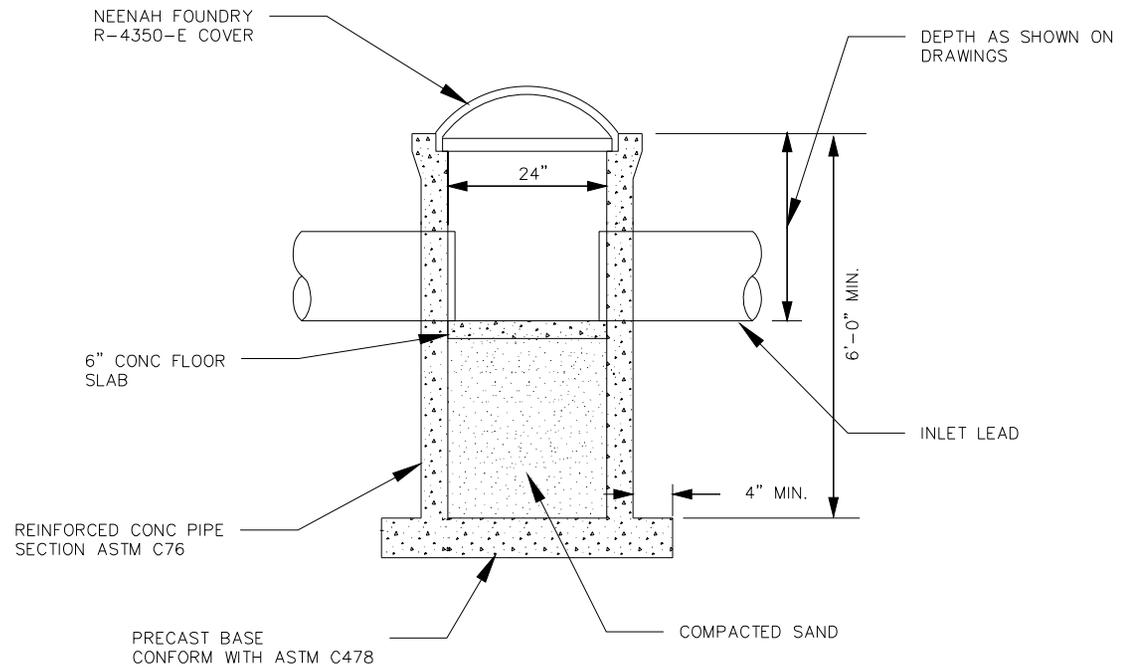
DETAIL No.



- INSTALL ANTI-SEEP COLLAR TO THE OUTLET PIPE WITH A WATER-TIGHT CONNECTION.
- COLLAR SHALL PROJECT A MINIMUM OF 5' AWAY FROM THE PIPE IN ALL DIRECTIONS.
  - COLLAR SHALL NOT BE INSTALLED WITHIN 2' OF A PIPE JOINT.
  - CONSTRUCT BENTONITE COLLAR. DIMENSIONS TO BE 2' THICK BY TRENCH WIDTH AND TRENCH HEIGHT.

ANTI SEEPAGE COLLAR DETAIL

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TYPE "C" CATCH BASIN DETAIL

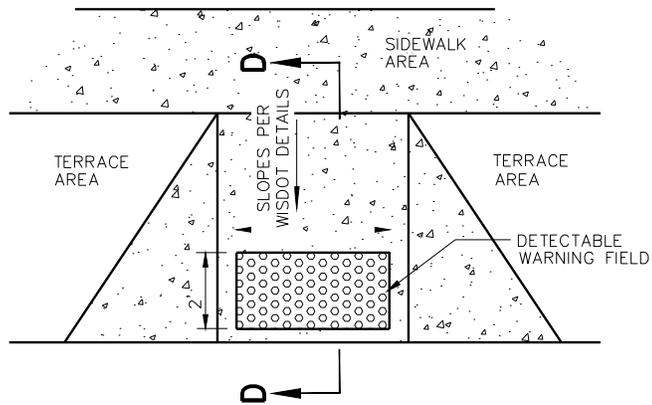
TYPE "C" INLET DETAIL

MUNICIPALITY OF GREENVILLE

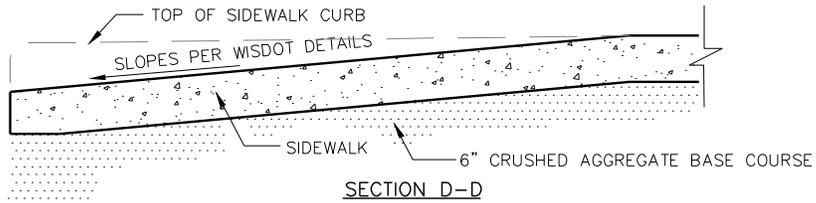


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DETAIL No.



PLAN VIEW



SECTION D-D

**NOTES:**

- \* 2'x4' DETECTABLE WARNING FIELD SHALL BE NEENAH FOUNDRY WITH NATURAL FINISH. INSTALL AS PER MANUFACTURES SPECS.
- \* THE SURFACE TEXTURE OF THE RAMP (EXCLUDING THE TRUNCATED DOME PANEL) SHALL BE A COARSE BROOMED FINISH, TRANSVERSE TO THE SLOPE OF THE RAMP.
- \* CONCRETE SHALL BE 6" THICK.

CURB RAMP DETAIL

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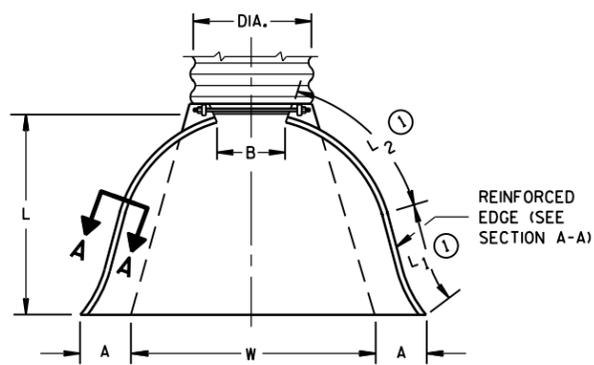
DETAIL No.

METAL APRON ENDWALLS											
PIPE DIA. (IN.)	MIN. THICK. (Inches)		DIMENSIONS (Inches)							APPROX. SLOPE	BODY
	STEEL	ALUM.	A (±1")	B (MAX.)	H (±1/2")	L (±1/2")	L1 (Ⓛ)	L2 (Ⓛ)	W (±2")		
12	.064	.060	6	6	6	21	12	17 1/2	24	2 1/2 to 1	1 Pc.
15	.064	.060	7	8	6	26	14	21 3/4	30	2 1/2 to 1	1 Pc.
18	.064	.060	8	10	6	31	15	28 1/4	36	2 1/2 to 1	1 Pc.
21	.064	.060	9	12	6	36	18	29 5/8	42	2 1/2 to 1	1 Pc.
24	.064	.075	10	13	6	41	18	37 1/4	48	2 1/2 to 1	1 Pc.
30	.079	.075	12	16	8	51	18	52 1/4	60	2 1/2 to 1	1 Pc.
36	.079	.105	14	19	9	60	24	59 3/4	72	2 1/2 to 1	2 Pc.
42	.109	.105	16	22	8	69	24	75 5/8	84	2 1/2 to 1	2 Pc.
48	.109	.105	18	27	12	78	24	81	90	2 1/4 to 1	3 Pc.
54	.109	.105	18	30	12	84	30	85 1/2	102	2 1/4 to 1	3 Pc.
60	.109x	.105x	18	33	12	87	—	—	114	2 to 1	3 Pc.
66	.109x	.105x	18	36	12	87	—	—	120	2 to 1	3 Pc.
72	.109x	.105x	18	39	12	87	—	—	126	2 to 1	3 Pc.
78	.109x	.105x	18	42	12	87	—	—	132	1 1/2 to 1	3 Pc.
84	.109x	.105x	18	45	12	87	—	—	138	1 1/2 to 1	3 Pc.
90	.109x	.105x	18	37	12	87	—	—	144	1 1/2 to 1	3 Pc.
96	.109x	.105x	18	35	12	87	—	—	150	1 1/2 to 1	3 Pc.

\* EXCEPT CENTER PANEL SEE GENERAL NOTES

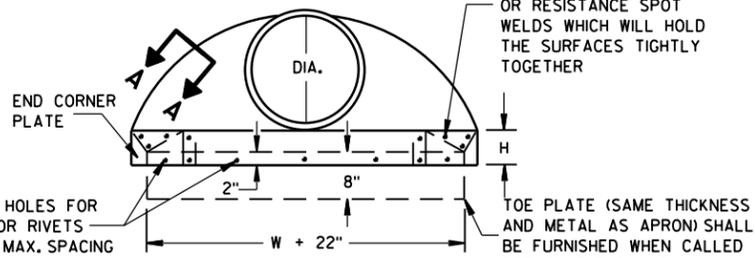
REINFORCED CONCRETE APRON ENDWALLS									
PIPE DIA. (IN.)	DIMENSIONS (Inches)							APPROX. SLOPE	
	T	A	B	C	D	E	G		
12	2	4	24	48 1/8	72 7/8	24	2	3 to 1	
15	2 1/4	6	27	46	73	30	2 1/4	3 to 1	
18	2 1/2	9	27	46	73	36	2 1/2	3 to 1	
21	2 3/4	9	36	37 1/2	73 1/2	42	2 3/4	3 to 1	
24	3	9 1/2	43 1/2	30	73 1/2	48	3	3 to 1	
27	3 1/4	10 1/2	49 1/2	24	73 1/2	54	3 1/4	3 to 1	
30	3 1/2	12	54	19 1/4	73 1/2	60	3 1/2	3 to 1	
36	4	15	63	34 3/4	97 3/4	72	4	3 to 1	
42	4 1/2	21	63	35	98	78	4 1/2	3 to 1	
48	5	24	72	26	98	84	5	3 to 1	
54	5 1/2	27	65	33 1/4-35	98 1/4-100	90	5 1/2	2 2/5 to 1	
60	6	30-35	60	39	99	96	5	2 to 1	
66	6 1/2	24-30	72-78	21-27	99	102	5 1/2	2 to 1	
72	7	24-36	78	21	99	108	6	2 to 1	
78	7 1/2	24-36	78	21	99	114	6 1/2	2 to 1	
84	8	36	90 1/2	21	111 1/2	120	6 1/2	1 1/2 to 1	
90	8 1/2	41	87 1/2	24	111 1/2	132	6 1/2	1 1/2 to 1	

\*MINIMUM  
\*\*MAXIMUM



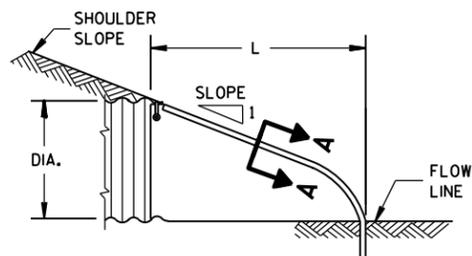
PLAN VIEW

REINFORCED EDGE (SEE SECTION A-A)  
END CORNER PLATES MAY BE FASTENED TO APRON PROPER BY BOLTS, RIVETS, OR RESISTANCE SPOT WELDS WHICH WILL HOLD THE SURFACES TIGHTLY TOGETHER

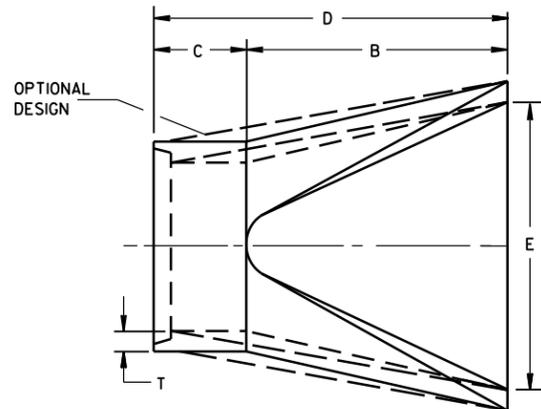


END VIEW

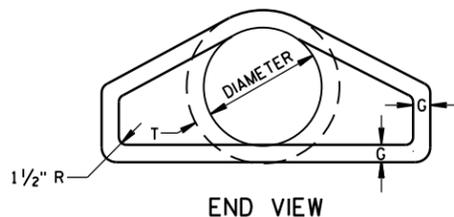
TOE PLATE (SAME THICKNESS AND METAL AS APRON) SHALL BE FURNISHED WHEN CALLED FOR ON THE PLANS



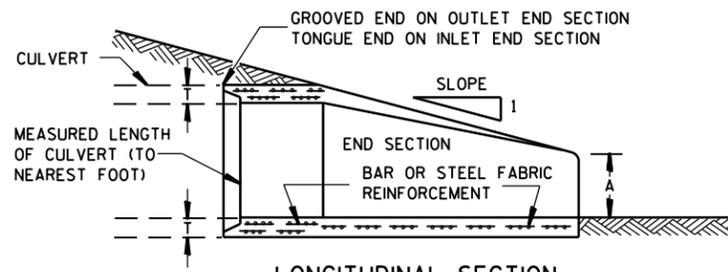
SIDE ELEVATION  
METAL ENDWALLS



PLAN

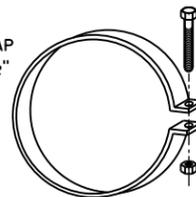


END VIEW



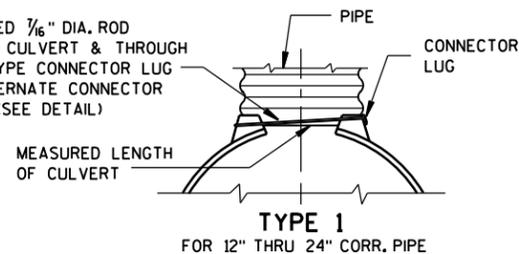
LONGITUDINAL SECTION  
CONCRETE ENDWALLS

1" WIDE, 12 GA. (0.109" THICK) GALVANIZED STRAP WITH STANDARD 6" X 1/2" BAND BOLT AND NUT



ALTERNATE FOR TYPE 1 CONNECTION  
END SECTION CONNECTOR STRAP

THREADED 1/8" DIA. ROD AROUND CULVERT & THROUGH TANK TYPE CONNECTOR LUG OR ALTERNATE CONNECTOR STRAP (SEE DETAIL)



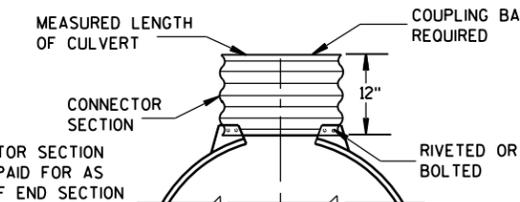
TYPE 1  
FOR 12" THRU 24" CORR. PIPE

THREADED 1/8" DIA. ROD OVER TOP OF APRON, SIDE LUGS TO BE RIVETED TO APRON



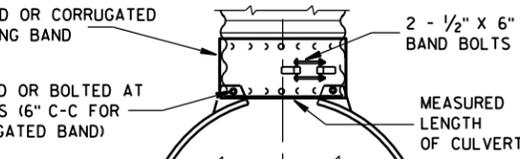
TYPE 2  
FOR 30" THRU 96" CORR. PIPE

MEASURED LENGTH OF CULVERT  
CONNECTOR SECTION TO BE PAID FOR AS PART OF END SECTION



TYPE 3  
FOR 42" THRU 96" CORR. PIPE

DIMPLED OR CORRUGATED COUPLING BAND  
RIVETED OR BOLTED AT DIMPLES (6" C-C FOR CORRUGATED BAND)



TYPE 5  
ALTERNATE FOR:  
ALL SIZES CORRUGATED CIRCULAR PIPE

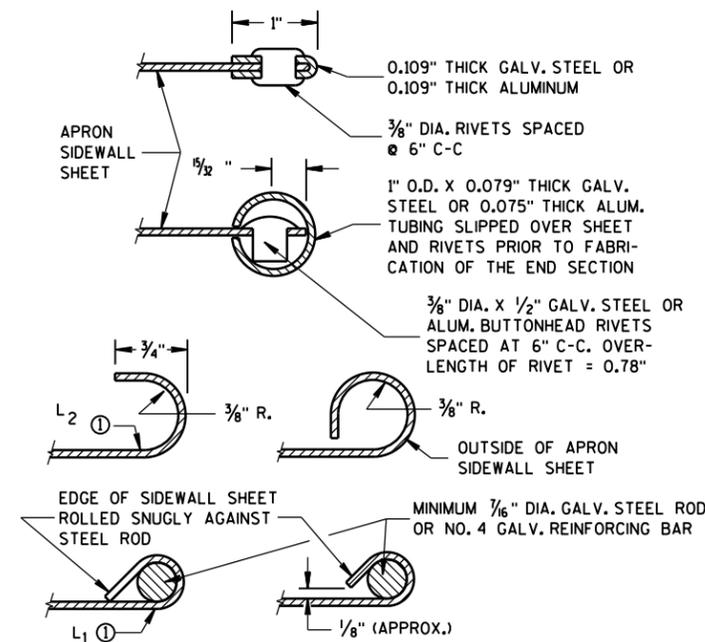
NOTE: DIMPLED BAND FITS OVER OUTSIDE OF ENDWALL, AND CORRUGATED BAND FITS INSIDE ENDWALL. DIMPLED BAND MAY BE USED WITH HELICALLY CORRUGATED PIPE.

FOR CIRCUMFERENTIALLY CORRUGATED PIPE USE ENDWALL CONNECTION DETAILS 1, 2, 3 OR 5 AS APPLICABLE.

FOR HELICALLY CORRUGATED PIPE USE ENDWALL CONNECTION DETAILS 1, 2 OR 5.

FOR HELICALLY CORRUGATED PIPES WITH TWO CIRCUMFERENTIAL CORRUGATIONS AT EACH END USE ENDWALL CONNECTION DETAILS 1, 2 OR 3.

CONNECTION DETAILS



SECTION A-A

GENERAL NOTES

DETAILS OF CONSTRUCTION, MATERIALS AND WORKMANSHIP NOT SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE STANDARD SPECIFICATIONS AND THE APPLICABLE SPECIAL PROVISIONS.

CONCRETE CULVERT ENDWALLS MAY NOT BE USED WITH GALVANIZED STEEL OR ALUMINUM CULVERT PIPE OR VICE VERSA. GALVANIZED STEEL OR ALUMINUM ENDWALLS SHALL NORMALLY BE INSTALLED ON CULVERT PIPE OF THE SAME METAL.

ALL THREE PIECE STEEL APRON ENDWALLS FOR 60" DIAMETER PIPE AND LARGER SHALL HAVE 0.109" SIDES AND 0.138" CENTER PANELS. ALL THREE PIECE ALUMINUM APRON ENDWALLS FOR 60" DIAMETER PIPE AND LARGER SHALL HAVE 0.105" SIDES AND 0.134" CENTER PANELS. THE WIDTH OF CENTER PANELS SHALL BE GREATER THAN 20 PERCENT OF THE PIPE PERIMETER.

LAP SEAMS SHALL BE TIGHTLY JOINED BY GALVANIZED RIVETS OR BOLTS FOR STEEL UNITS AND ALUMINUM RIVETS AND BOLTS FOR ALUMINUM UNITS. FOR THE 60" THROUGH 96" DIAMETER APRON ENDWALL SIZES, THE REINFORCED EDGES AND CENTER PANEL SEAMS SHALL BE FURTHER REINFORCED WITH GALVANIZED STEEL OR ALUMINUM STIFFENER ANGLES. THE ANGLES SHALL BE ATTACHED BY GALVANIZED NUTS AND BOLTS FOR STEEL UNITS AND ALUMINUM NUTS AND BOLTS FOR ALUMINUM UNITS.

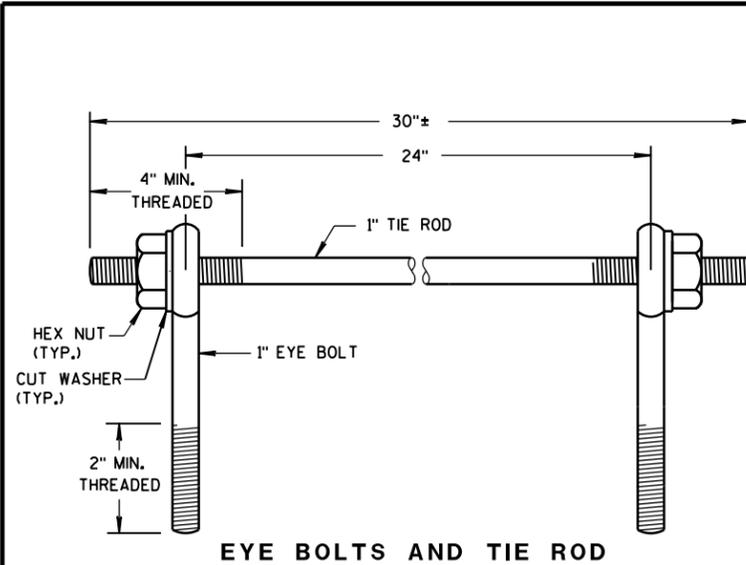
WHERE TWO OR MORE PIPES WITH APRON ENDWALLS ARE LAID ADJACENT TO EACH OTHER, THEY SHALL BE SEPARATED BY A DISTANCE SUFFICIENT TO PROVIDE A MINIMUM CLEARANCE OF 6 INCHES BETWEEN APRON ENDWALLS.

Ⓛ FOR PIPE SIZES UP TO 60" DIAMETER, A 180° ROLLED EDGE MAY BE USED INSTEAD OF STEEL ROD REINFORCEMENT. SEE SECTION A-A.

APRON ENDWALLS FOR  
CULVERT PIPE

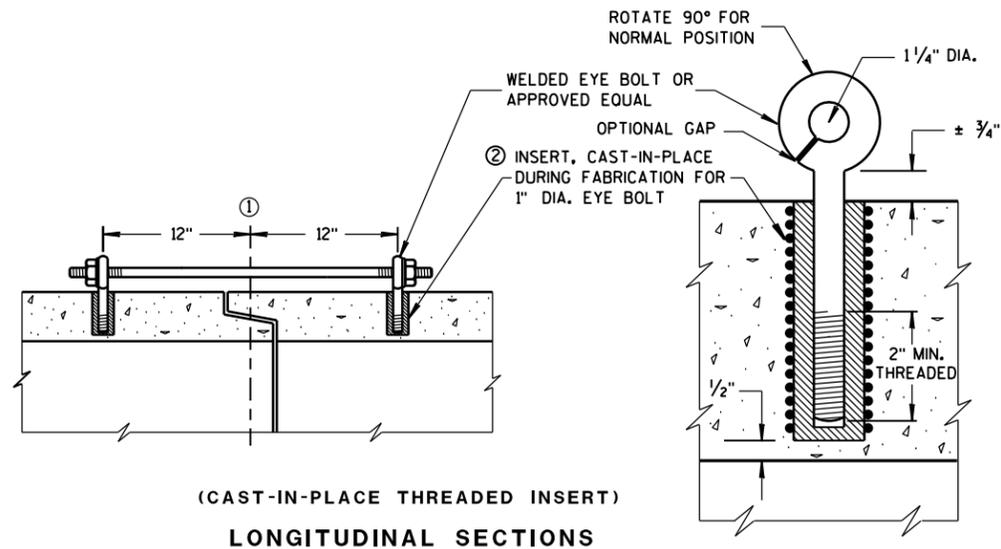
STATE OF WISCONSIN  
DEPARTMENT OF TRANSPORTATION

APPROVED  
8-30-94 /s/ Rory L. Rhinesmith  
DATE CHIEF ROADWAY DEVELOPMENT ENGINEER  
FHWA



EYE BOLTS AND TIE ROD

EYE BOLT AND TIE ROD ASSEMBLY (ALTERNATE NO. 1)



(CAST-IN-PLACE THREADED INSERT)  
LONGITUDINAL SECTIONS

**GENERAL NOTES**

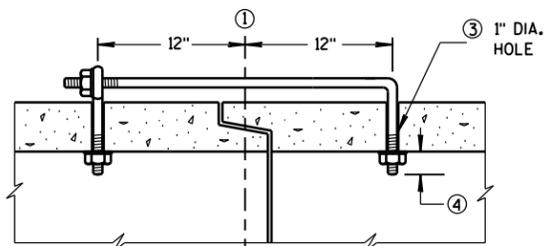
DETAILS OF CONSTRUCTION, MATERIALS, AND WORKMANSHIP NOT SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE STANDARD SPECIFICATIONS AND APPLICABLE SPECIAL PROVISIONS.

CONCRETE CULVERT AND STORM SEWER PIPE SHALL BE TIED TOGETHER IN THE MANNER ILLUSTRATED BY THIS DETAIL AT LOCATIONS DESIGNATED IN THE STANDARD SPECIFICATIONS AND THE PLAN. THE CONTRACTOR MAY USE EITHER ALTERNATE 1, 2 OR 3 FOR DRAINAGE STRUCTURES. ONLY ALTERNATE 1 AND 3 MAY BE USED FOR CATTLE PASSES, UNLESS OTHERWISE STATED IN THE CONTRACT. THE MATERIALS, FABRICATION AND WORK NECESSARY TO TIE THE PIPE BY THIS DETAIL WILL BE CONSIDERED INCIDENTAL TO THE PIPE AND APRON ENDWALLS IF REQUIRED.

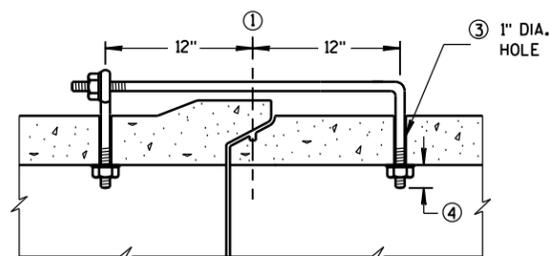
DETAILED DRAWINGS FOR PROPOSED ALTERNATE DESIGNS FOR JOINT TIES SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL.

JOINT TIES TO BE HOT-DIP GALVANIZED PER ASTM A 153.

- ①  $\phi$  OF TONGUE AND GROOVE OR BELL AND SPIGOT JOINTS.
- ② THE INSIDE OF THE THREADED INSERTS SHALL BE CLEAN TO ALLOW THE INSERTION OF THREADED EYE BOLTS.
- ③ HOLES SHALL BE CAST-IN-PLACE OR DRILLED 12 INCHES FROM  $\phi$  OF TONGUE AND GROOVE.
- ④ BOLT PROJECTION INSIDE OF PIPE SHALL NOT EXCEED 2 INCHES.
- ⑤ OPENING TO BE ROD DIAMETER PLUS 1 INCH.
- ⑥ LENGTH ADEQUATE TO EXTEND TO WITHIN 1/2 INCH OF THE INNER SURFACE OF THE PIPE.



(TONGUE & GROOVE PIPE)



(MODIFIED BELL PIPE)  
LONGITUDINAL SECTION

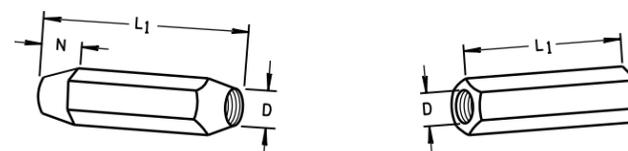
EYE BOLT DIMENSION TABLE

PIPE SIZE	L = LENGTH	
	TONGUE & GROOVE PIPE	MODIFIED BELL PIPE
18" TO 24"	4 1/2"	6 1/4"
30"	5"	7"
36"	5 1/2"	7"
42"	6"	
48"	6 1/2"	
60"	7 1/2"	
66"	8"	

ADJUSTABLE TIE ROD TABLE

PIPE DIAMETER	TIE ROD DIAMETER	D	L <sub>1</sub>	N
12-60	5/8	5/8	5	1/2
66-84	3/4	3/4	5	1/2
90-108	1	1	7	1 1/8

DIMENSIONS SHOWN ARE IN INCHES

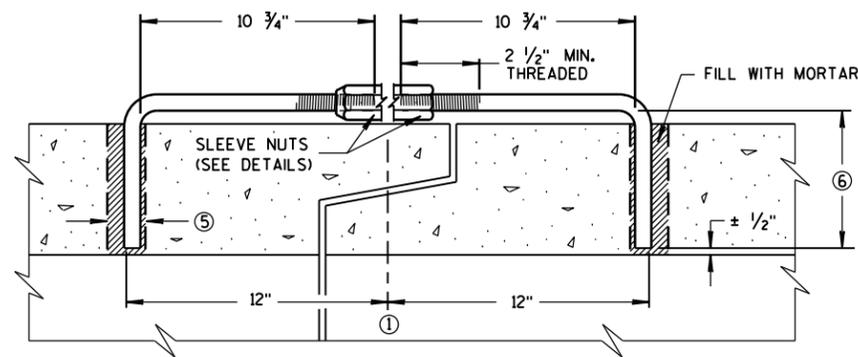


TAPERED

PLAIN

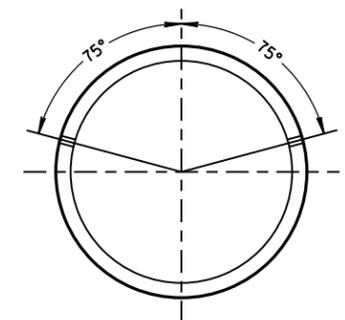
RIGHT AND LEFT THREADS

SLEEVE NUTS



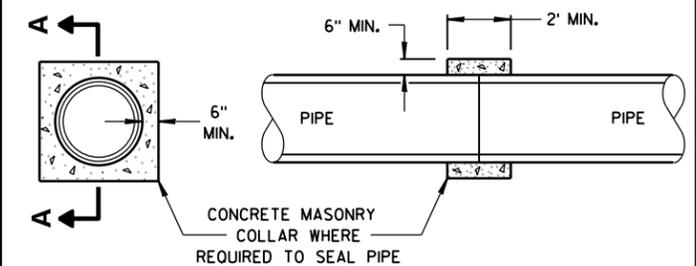
LONGITUDINAL SECTION

(JOINT TIES FOR 12" TO 108" DIA. CONCRETE PIPE)  
ADJUSTABLE TIE ROD (ALTERNATE NO. 3)



PLACEMENT OF (2) CAST-IN-PLACE INSERTS OR HOLES DURING FABRICATION FOR PIPE SECTIONS REQUIRING TIE RODS

TRANSVERSE SECTION



SECTION A-A

CONCRETE COLLAR DETAIL

JOINT TIES FOR CONCRETE PIPE AND CONCRETE COLLAR DETAIL

STATE OF WISCONSIN  
DEPARTMENT OF TRANSPORTATION

APPROVED  
6-5-2012 /s/ Jerry H. Zogg  
DATE ROADWAY STANDARDS DEVELOPMENT ENGINEER  
FHWA

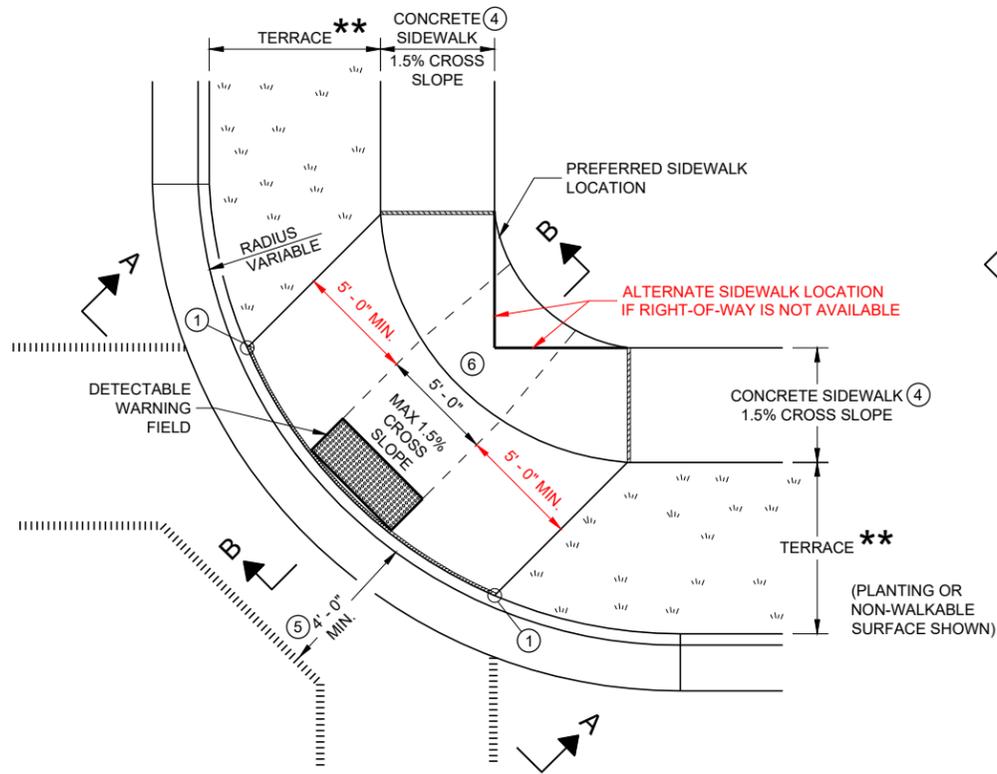
NOTE: TWO EYE BOLTS MAY BE USED WITH A 30" LONG THREADED ROD IN LIEU OF THE 90° BENT TIE ROD.

(JOINT TIES FOR 18" TO 66" DIA. CONCRETE PIPE)

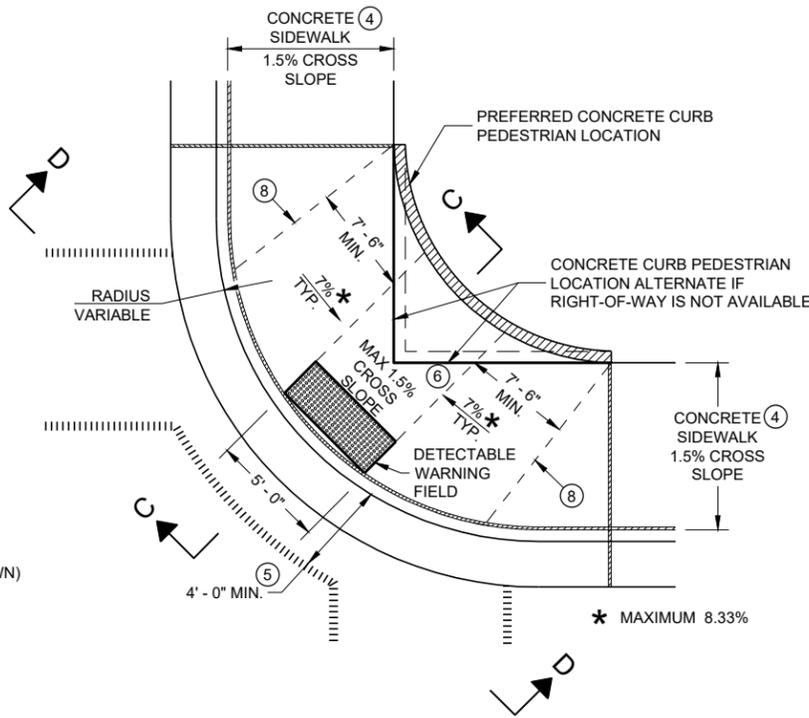
EYE BOLT AND TIE ROD ASSEMBLY (ALTERNATE NO. 2)



# SDD 08D05-a: Curb Ramps Types 1 and 1-A



**PLAN VIEW**  
**CURB RAMP TYPE 1**  
**(CENTER OF CORNER RADIUS)**



**PLAN VIEW**  
**CURB RAMP TYPE 1 - A**  
**(NO TERRACE)**

## GENERAL NOTES

AVOID PLACING DRAINAGE STRUCTURES, JUNCTION BOXES OR OTHER OBSTRUCTIONS IN FRONT OF RAMP ACCESS AREAS.

DETAILS OF CONSTRUCTION, MATERIALS AND WORKMANSHIP NOT SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE STANDARD SPECIFICATIONS AND THE APPLICABLE SPECIAL PROVISIONS.

WHEN NECESSARY, THE SIDEWALK ELEVATION MAY BE LOWERED TO MEET THE HIGH POINT ON THE RAMP.

TYPE 1 CURB RAMPS SHALL HAVE A NORMAL SIDEWALK APRON AND CURB ON BOTH SIDES OF RAMP.

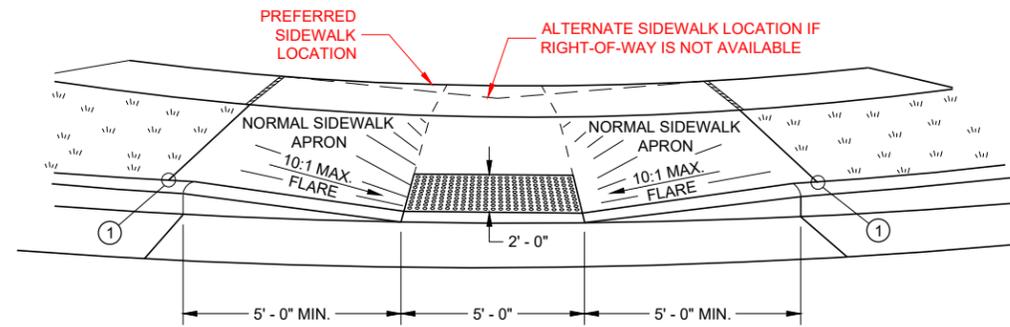
DETECTABLE WARNING FIELD SHALL BE MEASURED AND PAID BY THE SQUARE FOOT AS "CURB RAMP DETECTABLE WARNING FIELD". THE CONCRETE PEDESTRIAN CURB, IF NEEDED, SHALL BE MEASURED AND PAID BY THE LINEAR FOOT AS "CONCRETE CURB PEDESTRIAN". CONCRETE SIDEWALK IN THE CURB RAMP AREA SHALL BE MEASURED AND PAID BY THE SQUARE FOOT AS CONCRETE SIDEWALK, INCLUDING THE AREA UNDER THE DETECTABLE WARNING FIELD.

SELECT CURB RAMP DETECTABLE WARNING FIELD MATERIALS AND DEVICES FROM THE DEPARTMENT'S APPROVED MATERIALS LIST. THE COLOR OF THE DETECTABLE WARNING FIELD IS SPECIFIED ELSEWHERE AND IS INCIDENTAL TO THE BID ITEM OF "CURB RAMP DETECTABLE WARNING FIELD"

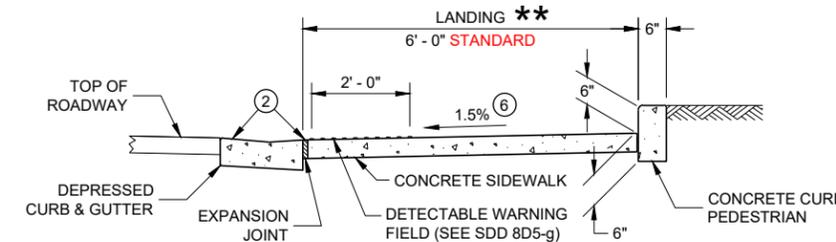
DETECTABLE WARNING FIELDS THAT ARE INSTALLED AS A GROUP OR SIDE BY SIDE, SHALL BE FROM THE SAME MANUFACTURER.

SURFACE TEXTURE OF THE RAMP SHALL BE OBTAINED BY COARSE BROOMING TRANSVERSE TO THE SLOPE OF THE RAMP.

- ① THIS POINT IS AN EXTENSION OF OUTSIDE EDGE OF APPROACHING SIDEWALK WHERE IT MEETS THE BACK OF CONCRETE CURB. POINT LOCATION MAY BE ADJUSTED TO ALIGN WITH BEGINNING OF FULL-HEIGHT CURB IF THIS DISTANCE IS SHORT.
- ② GRADE CHANGE BETWEEN GUTTER FLAG SLOPE AND THE CURB RAMP SLOPE SHALL NOT EXCEED 11%. MAXIMUM GUTTER FLAG SLOPE IS 4%. PROVIDE LONGITUDINAL DRAINAGE AROUND CURB AND AWAY FROM CURB RAMP. NO VERTICAL LIPS OR DISCONTINUITIES GREATER THAN 1/4" INCH ARE ALLOWED. SLOPE OF CURB HEAD OPENING SHALL MATCH THE RAMP SLOPE, MINIMALLY 1.5% AND NOT TO EXCEED 7%. WHEN ADJACENT TO 1.5% LANDING, CONSTRUCT CURB HEAD OPENING AT 1.5% IN THE DIRECTION OF PEDESTRIAN TRAVEL.
- ③ MAXIMUM 8.33% CURB RAMP SLOPE IS ALLOWABLE WITH FLATTENED GUTTER FLAG SLOPE AND NOT TO EXCEED 11% GRADE CHANGE.
- ④ ±0.5% CONSTRUCTION TOLERANCE IN SIDEWALK CROSS SLOPE. THE SIDEWALK CROSS SLOPE SHALL NOT EXCEED 2% WITHOUT PRIOR APPROVAL FROM THE ENGINEER.
- ⑤ PROVIDE A LEVEL LANDING IN THE STREET AND GUTTER AREA (2% MAXIMUM SLOPE IN ANY DIRECTION). WHEN THE GUTTER SLOPE EXCEEDS 2%, CONSTRUCT THE LEVEL LANDING IN THE STREET AREA.
- ⑥ PROVIDE A LEVEL LANDING (MAXIMUM 2% SLOPE) IN ANY DIRECTION OF PEDESTRIAN TRAVEL. STANDARD LEVEL LANDING SIZE IS 5 FEET BY 5 FEET.
- ⑧ PROVIDE GRADE BREAK PERPENDICULAR TO DIRECTION OF WHEELCHAIR TRAVEL.



**VIEW A - A FOR TYPE 1**

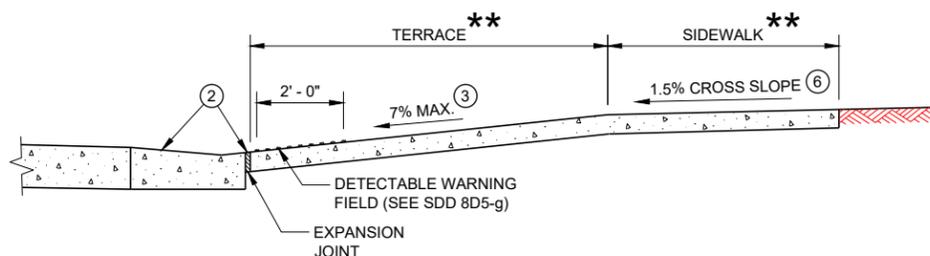


**SECTION C - C FOR TYPE 1 - A**

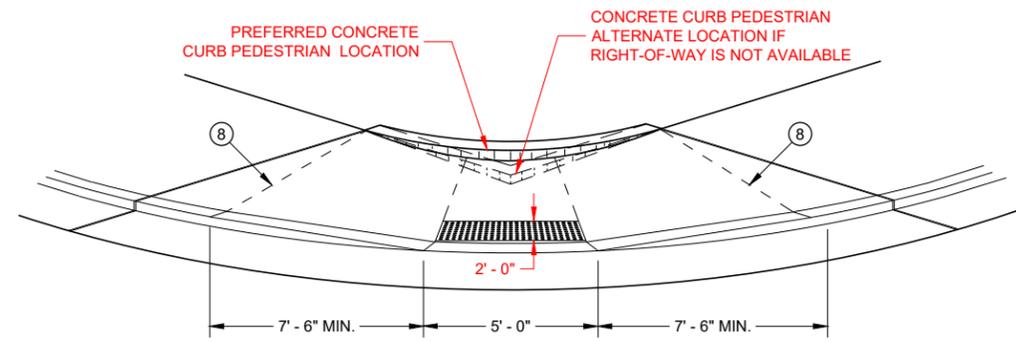
## LEGEND

- 1/2" EXPANSION JOINT SIDEWALK
- CONTRACTION JOINT FIELD LOCATED
- PAVEMENT MARKING CROSSWALK (WHITE)

\*\* WIDTH SHOWN ELSEWHERE IN THE PLANS



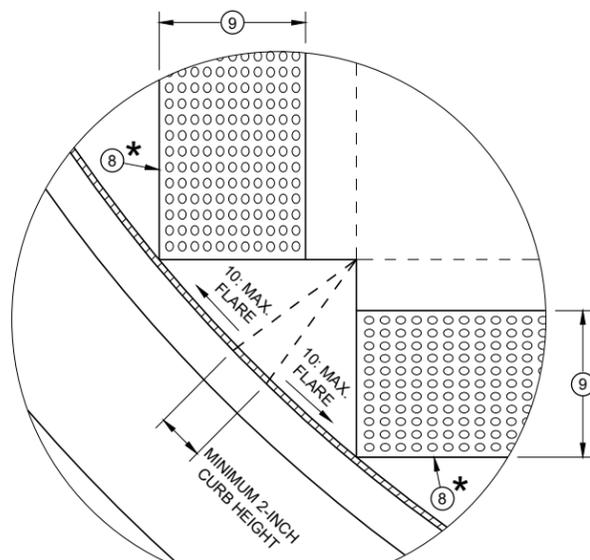
**SECTION B - B FOR TYPE 1**



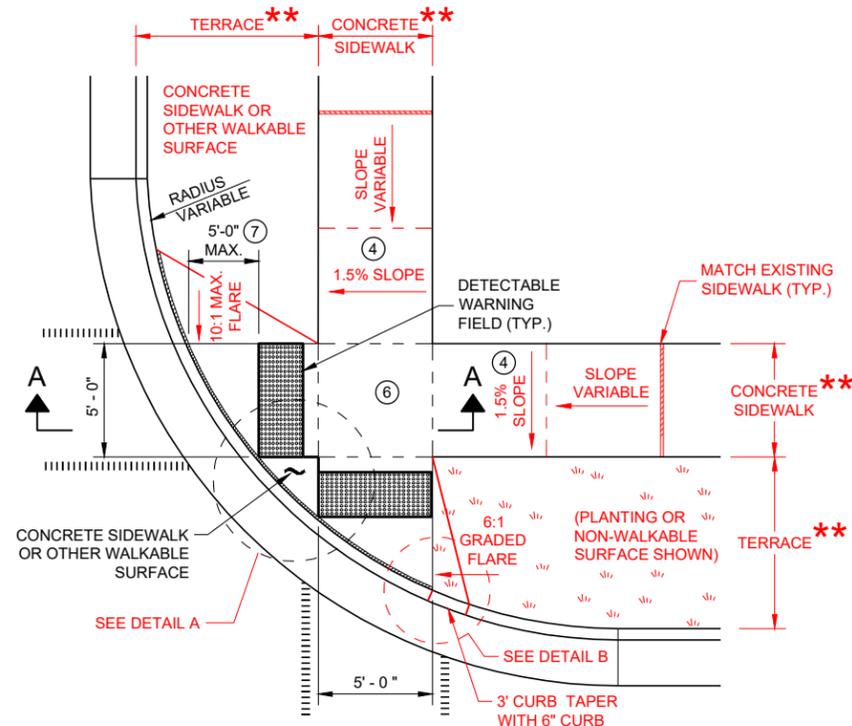
**VIEW D - D FOR TYPE 1 - A**

**CURB RAMPS**  
**TYPE 1 AND 1-A**

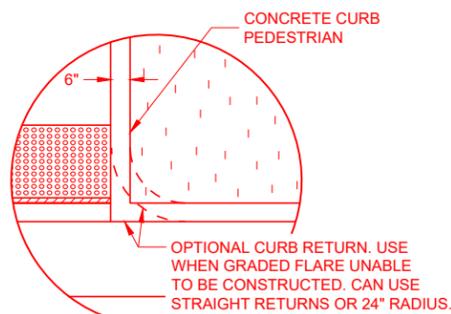
STATE OF WISCONSIN  
DEPARTMENT OF TRANSPORTATION



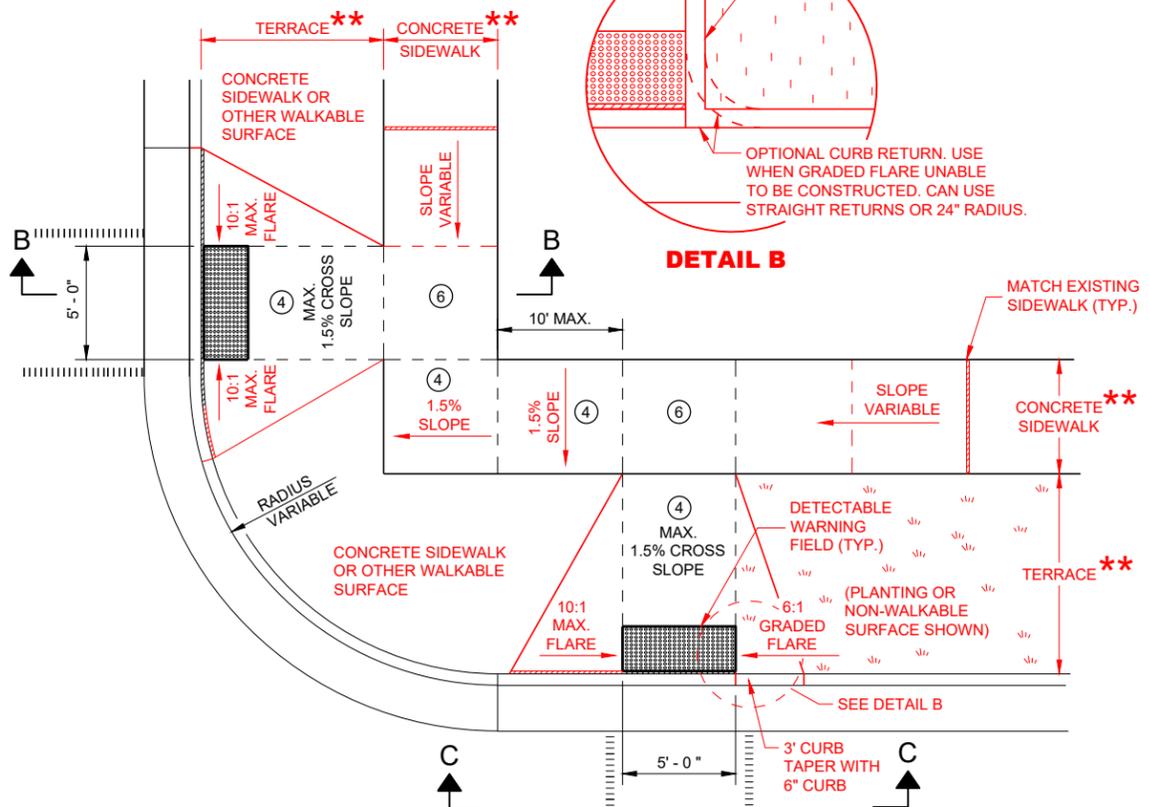
**DETAIL A**



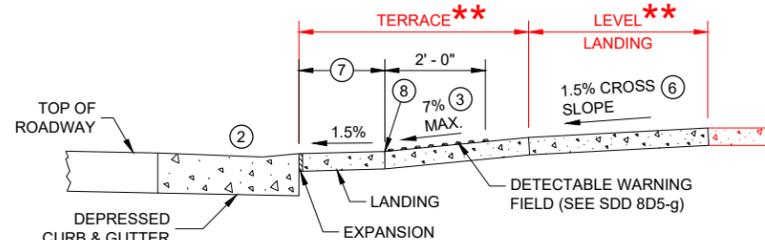
**PLAN VIEW  
CURB RAMP TYPE 2  
(CENTER OF CORNER RADIUS)**



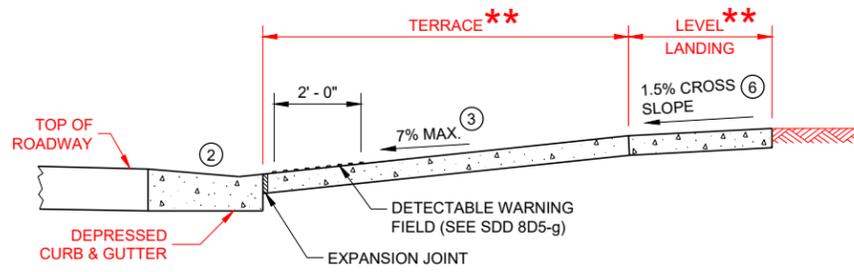
**DETAIL B**



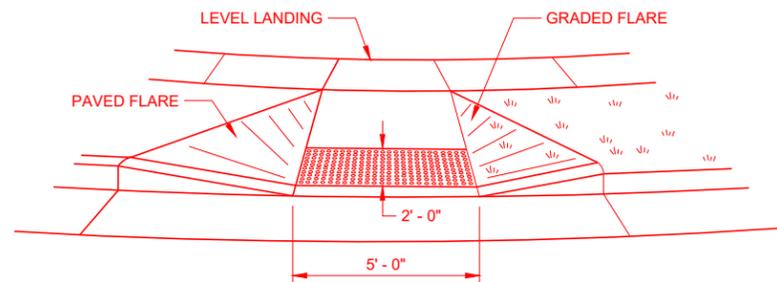
**PLAN VIEW  
CURB RAMP TYPE 3  
(OUTSIDE OF CROSSWALK AREA)**



**SECTION A - A FOR TYPE 2**



**SECTION B - B FOR TYPE 3**



**VIEW C - C FOR TYPE 3**

**GENERAL NOTES**

- AVOID PLACING DRAINAGE STRUCTURES, JUNCTION BOXES OR OTHER OBSTRUCTIONS IN FRONT OF RAMP ACCESS AREAS.
- DETAILS OF CONSTRUCTION, MATERIALS AND WORKMANSHIP NOT SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE STANDARD SPECIFICATIONS AND THE APPLICABLE SPECIAL PROVISIONS.
- DETECTABLE WARNING FIELDS THAT ARE INSTALLED AS A GROUP OR SIDE BY SIDE SHALL BE FROM THE SAME MANUFACTURER.
- ② GRADE CHANGE BETWEEN GUTTER FLAG SLOPE AND THE CURB RAMP SLOPE SHALL NOT EXCEED 11%. MAXIMUM GUTTER FLAG SLOPE IS 4%. PROVIDE LONGITUDINAL DRAINAGE AROUND CURB AND AWAY FROM CURB RAMP. NO VERTICAL LIPS OR DISCONTINUITIES GREATER THAN 1/4 - INCH ARE ALLOWED. SLOPE OF CURB HEAD OPENING SHALL MATCH THE RAMP SLOPE, MINIMALLY 1.5% AND NOT TO EXCEED 7%. WHEN ADJACENT TO 1.5% LANDING, CONSTRUCT CURB HEAD OPENING AT 1.5% IN THE DIRECTION OF PEDESTRIAN TRAVEL.
- ③ AN 8.33% CURB RAMP SLOPE IS ALLOWABLE WITH FLATTENED GUTTER FLAG SLOPE (2.67% OR LESS) AND NOT TO EXCEED 11% GRADE CHANGE.
- ④ ±0.5% CONSTRUCTION TOLERANCE IN SIDEWALK CROSS SLOPE. THE SIDEWALK CROSS SLOPE SHALL NOT EXCEED 2% WITHOUT PRIOR APPROVAL FROM THE ENGINEER.
- ⑥ PROVIDE A LEVEL LANDING (MAXIMUM 2% SLOPE) IN ANY DIRECTION OF PEDESTRIAN TRAVEL. STANDARD LEVEL LANDING SIZE IS 5 FEET X 5 FEET.
- ⑦ WHEN GRADE BREAK DISTANCE EXCEEDS 5 FEET, USE RADIAL DETECTABLE WARNING FIELD PER SDD 8D5-f.
- ⑧ PROVIDE GRADE BREAK PERPENDICULAR TO DIRECTION OF WHEELCHAIR TRAVEL.
- ⑨ WHEN DISTANCE IS LESS THAN 6' - 0", IT MAY BE DIFFICULT TO ACHIEVE A 7% SLOPE OR FLATTER ALONG THE RAMP. REDUCE CURB HEIGHT IN TRIANGLE AREA TO ACHIEVE 7% SLOPE OR FLATTER ON RAMP. CONSTRUCT 2-INCH MINIMUM CURB HEIGHT BETWEEN 10:1 FLARES.

\* MAXIMUM 2.0% SLOPE IN ALL DIRECTIONS IN FRONT OF GRADE BREAK  
 \*\* WIDTH SHOWN ELSEWHERE IN THE PLANS

**LEGEND**

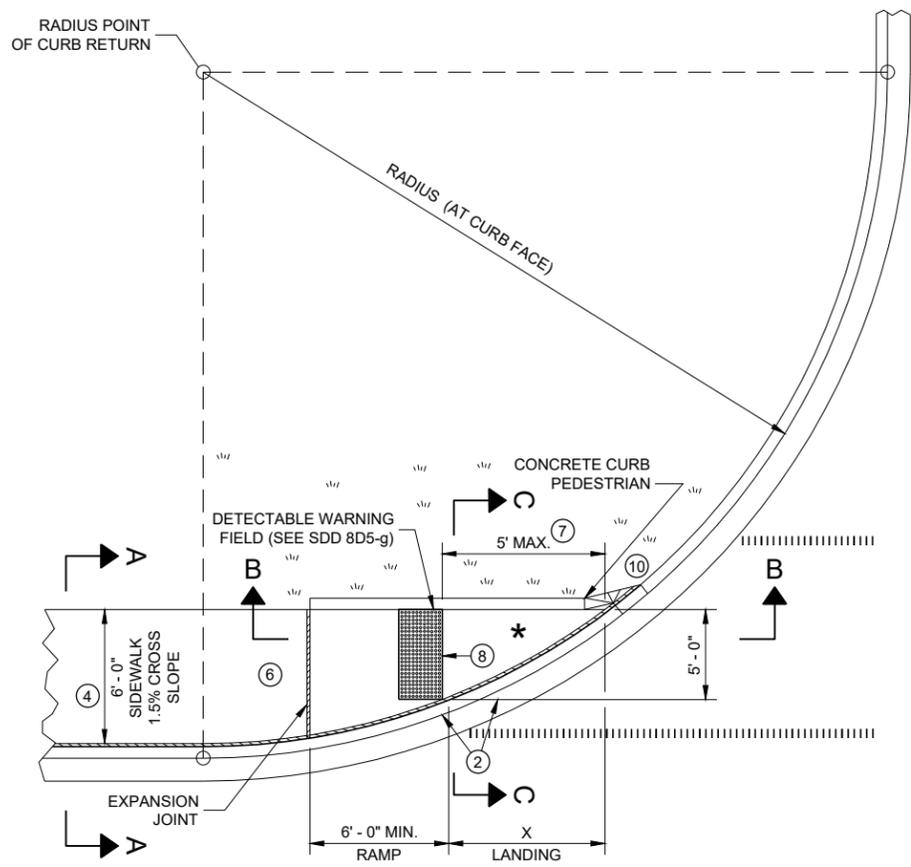
- 1/2" EXPANSION JOINT SIDEWALK
- CONTRACTION JOINT SIDEWALK
- PAVEMENT MARKING CROSSWALK (WHITE)

**CURB RAMPS  
TYPE 2 AND 3**

STATE OF WISCONSIN  
DEPARTMENT OF TRANSPORTATION



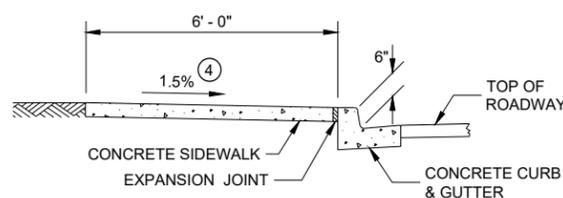
# SDD 08D05-c Curb Ramps Types 4A and 4A1



**PLAN VIEW CURB RAMP TYPE 4A**

RADIUS (AT CURB FACE)	X
10 FEET	4' - 7"
15 FEET	6' - 5 1/2"

INTERMEDIATE RADII CAN BE INTERPOLATED



**SECTION A - A FOR TYPE 4A**

## GENERAL NOTES

AVOID PLACING DRAINAGE STRUCTURES, JUNCTION BOXES OR OTHER OBSTRUCTIONS IN FRONT OF RAMP ACCESS AREAS.

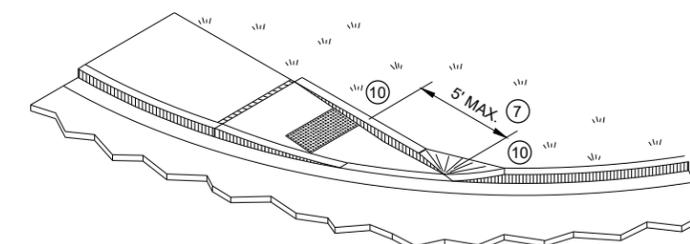
DETAILS OF CONSTRUCTION, MATERIALS AND WORKMANSHIP NOT SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE STANDARD SPECIFICATIONS AND THE APPLICABLE SPECIAL PROVISIONS.

DETECTABLE WARNING FIELDS THAT ARE INSTALLED AS A GROUP OR SIDE BY SIDE, SHALL BE FROM THE SAME MANUFACTURER.

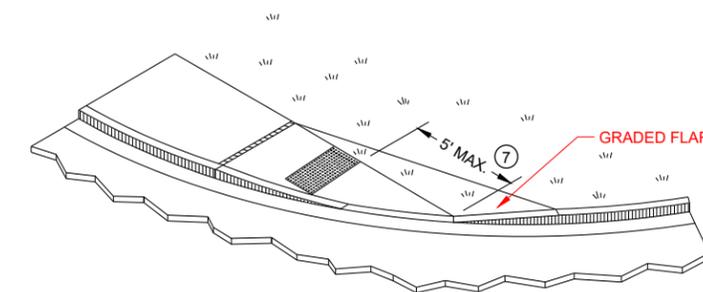
- ② GRADE CHANGE BETWEEN GUTTER FLAG SLOPE AND THE CURB RAMP SLOPE SHALL NOT EXCEED 11%. MAXIMUM GUTTER FLAG SLOPE IS 4%. PROVIDE LONGITUDINAL DRAINAGE AROUND CURB AND AWAY FROM CURB RAMP. NO VERTICAL LIPS OR DISCONTINUITIES GREATER THAN 1/4" INCH ARE ALLOWED. SLOPE OF CURB HEAD OPENING SHALL MATCH THE RAMP SLOPE, MINIMALLY 1.5% AND NOT TO EXCEED 7%. WHEN ADJACENT TO 1.5% LANDING, CONSTRUCT CURB HEAD OPENING AT 1.5% IN THE DIRECTION OF PEDESTRIAN TRAVEL.
- ③ AN 8.33% CURB RAMP SLOPE IS ALLOWABLE WITH FLATTENED GUTTER FLAG SLOPE AND NOT TO EXCEED 11% GRADE CHANGE.
- ④ ±0.5% CONSTRUCTION TOLERANCE IN SIDEWALK CROSS SLOPE. THE SIDEWALK CROSS SLOPE SHALL NOT EXCEED 2% WITHOUT PRIOR APPROVAL FROM THE ENGINEER.
- ⑥ PROVIDE A LEVEL LANDING (MAXIMUM 2% SLOPE) IN ANY DIRECTION OF PEDESTRIAN TRAVEL. STANDARD LEVEL LANDING SIZE IS 5 FEET BY 5 FEET.
- ⑦ WHEN THIS GRADE BREAK DISTANCE EXCEEDS 5 FEET, USE RADIAL DETECTABLE WARNING FIELD PER SDD 8D5-f.
- ⑧ PROVIDE GRADE BREAK PERPENDICULAR TO DIRECTION OF WHEELCHAIR TRAVEL.
- ⑩ INSTALL TRANSITION NOSE (INCIDENTAL TO OTHER PAY ITEMS). DO NOT MARK TRANSITION NOSE.

## LEGEND

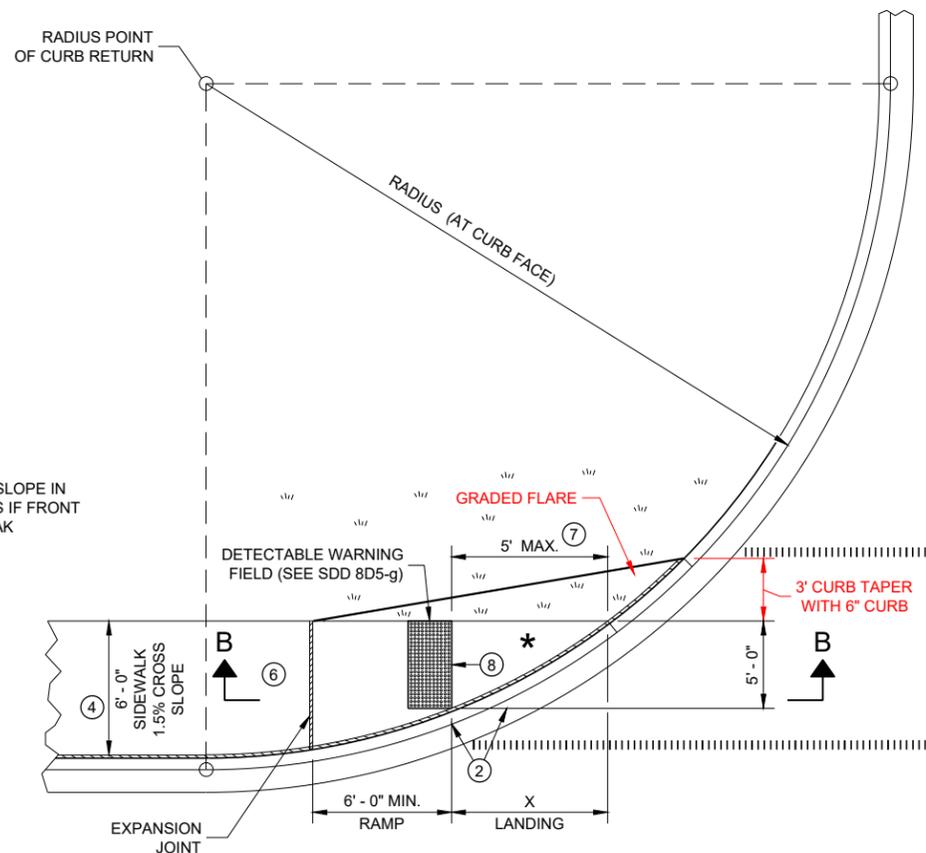
- 1/2" EXPANSION JOINT SIDEWALK
- - - CONTRACTION JOINT SIDEWALK
- ||||| PAVEMENT MARKING CROSSWALK (WHITE)



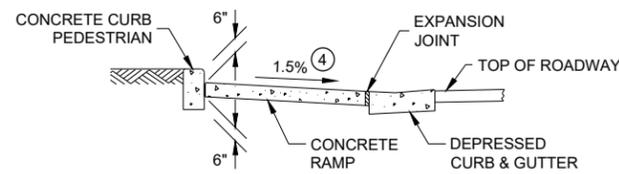
**ISOMETRIC VIEW FOR TYPE 4A**



**ISOMETRIC VIEW FOR TYPE 4A1**

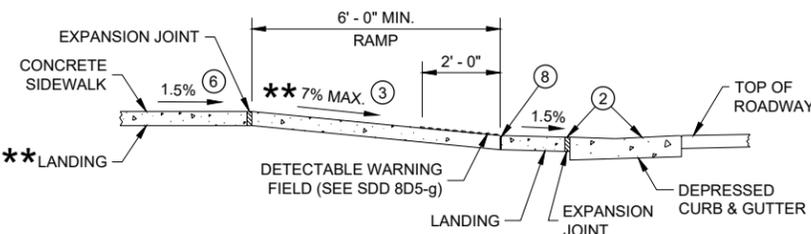


**PLAN VIEW CURB RAMP TYPE 4A1**



**SECTION C - C FOR TYPE 4A**

\* MAXIMUM 2.0% SLOPE IN ALL DIRECTIONS IF FRONT OF GRADE BREAK



**SECTION B - B FOR TYPE 4A AND TYPE 4A1**

\*\* IF RAMP SLOPE IS LESS THAN 5.0%, THEN NO ADJACENT UPHILL LANDING IS REQUIRED

## CURB RAMPS TYPE 4A AND 4A1

STATE OF WISCONSIN DEPARTMENT OF TRANSPORTATION

6

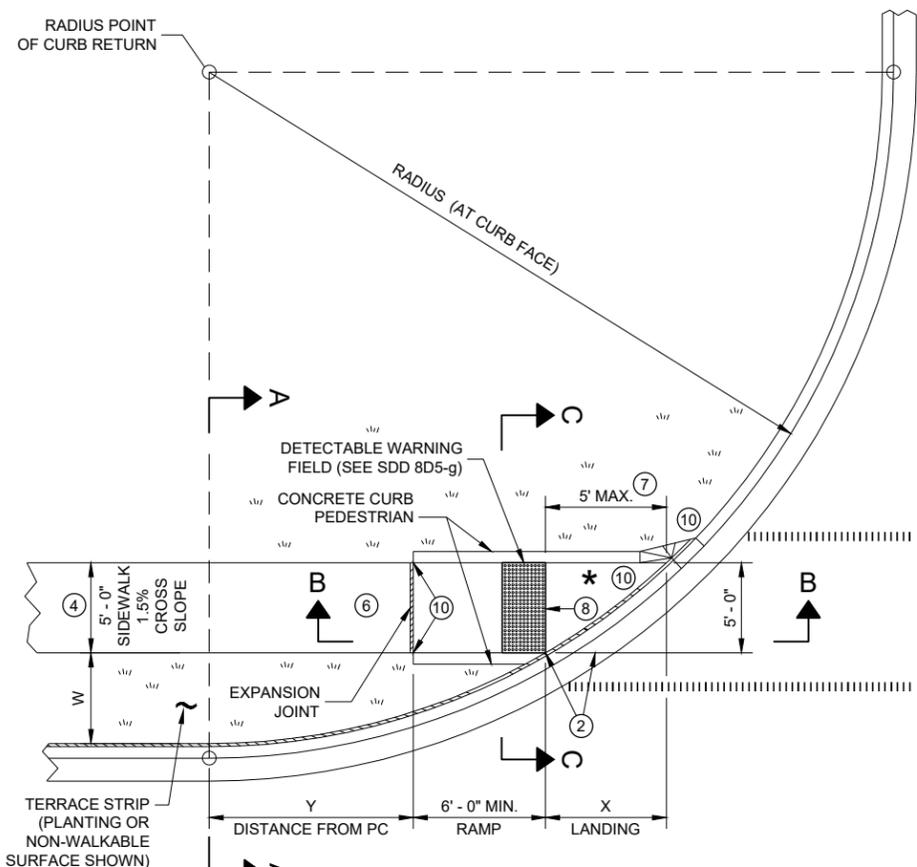
6

SDD 08D05 - 20c

SDD 08D05 - 20c



# SDD 08D05-d: Curb Ramps Types 4B and 4B1



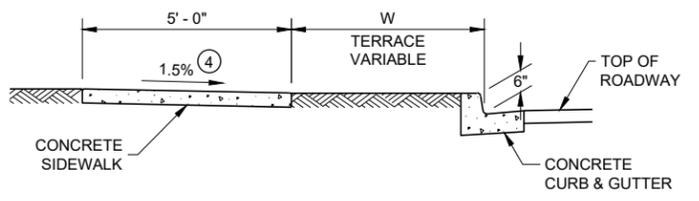
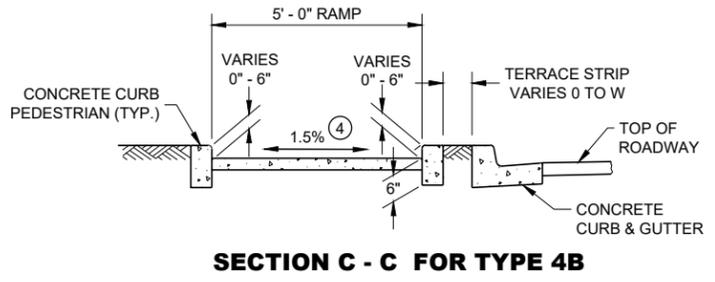
RADIUS (AT CURB FACE)	W = 3' - 0"		W = 4' - 0"		W = 5' - 0"		W = 6' - 0"		W = 7' - 0"		W = 8' - 0"		W = 9' - 0"		W = 10' - 0"	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
10 FEET	2' - 10 1/4"	0' - 5"	2' - 1"	1' - 4 1/2"	1' - 5"	2' - 1"	0' - 10"	2' - 7 1/2"	0' - 3 1/4"	3' - 0 1/4"						
15 FEET	4' - 6 3/4"	2' - 1 3/4"	3' - 9"	3' - 5 3/4"	3' - 1 1/4"	4' - 6"	2' - 6 3/4"	5' - 4 1/2"	2' - 1"	6' - 1"	1' - 8"	6' - 8 1/2"	1' - 3 1/4"	7' - 2 1/2"	0' - 10 3/4"	7' - 7 1/4"
20 FEET	5' - 9 3/4"	3' - 6 1/2"	4' - 11 1/2"	5' - 1 3/4"	4' - 3 1/4"	6' - 5 1/2"	3' - 8 3/4"	7' - 7"	3' - 3"	8' - 6 1/2"	2' - 10"	9' - 4 1/2"	2' - 5 1/2"	10' - 1 1/4"	2' - 1 1/4"	10' - 9"
30 FEET			6' - 9 1/4"	7' - 11 1/4"	6' - 0 1/4"	9' - 8"	5' - 5"	11' - 1 3/4"	4' - 10 3/4"	12' - 5 3/4"	4' - 5 1/2"	13' - 7 3/4"	4' - 0 3/4"	14' - 8 1/2"	3' - 8 1/2"	15' - 8 1/4"
40 FEET									6' - 1 3/4"	15' - 8 1/2"	5' - 8"	17' - 2"	5' - 3"	18' - 5 3/4"	4' - 10 3/4"	19' - 8 1/4"
50 FEET															5' - 10 1/4"	23' - 2"

INTERMEDIATE RADII CAN BE INTERPOLATED  
 DIMENSION "Y" IS CALCULATED BASED ON 6'-0" RAMP LENGTH  
 DIMENSION "X" IS CALCULATED BASED ON 5'-0" SIDEWALK WIDTH

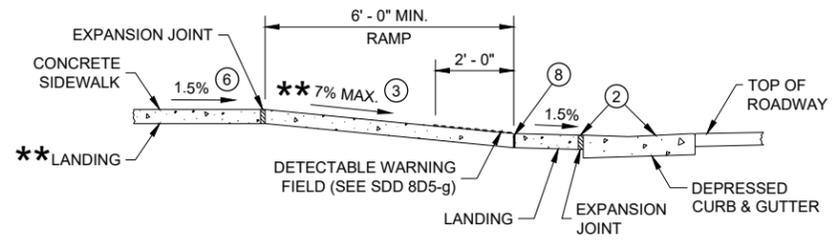
- LEGEND**
- 1/2" EXPANSION JOINT SIDEWALK
  - CONTRACTION JOINT SIDEWALK
  - PAVEMENT MARKING CROSSWALK (WHITE)

### GENERAL NOTES

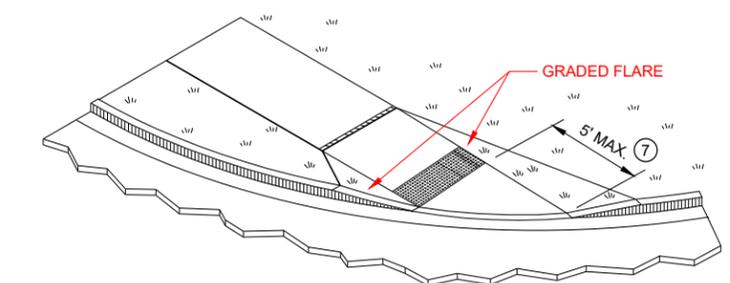
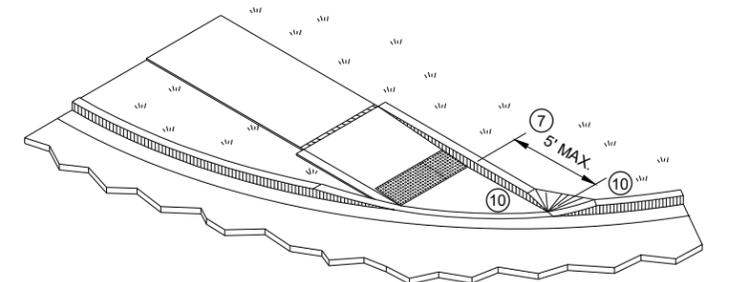
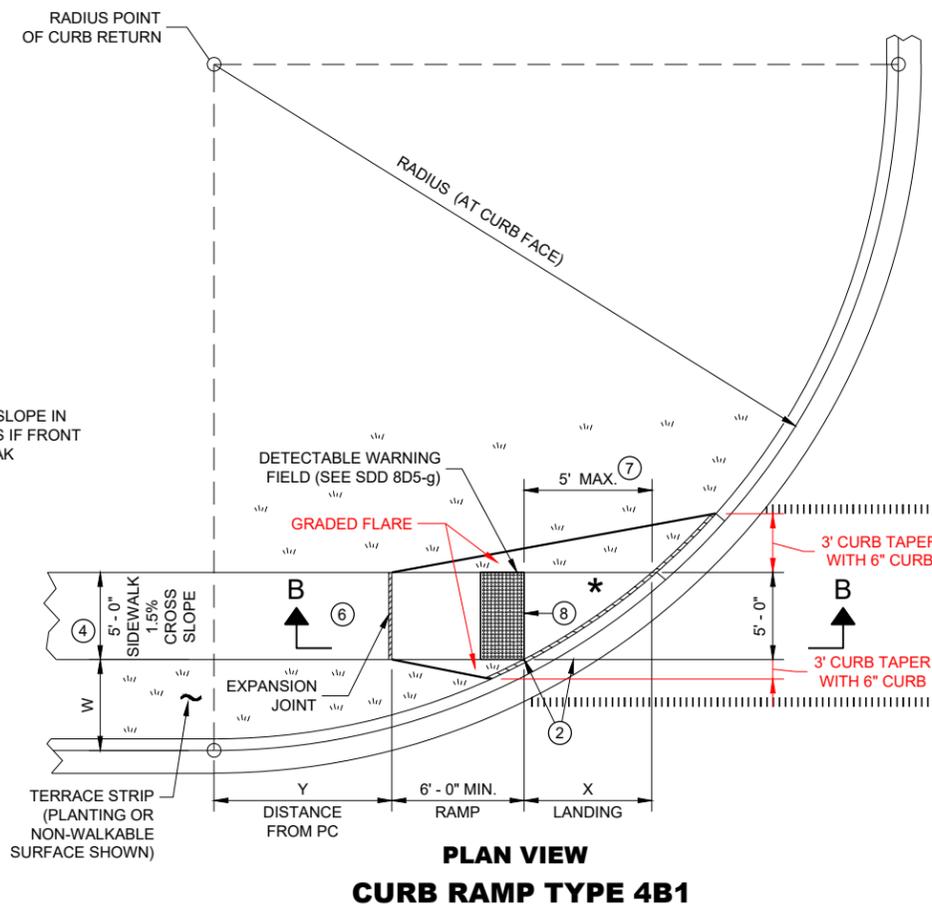
- AVOID PLACING DRAINAGE STRUCTURES, JUNCTION BOXES OR OTHER OBSTRUCTIONS IN FRONT OF RAMP ACCESS AREAS.
- DETAILS OF CONSTRUCTION, MATERIALS AND WORKMANSHIP NOT SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE STANDARD SPECIFICATIONS AND THE APPLICABLE SPECIAL PROVISIONS.
- DETECTABLE WARNING FIELDS THAT ARE INSTALLED AS A GROUP OR SIDE BY SIDE, SHALL BE FROM THE SAME MANUFACTURER.
- ② GRADE CHANGE BETWEEN GUTTER FLAG SLOPE AND THE CURB RAMP SLOPE SHALL NOT EXCEED 11%. MAXIMUM GUTTER FLAG SLOPE IS 4%. PROVIDE LONGITUDINAL DRAINAGE AROUND CURB AND AWAY FROM CURB RAMP. NO VERTICAL LIPS OR DISCONTINUITIES GREATER THAN 1/4" INCH ARE ALLOWED. SLOPE OF CURB HEAD OPENING SHALL MATCH THE RAMP SLOPE, MINIMALLY 1.5% AND NOT TO EXCEED 7%. WHEN ADJACENT TO 1.5% LANDING, CONSTRUCT CURB HEAD OPENING AT 1.5% IN THE DIRECTION OF PEDESTRIAN TRAVEL.
- ③ AN 8.33% CURB RAMP SLOPE IS ALLOWABLE WITH FLATTENED GUTTER FLAG SLOPE AND NOT TO EXCEED 11% GRADE CHANGE.
- ④ ±0.5% CONSTRUCTION TOLERANCE IN SIDEWALK CROSS SLOPE. THE SIDEWALK CROSS SLOPE SHALL NOT EXCEED 2% WITHOUT PRIOR APPROVAL FROM THE ENGINEER.
- ⑥ PROVIDE A LEVEL LANDING (MAXIMUM 2% SLOPE) IN ANY DIRECTION OF PEDESTRIAN TRAVEL. STANDARD LEVEL LANDING SIZE IS 5 FEET BY 5 FEET.
- ⑦ WHEN THIS GRADE BREAK DISTANCE EXCEEDS 5 FEET, USE RADIAL DETECTABLE WARNING FIELD PER SDD 8D5-f.
- ⑧ PROVIDE GRADE BREAK PERPENDICULAR TO DIRECTION OF WHEELCHAIR TRAVEL.
- ⑩ INSTALL TRANSITION NOSE (INCIDENTAL TO OTHER PAY ITEMS). DO NOT MARK TRANSITION NOSE.



\* MAXIMUM 2.0% SLOPE IN ALL DIRECTIONS IF FRONT OF GRADE BREAK



\*\* IF RAMP SLOPE IS LESS THAN 5.0%, THEN NO ADJACENT UPHILL LANDING IS REQUIRED

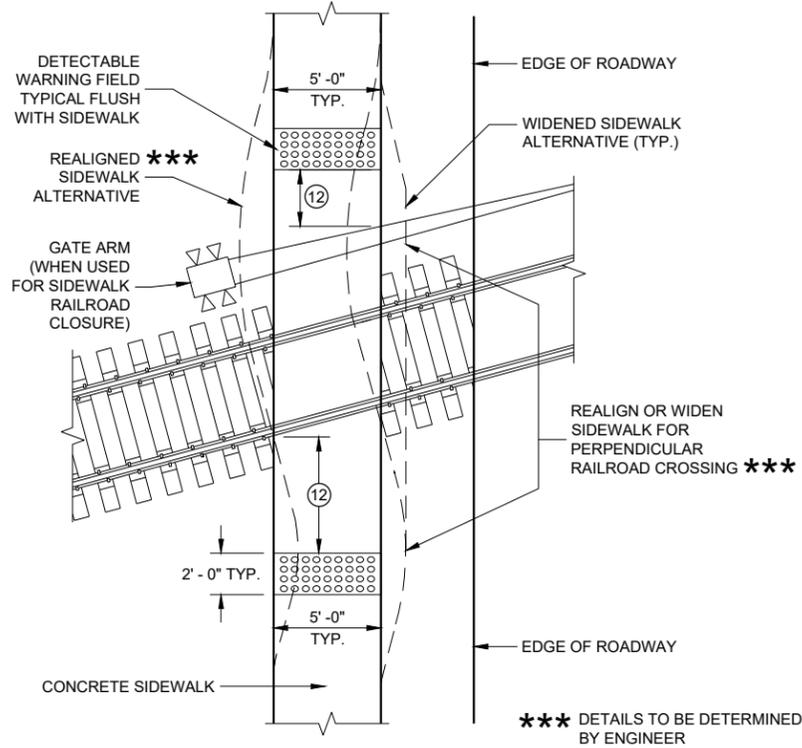


**CURB RAMPS  
TYPE 4B AND 4B1**

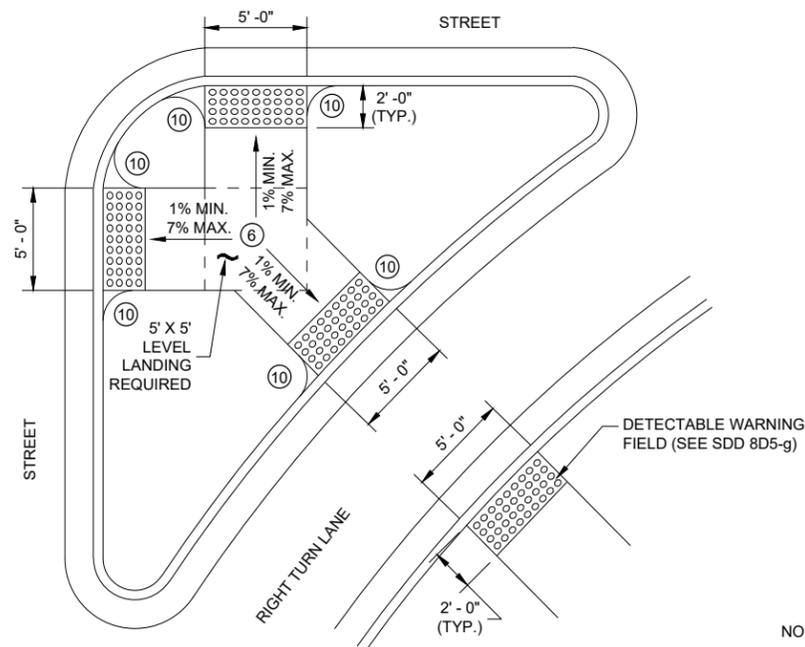
STATE OF WISCONSIN  
DEPARTMENT OF TRANSPORTATION

SDD 08D05 - 20d

SDD 08D05 - 20d

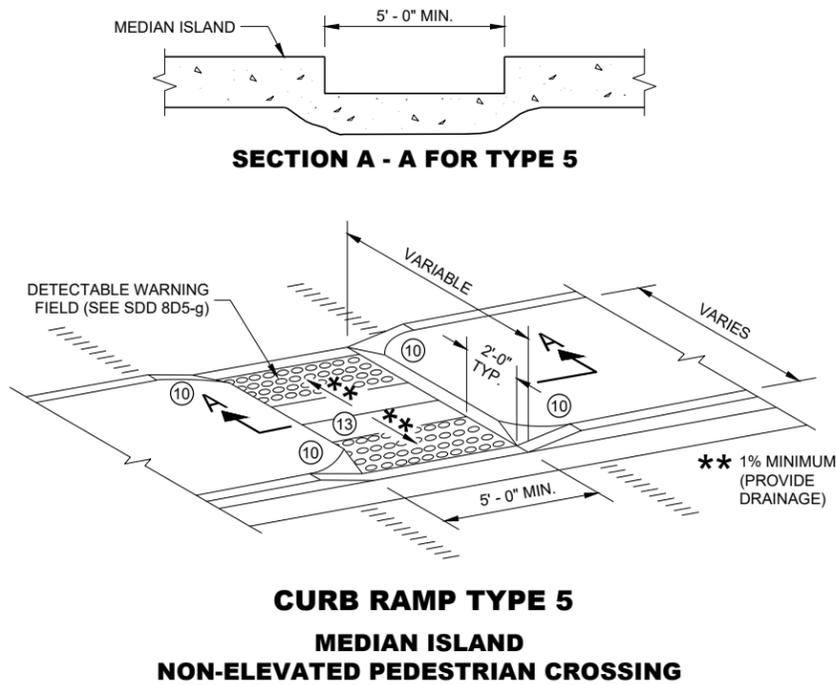


**CURB RAMP TYPE 8  
DETECTABLE WARNINGS  
AT RAILROAD CROSSING**

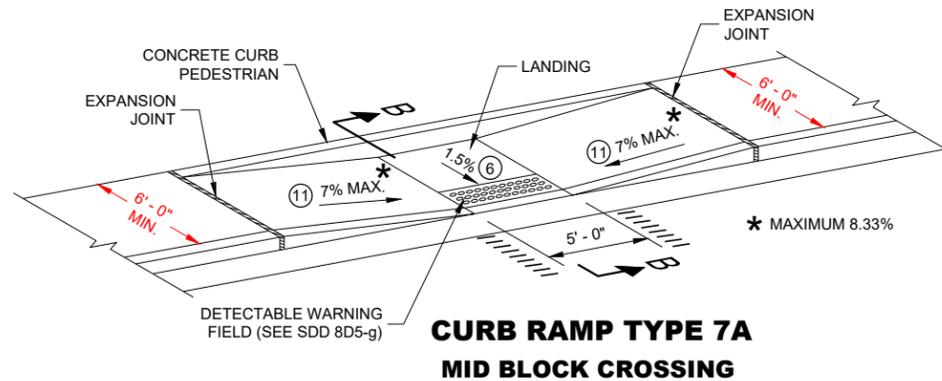


**CURB RAMP TYPE 6  
DETECTABLE WARNING AT ISLANDS**

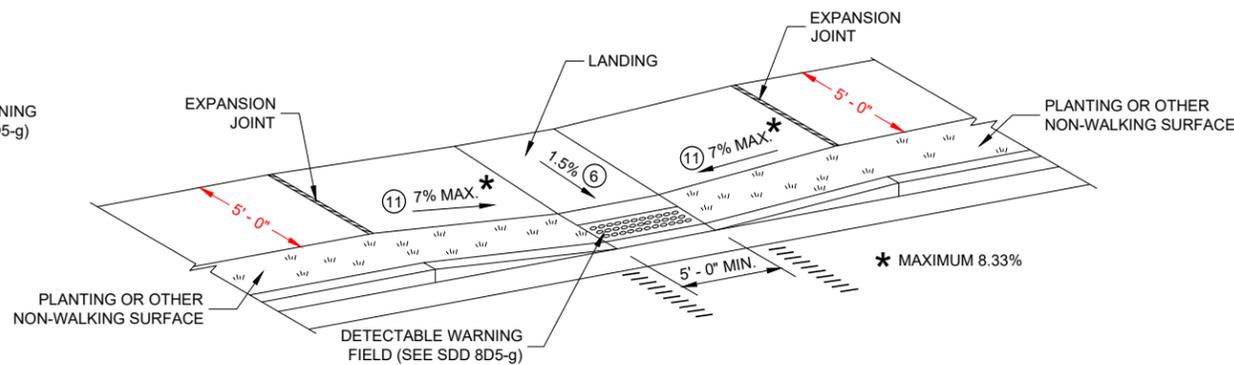
REFER TO GENERAL NOTES (2) AND (3)  
FOR ALL ISLAND CURB RAMPS



**CURB RAMP TYPE 5  
MEDIAN ISLAND  
NON-ELEVATED PEDESTRIAN CROSSING**



**CURB RAMP TYPE 7A  
MID BLOCK CROSSING**



**CURB RAMP TYPE 7B  
MID BLOCK CROSSING**

NOTE: THESE PARALLEL AND PARALLEL/PERPENDICULAR CURB RAMPS  
MAY BE USED AT INTERSECTIONS AND MID BLOCK LOCATIONS.

## GENERAL NOTES

AVOID PLACING DRAINAGE STRUCTURES, JUNCTION BOXES OR OTHER OBSTRUCTIONS IN FRONT OF RAMP ACCESS AREAS.

DETAILS OF CONSTRUCTION, MATERIALS AND WORKMANSHIP NOT SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE STANDARD SPECIFICATIONS AND THE APPLICABLE SPECIAL PROVISIONS.

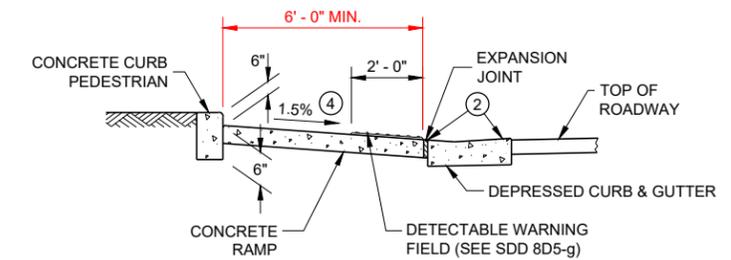
SIDEWALK CROSS SLOPE SHALL NOT EXCEED 2%.

DETECTABLE WARNING FIELDS THAT ARE INSTALLED AS A GROUP OR SIDE BY SIDE, SHALL BE FROM THE SAME MANUFACTURER.

- (2) GRADE CHANGE BETWEEN GUTTER FLAG SLOPE AND THE CURB RAMP SLOPE SHALL NOT EXCEED 11%. MAXIMUM GUTTER FLAG SLOPE IS 4%. PROVIDE LONGITUDINAL DRAINAGE AROUND CURB AND AWAY FROM CURB RAMP. NO VERTICAL LIPS OR DISCONTINUITIES GREATER THAN 1/4 - INCH ARE ALLOWED. SLOPE OF CURB HEAD OPENING SHALL MATCH THE RAMP SLOPE, MINIMALLY 1.5% AND NOT TO EXCEED 7%. WHEN ADJACENT TO 1.5% LANDING, CONSTRUCT CURB HEAD OPENING AT 1.5% IN THE DIRECTION OF PEDESTRIAN TRAVEL.
- (3) AN 8.33% CURB RAMP SLOPE IS ALLOWABLE WITH FLATTENED GUTTER FLAG SLOPE AND NOT TO EXCEED 11% GRADE CHANGE.
- (4) ±0.5% CONSTRUCTION TOLERANCE IN SIDEWALK CROSS SLOPE. THE SIDEWALK CROSS SLOPE SHALL NOT EXCEED 2% WITHOUT PRIOR APPROVAL FROM THE ENGINEER.
- (6) PROVIDE A LEVEL LANDING (MAXIMUM 2% SLOPE) IN ANY DIRECTION OF PEDESTRIAN TRAVEL. STANDARD LEVEL LANDING SIZE IS 5 FEET BY 5 FEET.
- (10) INSTALL TRANSITION NOSE (INCIDENTAL TO OTHER PAY ITEMS). DO NOT MARK TRANSITION NOSE.
- (11) SLOPE SIDEWALK TOWARD LANDING AS SHOWN WHERE THERE IS NO TERRACE OR WHERE THE TERRACE WIDTH IS LESS THAN 6 FEET WIDE.
- (12) THE EDGE OF THE DETECTABLE WARNING FIELD NEAREST TO A RAILROAD CROSSING SHALL BE 1.5 FEET ±0.1' FROM THE FACE OF THE GATE ARM IF THE GATE ARM EXTENDS ACROSS THE SIDEWALK. WHERE THERE IS NO PEDESTRIAN GATE, THE EDGE OF THE DETECTABLE WARNING FIELD NEAREST TO THE RAILROAD CROSSING SHALL BE 15 FEET FROM THE NEAREST RAIL.
- (13) DO NOT INSTALL DETECTABLE WARNING FIELDS AT THE EDGES OF STREET-LEVEL PEDESTRIAN REFUGE ISLANDS IF A MINIMUM 2 FOOT CONCRETE SURFACE WITHOUT DETECTABLE WARNINGS (MEASURED IN THE DIRECTION OF PEDESTRIAN TRAVEL) CANNOT BE ACHIEVED.

## LEGEND

- ===== 1/2" EXPANSION JOINT SIDEWALK
- - - - - CONTRACTION JOINT FIELD LOCATED
- ||||||| PAVEMENT MARKING CROSSWALK (WHITE)



**SECTION B - B FOR TYPE 7A**

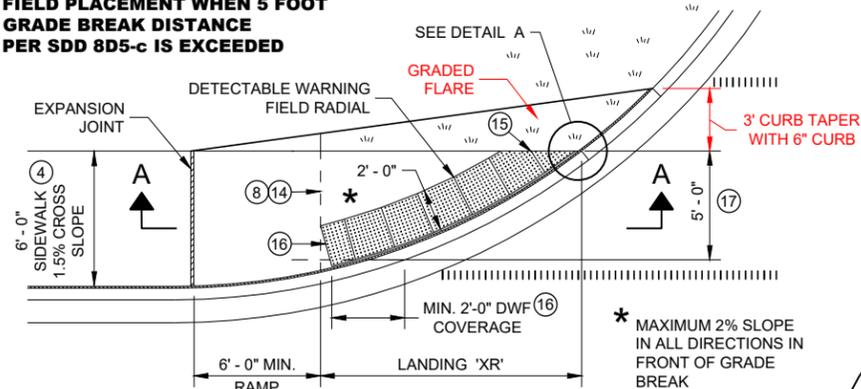
**CURB RAMPS  
TYPE 5, 6, 7A, 7B & 8**

STATE OF WISCONSIN  
DEPARTMENT OF TRANSPORTATION



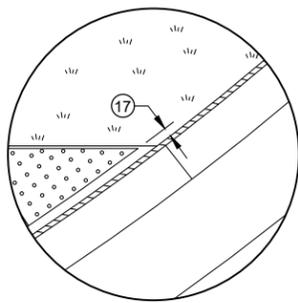
# SDD 08D05-f Curb Ramps Radial Detectable Warning Field Applications

## RADIAL DETECTABLE WARNING FIELD PLACEMENT WHEN 5 FOOT GRADE BREAK DISTANCE PER SDD 8D5-c IS EXCEEDED



**PLAN VIEW  
CURB RAMP TYPE 4A1  
(GRADE BREAK DISTANCE GREATER THAN 5 FEET)**

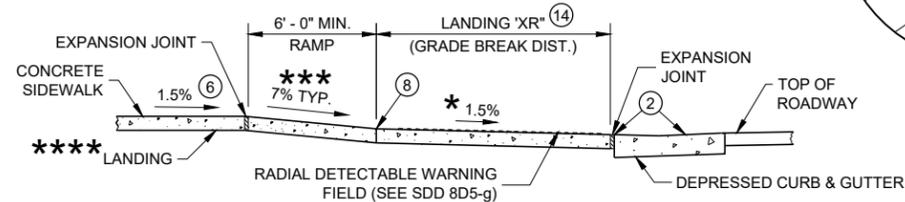
- LEGEND**
- 1/2" EXPANSION JOINT SIDEWALK
  - CONTRACTION JOINT SIDEWALK
  - PAVEMENT MARKING CROSSWALK (WHITE)



**DETAIL A**

## GENERAL NOTES

- AVOID PLACING DRAINAGE STRUCTURES, JUNCTION BOXES OR OTHER OBSTRUCTIONS IN FRONT OF RAMP ACCESS AREAS.
- DETAILS OF CONSTRUCTION, MATERIALS AND WORKMANSHIP NOT SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE STANDARD SPECIFICATIONS AND THE APPLICABLE SPECIAL PROVISIONS.
- DETECTABLE WARNING FIELDS THAT ARE INSTALLED AS A GROUP OR SIDE BY SIDE, SHALL BE FROM THE SAME MANUFACTURER.
- APPLY RADIAL DETECTABLE WARNING PLACEMENT SIMILARLY FOR TYPE 4A AND 4A1 CURB RAMP AND SIMILARLY FOR TYPE 4B AND 4B1 CURB RAMP. TYPE 4A AND 4B RAMP ARE NOT SHOWN.
- REFER TO SDD 8D5-g FOR ADDITIONAL RADIAL PLATE REQUIREMENTS.
- FIELD CUTS AT INTERMEDIATE JOINTS WITHIN THE RADIAL DETECTABLE WARNING FIELD ARE PROHIBITED.
- DETERMINE FINAL RADIAL WARNING FIELD CONFIGURATION AND ITS INDIVIDUAL PLATE LOCATIONS. PERFORM PRE-LAYOUT PRIOR TO PLACEMENT IN PLASTIC CONCRETE. FOLLOW MANUFACTURER'S PRODUCT LIST AND INSTALLATION RECOMMENDATIONS.
- 2 GRADE CHANGE BETWEEN GUTTER FLAG SLOPE AND THE CURB RAMP SLOPE SHALL NOT EXCEED 11%. MAXIMUM GUTTER FLAG SLOPE IS 4%. PROVIDE LONGITUDINAL DRAINAGE AROUND CURB AND AWAY FROM CURB RAMP. NO VERTICAL LIPS OR DISCONTINUITIES GREATER THAN 1/4 - INCH ARE ALLOWED. SLOPE OF CURB HEAD OPENING SHALL MATCH THE RAMP SLOPE, MINIMALLY 1.5% AND NOT TO EXCEED 7%. WHEN ADJACENT TO 1.5% LANDING, CONSTRUCT CURB HEAD OPENING AT 1.5% IN THE DIRECTION OF PEDESTRIAN TRAVEL.
  - 3 AN 8.33% CURB RAMP SLOPE IS ALLOWABLE WITH FLATTENED GUTTER FLAG SLOPE AND NOT TO EXCEED 11% GRADE CHANGE.
  - 4 ±0.5% CONSTRUCTION TOLERANCE IN SIDEWALK CROSS SLOPE. THE SIDEWALK CROSS SLOPE SHALL NOT EXCEED 2% WITHOUT PRIOR APPROVAL FROM THE ENGINEER.
  - 6 PROVIDE A LEVEL LANDING (MAXIMUM 2% SLOPE) IN ANY DIRECTION OF PEDESTRIAN TRAVEL. STANDARD LANDING SIZE IS 5 FEET BY 5 FEET.
  - 8 PROVIDE GRADE BREAK PERPENDICULAR TO DIRECTION OF WHEELCHAIR TRAVEL.
  - 14 CONSULT ENGINEER IF GRADE BREAK LOCATION (END OF LANDING DIMENSION "XR") REQUIRES FIELD ADJUSTMENT WHEN ESTABLISHING FINAL RADIAL DETECTABLE WARNING FIELD LOCATION.
  - 15 FIELD SAW CUTS ALONG RADIAL DETECTABLE WARNING PLATES WILL BE NECESSARY TO MATCH EACH CURB RAMP EDGE. AVOID CUTTING THROUGH DOMES WHENEVER POSSIBLE. MAKE FIELD CUTS TRUE TO LINE AND WITHIN 1/8" DEVIATION. SMOOTH EDGES OF FIELD CUT PLATES.
  - 16 USE 1' X 2" RECTANGULAR END PLATE AT END OF TYPE 4A1 RAMP AND PROVIDE MINIMUM 2' - 0" DETECTABLE WARNING FIELD COVERAGE (IN DIRECTION OF PEDESTRIAN TRAVEL) ALONG THE ENTIRE CURB RAMP WIDTH.
  - 17 A MAXIMUM 3 INCH CONCRETE BORDER WITH IS ALLOWABLE IN FROM OF RADIAL DETECTABLE WARNING FIELD FOR CONSTRUCTABILITY PURPOSES. CONCRETE BORDER WIDTH MAY VARY UP TO 1 INCH.

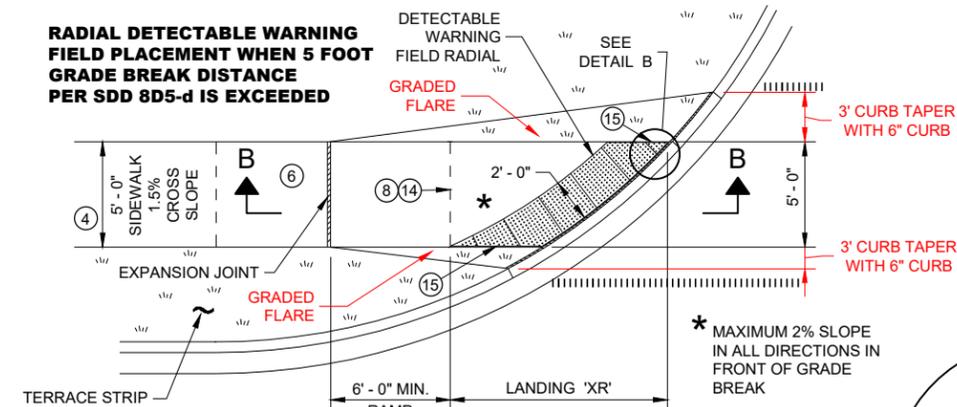


**SECTION A - A FOR TYPE 4A1**

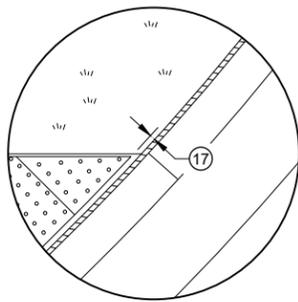
\*\*\*\* IF RAMP SLOPE IS LESS THAN 5.0%, THEN NO ADJACENT UPHILL LANDING IS REQUIRED

\*\*\* MAXIMUM 8.33%

## RADIAL DETECTABLE WARNING FIELD PLACEMENT WHEN 5 FOOT GRADE BREAK DISTANCE PER SDD 8D5-d IS EXCEEDED

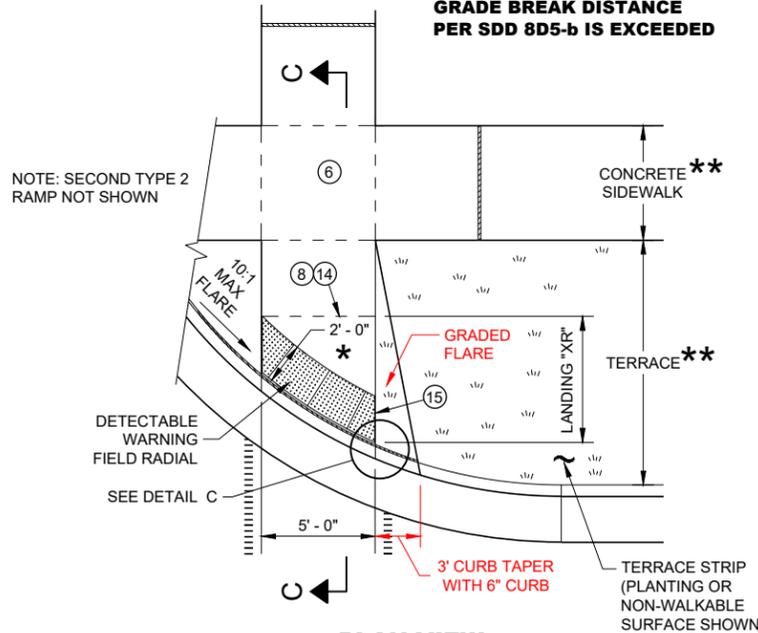


**PLAN VIEW  
CURB RAMP TYPE 4B1  
(GRADE BREAK DISTANCE GREATER THAN 5 FEET)**

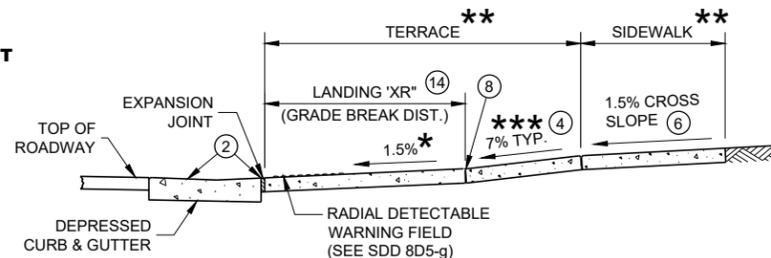


**DETAIL B**

## RADIAL DETECTABLE WARNING FIELD PLACEMENT WHEN 5 FOOT GRADE BREAK DISTANCE PER SDD 8D5-b IS EXCEEDED



**PLAN VIEW  
CURB RAMP TYPE 2  
(GRADE BREAK DISTANCE GREATER THAN 5 FEET)  
(ON LINE WITH SIDEWALK)**

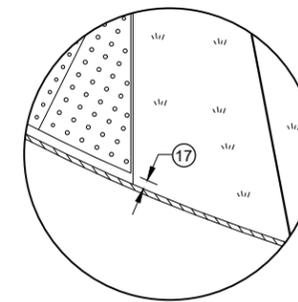


**SECTION C - C FOR TYPE 2**

\* MAXIMUM 2% SLOPE IN ALL DIRECTIONS IN FRONT OF GRADE BREAK

\*\* WIDTH SHOWN ELSEWHERE IN THE PLANS

\*\*\* MAXIMUM 8.33%



**DETAIL C**

## CURB RAMP RADIAL DETECTABLE WARNING FIELD APPLICATIONS

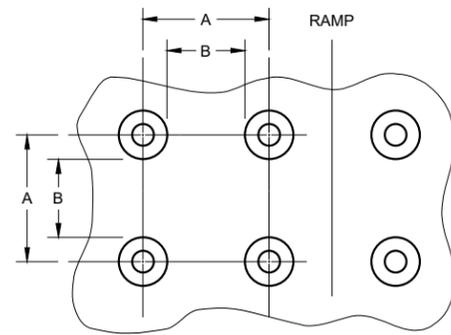
STATE OF WISCONSIN  
DEPARTMENT OF TRANSPORTATION

SDD 08D05 - 20f

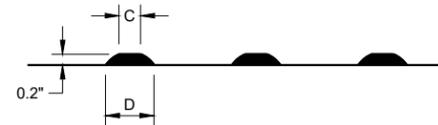
SDD 08D05 - 20f

	MIN.	MAX.
A	1.6"	2.4"
B	0.65"	1.5"
C	*	*
D	0.9"	1.4"

\* THE C DIMENSION IS 50% TO 65% OF THE D DIMENSION.

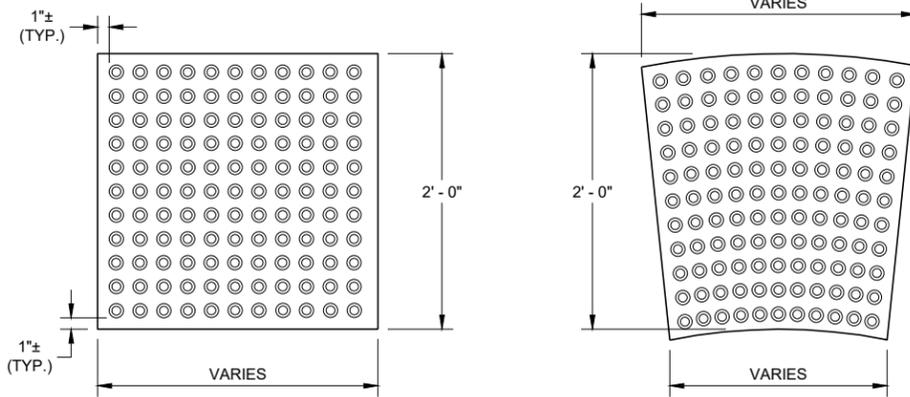


**PLAN VIEW**



**ELEVATION VIEW**

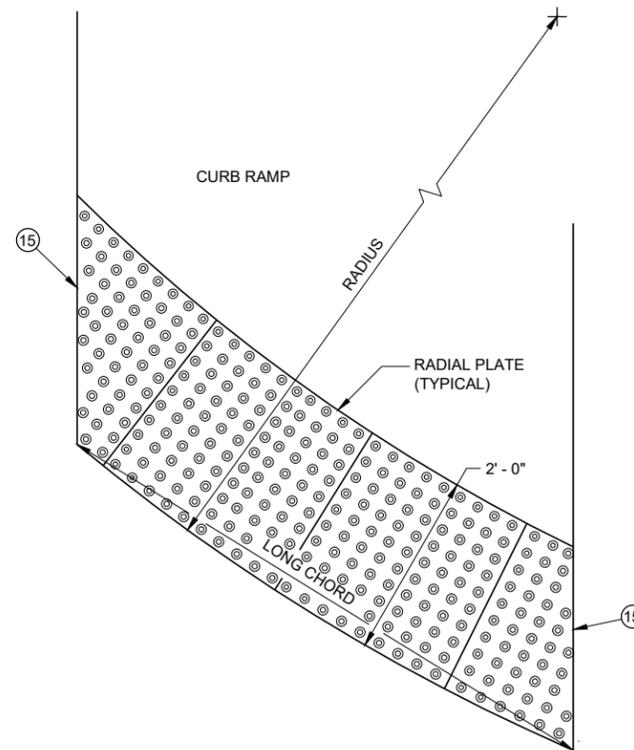
**TRUNCATED DOMES  
DETECTABLE WARNING PATTERN DETAIL**



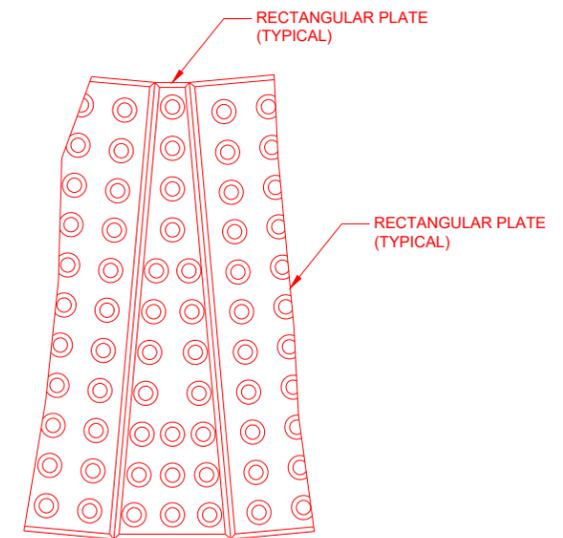
**RECTANGULAR  
PLATES**

**RADIAL  
PLATES**

**PLAN VIEW  
DETECTABLE WARNING FIELDS (TYPICAL)**



**PLAN VIEW  
RADIAL DETECTABLE  
WARNING FIELD ATTRIBUTES**



**PLAN VIEW  
RADIAL WEDGE PLATE  
CONNECTION DETAIL**

**GENERAL NOTES**

DETECTABLE WARNING FIELDS THAT ARE INSTALLED AT A CURB RAMP SHALL BE FROM THE SAME MANUFACTURER.

PLACE ALL DETECTABLE WARNING FIELD SYSTEMS IN ACCORDANCE TO THE MANUFACTURER'S RECOMMENDATION.

FIELD CUTS AT INTERMEDIATE JOINTS WITHIN THE RADIAL DETECTABLE WARNING FIELD ARE PROHIBITED.

DETERMINE FINAL RADIAL WARNING FIELD CONFIGURATION AND ITS INDIVIDUAL PLATE LOCATIONS. PERFORM PRE-LAYOUT PRIOR TO PLACEMENT IN PLASTIC CONCRETE. FOLLOW MANUFACTURER'S PRODUCT LIST AND INSTALLATION RECOMMENDATIONS.

FOR RADIAL DETECTABLE WARNING FIELD APPLICATIONS WHERE STANDARD RADIAL PLATES ARE NOT AVAILABLE AT AN INTERSECTION CURB RADIUS, A COMBINATION OF SQUARE OR RECTANGULAR PLATES AND RADIAL PLATES MAY BE USED TO FORM RADIAL CONFIGURATION. RADIAL WEDGE PLATES IN COMBINATION WITH SQUARE PLATES ARE ALSO ACCEPTABLE. FOLLOW MANUFACTURER'S RECOMMENDATIONS.

REFER TO CONTRACT AND STANDARD SPECIFICATIONS FOR FIELD CUTTING REQUIREMENTS.

DO NOT EMBED IN CONCRETE ANY FIELD-CUT PLATES WITH CUT EDGES SHORTER THAN 6 INCHES. CONSULT WITH MANUFACTURER FOR RE-DRILLING AND ANCHORING REQUIREMENTS OF FIELD-CUT PLATES.

15 FIELD SAW CUTS ALONG RADIAL DETECTABLE WARNING PLATES WILL BE NECESSARY TO MATCH EACH CURB RAMP EDGE. AVOID CUTTING THROUGH DOMES WHENEVER POSSIBLE. MAKE FIELD CUTS TRUE TO LINE AND WITHIN 1/8" DEVIATION. SMOOTH EDGES OF FIELD CUT PLATES.

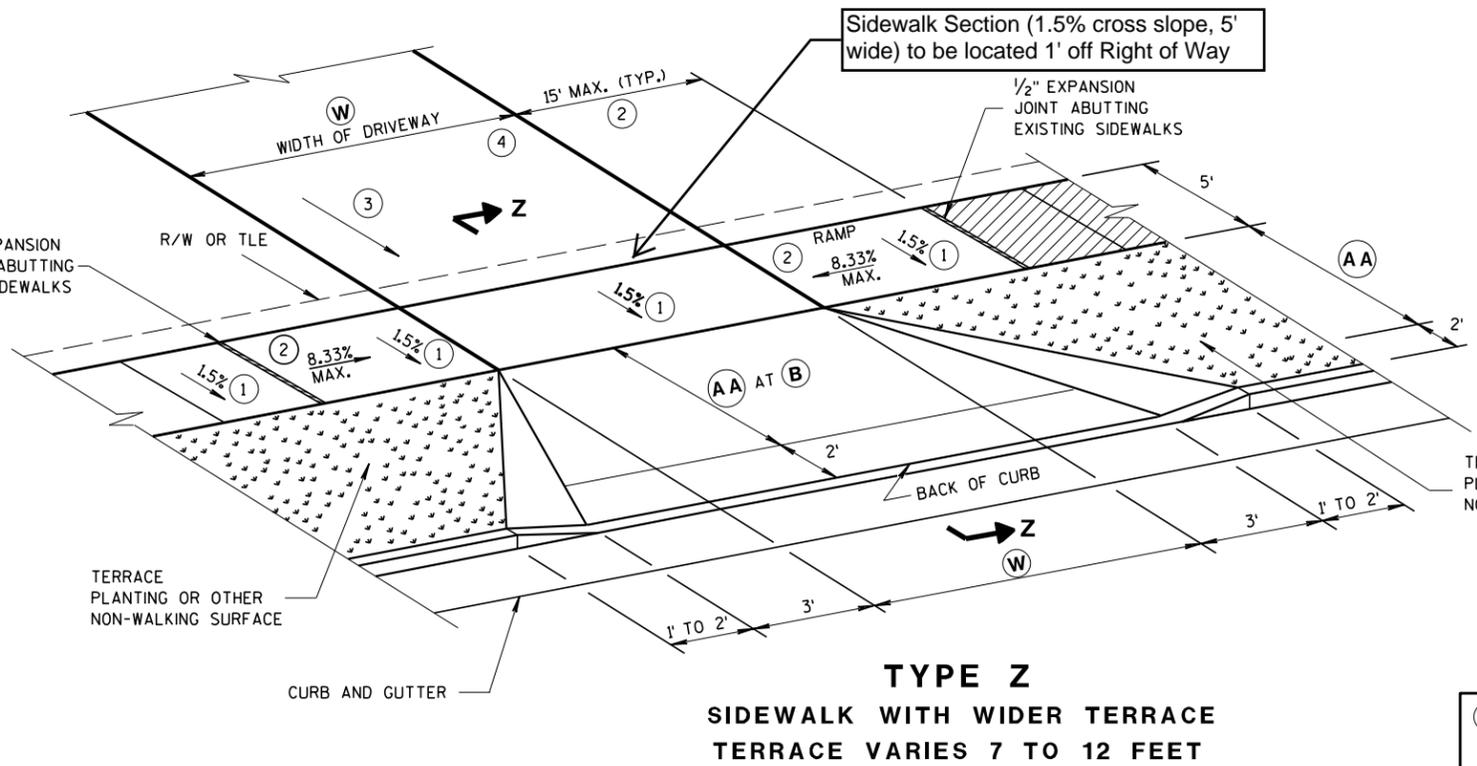
**CURB RAMPS  
RECTANGULAR AND RADIAL  
DETECTABLE WARNING PLATES**

STATE OF WISCONSIN  
DEPARTMENT OF TRANSPORTATION

APPROVED  
May 2019 /S/ Rodney Taylor  
DATE ROADWAY STANDARDS DEVELOPMENT  
UNIT SUPERVISOR



# SDD 8d19 Driveway and Sidewalk Ramps Type Z



**TABLE Z**

AA FEET	B % 6.25% GUTTER	B % 4% GUTTER
4.5'	11.5%	9% TO 11.5%
5.5'	9% TO 11.5%	8% TO 11.5%
6.5'	8% TO 11.5%	6% TO 11.5%
7.5'	7% TO 11.5%	6% TO 11.5%
8.5'	6% TO 11.5%	5% TO 11.5%
9.5'	5% TO 11.5%	4% TO 11.5%

## GENERAL NOTES

PROVIDE CONSTRUCTION JOINTS ALONG THE CENTER OF THE CONCRETE FOR DRIVEWAYS UNDER 20 FEET IN WIDTH AND AT THE THIRD POINTS OVER 20 FEET IN WIDTH.

(W) IS SHOWN ON PLAN AND PROFILE SHEETS.

OFFSETS, ELEVATIONS, AND PERCENT GRADE ARE SHOWN ON THE CROSS SECTIONS.

1 CONSTRUCTION TOLERANCE OF 0.5% ± FOR SIDEWALK CROSS SLOPE. THE SIDEWALK CROSS SLOPE SHALL NOT EXCEED 2%.

2 THE SIDEWALK RAMP MAXIMUM RUNNING SLOPE SHALL NOT REQUIRE THE RAMP LENGTH TO EXCEED 15 FEET TO AVOID CHASING THE SLOPE INDEFINITELY WHEN CONNECTING TO STEEP GRADES. WHEN APPLYING THE 15 FOOT MAXIMUM LENGTH, THE RUNNING SLOPE OF THE SIDEWALK SHALL BE AS FLAT AS FEASIBLE AND NOT EXCEED THE LONGITUDINAL GRADE OF THE ROADWAY.

3 DRIVEWAY SLOPES: DESIRABLE MAXIMUM  
10.5% UP AWAY FROM SIDEWALK (SAG)  
8.5% DOWN AWAY FROM SIDEWALK (CREST)  
ABSOLUTE MAXIMUM 15% FOR BOTH CREST AND SAG

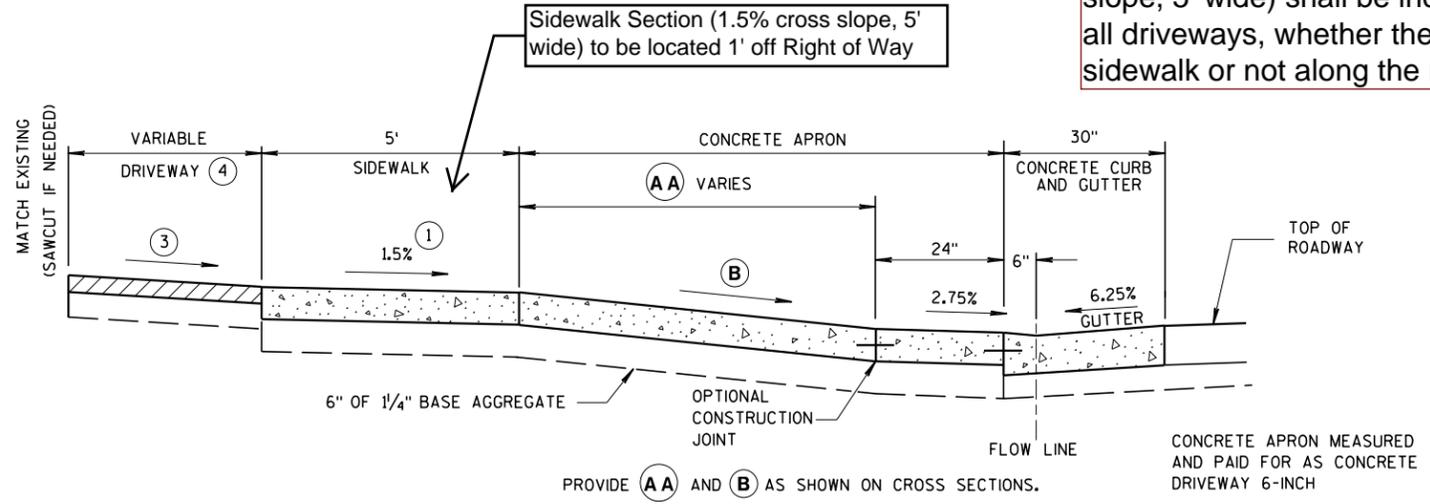
4 DRIVEWAY TYPES

- 6-INCH CONCRETE DRIVEWAY PAVEMENT OVER 6-INCH BASE AGGREGATE
- 2-INCH TO 3-INCH ASPHALTIC SURFACE OVER 6-INCH BASE AGGREGATE
- 6-INCH BASE AGGREGATE (MAY BE INCREASED FOR CLAY SUBGRADES)

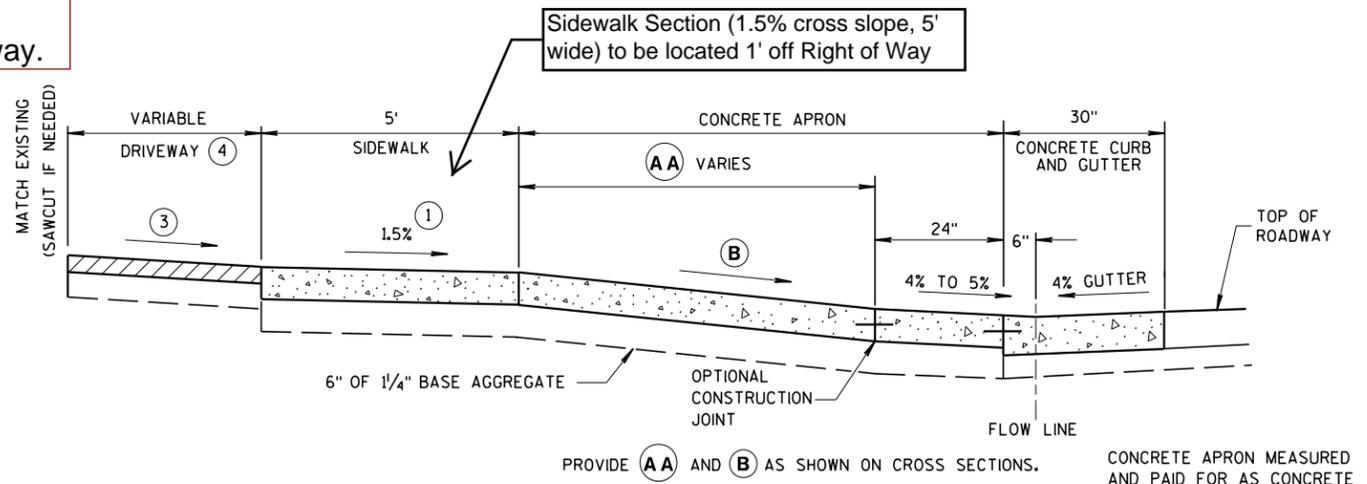
(W): 12' MIN. - 24' MAX. RESIDENTIAL AND NON-COMMERCIAL (PE & FE)  
16' MIN. - 35' MAX. COMMERCIAL (CE)

**TYPE Z  
SIDEWALK WITH WIDER TERRACE  
TERRACE VARIES 7 TO 12 FEET**

Note: Sidewalk Section (1.5% cross slope, 5' wide) shall be included on all driveways, whether there is sidewalk or not along the roadway.



**6.25% GUTTER SLOPE**



**4% GUTTER SLOPE**

NOTE: SIDEWALK MAY BE DEPRESSED IN DRIVEWAY AREAS FOR B VALUES NOT SHOWN IN TABLE Z.  
SIDEWALK WITHIN THE LIMITS OF THE DRIVEWAY PAID FOR AS CONCRETE DRIVEWAY 6-INCH.  
SEPARATE PAYMENT FOR BASE AGGREGATE WILL BE MADE.

**SECTION Z-Z  
DRIVEWAY DETAIL WITH CONCRETE CURB & GUTTER  
(URBAN AND SUBURBAN)**

**DRIVEWAY AND SIDEWALK RAMP TYPE Z**

STATE OF WISCONSIN  
DEPARTMENT OF TRANSPORTATION

APPROVED  
March 2018 /S/ Rodney Taylor  
DATE ROADWAY STANDARDS DEVELOPMENT UNIT SUPERVISOR  
FHWA

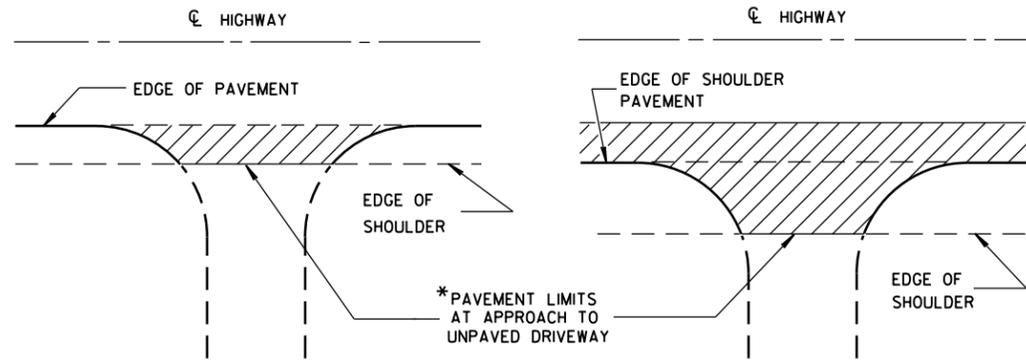
NOT TO SCALE

6

6

S.D.D. 8 D 19-2

S.D.D. 8 D 19-2



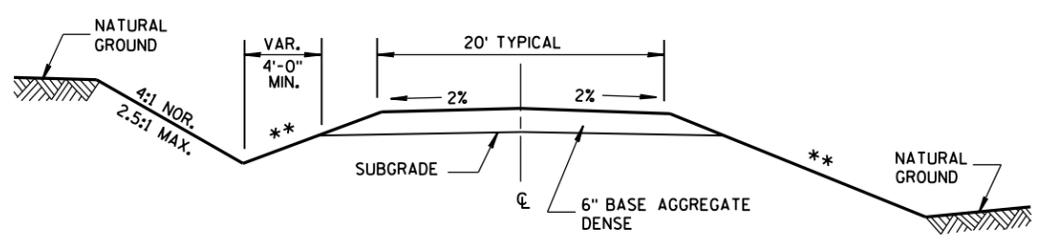
\*WHERE DRIVEWAY IS PAVED, APPROACH PAVEMENT SHOULD BE EXTENDED TO MATCH DRIVEWAY PAVEMENT.

**PLAN VIEW**  
(UNPAVED SHOULDER ON HIGHWAY)

**PLAN VIEW**  
(PAVED SHOULDER ON HIGHWAY)

**RURAL DRIVEWAY INTERSECTION DETAIL**  
(NO CURB & GUTTER OR SIDEWALK)

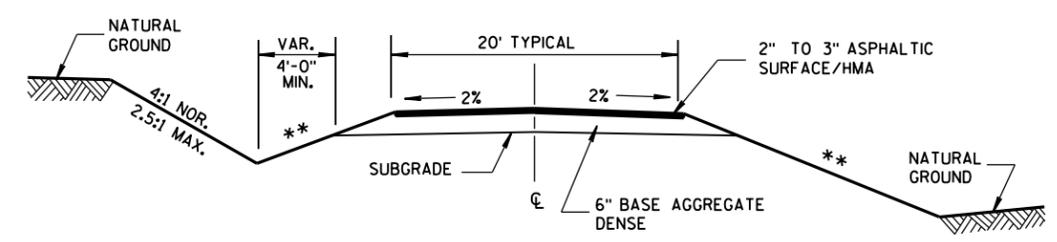
Note: In rural roadway sections concrete is not allowed in the right of way for driveways.



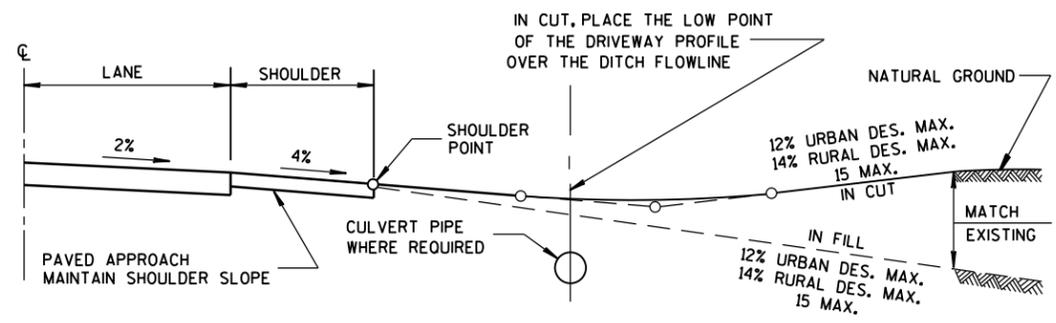
**TYPICAL CROSS SECTION FOR PRIVATE DRIVE OR FIELD ENTRANCE**  
**AGGREGATE SURFACE**

\*\* SLOPE CAN VARY WITH SPEED. SEE 11-45-2.6.2.

POSTED SPEED MPH	MAX. SLOPE
<35	4:1
≥35 TO <60	6:1
≥60	10:1

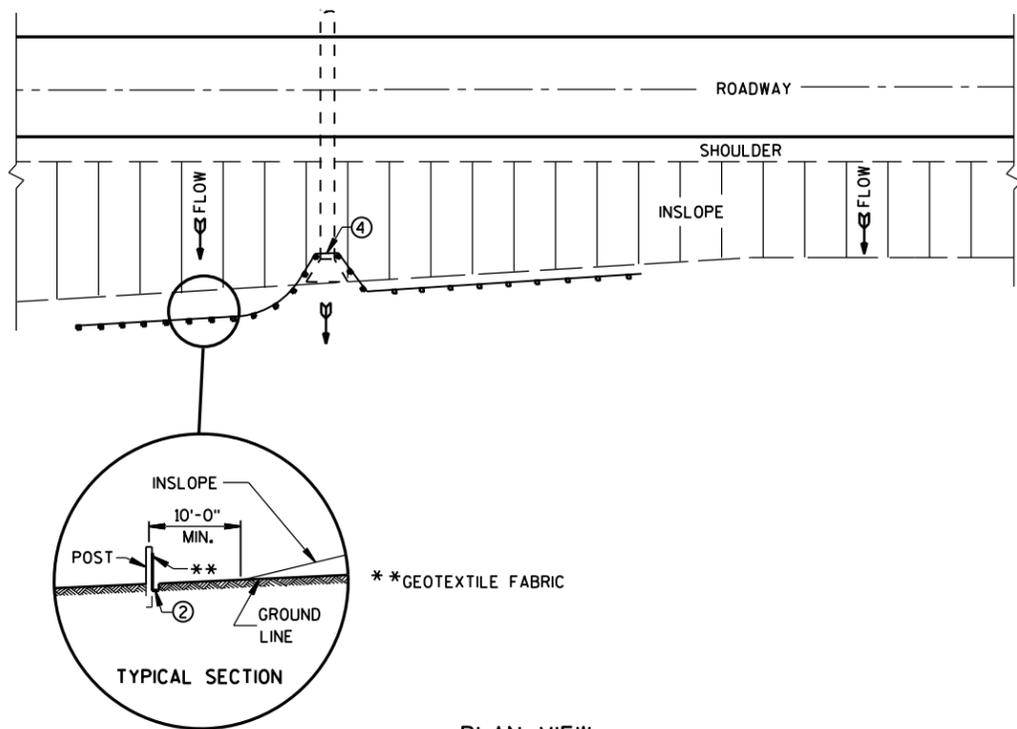


**TYPICAL CROSS SECTION FOR PRIVATE DRIVE OR FIELD ENTRANCE**  
**ASPHALTIC SURFACE**

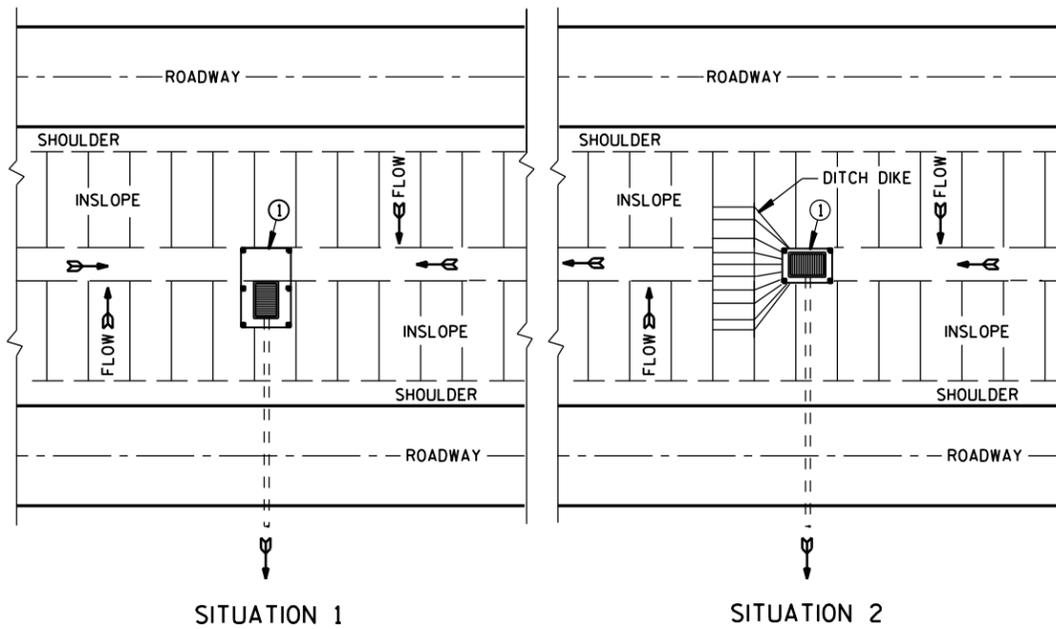


**TYPICAL DRIVEWAY PROFILES**

<b>DRIVEWAYS WITHOUT CURB &amp; GUTTER</b>	
STATE OF WISCONSIN DEPARTMENT OF TRANSPORTATION	
APPROVED December, 2016	/S/ Rodney Taylor ROADWAY STANDARDS DEVELOPMENT UNIT SUPERVISOR
DATE	FHWA



**PLAN VIEW  
TYPICAL APPLICATION OF SILT FENCE**

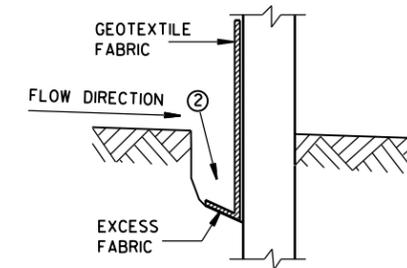


**SITUATION 1      SITUATION 2  
PLAN VIEW  
SILT FENCE AT MEDIAN SURFACE DRAINS**

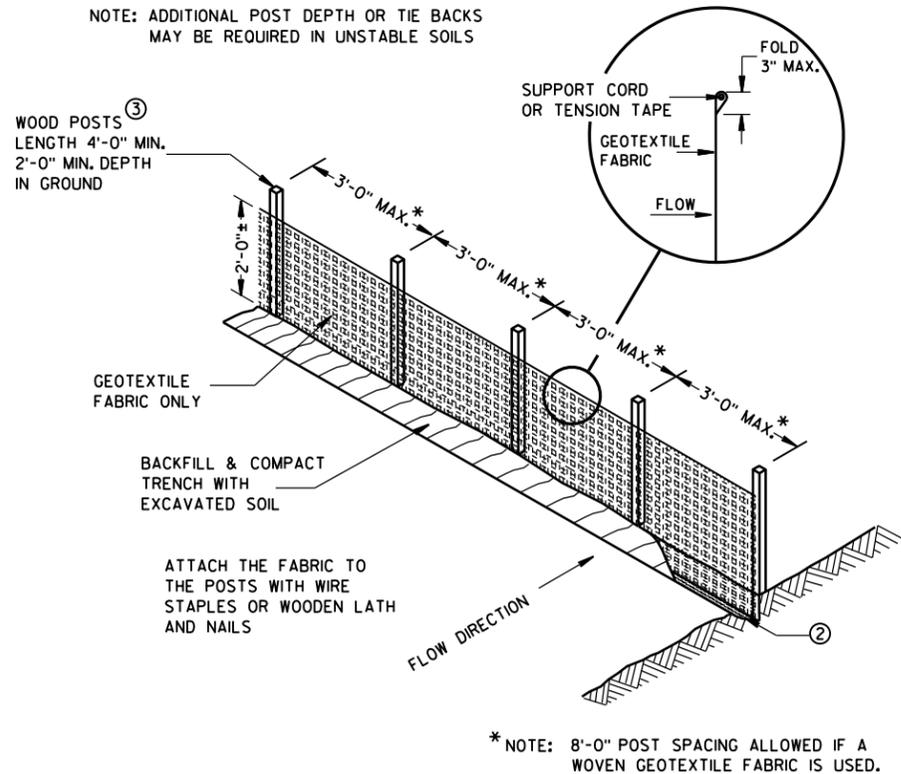
**GENERAL NOTES**

DETAILS OF CONSTRUCTION NOT SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE STANDARD SPECIFICATIONS AND APPLICABLE SPECIAL PROVISIONS.

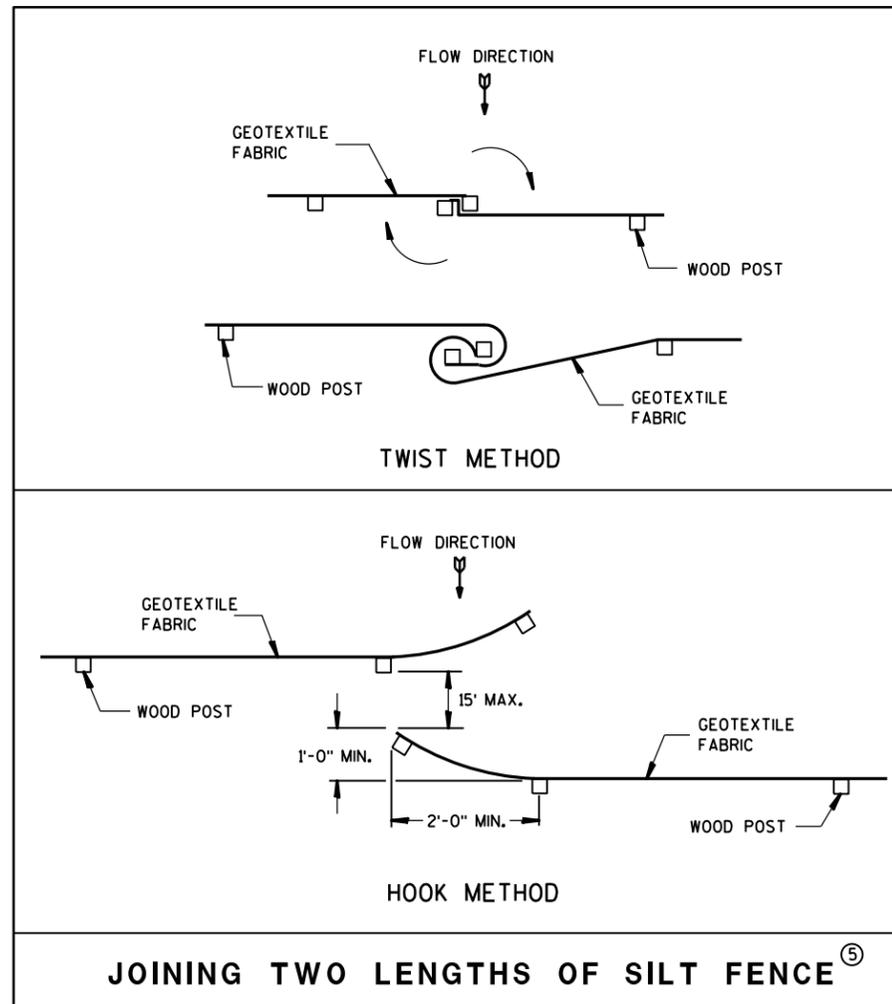
- ① HORIZONTAL BRACE REQUIRED WITH 2" X 4" WOODEN FRAME OR EQUIVALENT AT TOP OF POSTS.
- ② FOR MANUAL INSTALLATIONS THE TRENCH SHALL BE A MINIMUM OF 4" WIDE & 6" DEEP TO BURY AND ANCHOR THE GEOTEXTILE FABRIC. FOLD MATERIAL TO FIT TRENCH AND BACKFILL & COMPACT TRENCH WITH EXCAVATED SOIL.
- ③ WOOD POSTS SHALL BE A MINIMUM SIZE OF 1 1/8" X 1 1/8" OF OAK OR HICKORY.
- ④ SILT FENCE TO EXTEND ACROSS THE TOP OF THE PIPE.
- ⑤ CONSTRUCT SILT FENCE FROM A CONTINUOUS ROLL IF POSSIBLE BY CUTTING LENGTHS TO AVOID JOINTS. IF A JOINT IS NECESSARY USE ONE OF THE FOLLOWING TWO METHODS; A) OVERLAP THE END POSTS AND TWIST, OR ROTATE, AT LEAST 180 DEGREES, B) HOOK THE END OF EACH SILT FENCE LENGTH.



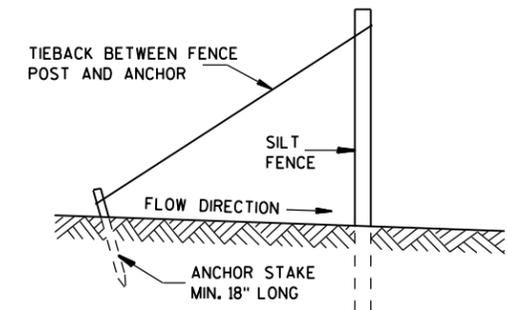
**TRENCH DETAIL**



**SILT FENCE**

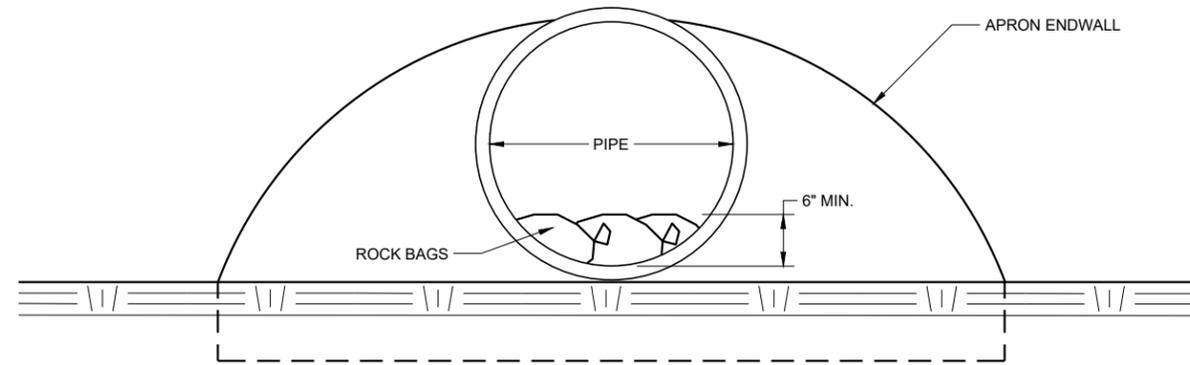


**JOINING TWO LENGTHS OF SILT FENCE ⑤**

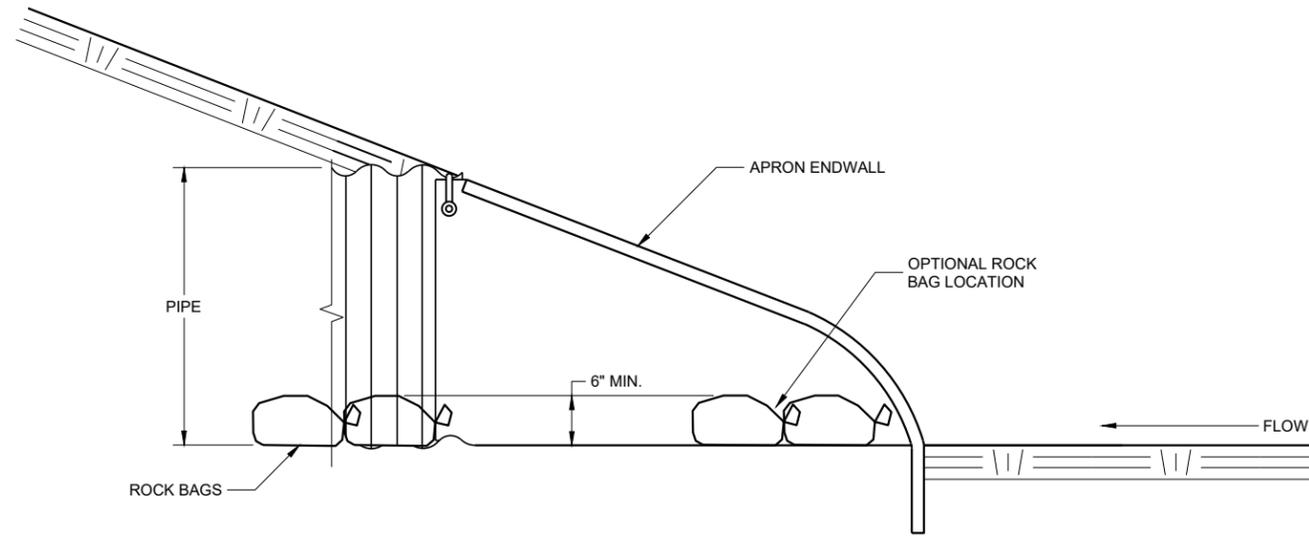


**SILT FENCE TIE BACK  
(WHEN REQUIRED BY THE ENGINEER)**

<b>SILT FENCE</b>	
STATE OF WISCONSIN DEPARTMENT OF TRANSPORTATION	
APPROVED 4-29-05 DATE	/S/ Beth Cannestra CHIEF ROADWAY DEVELOPMENT ENGINEER
FHWA	



END VIEW



SIDE VIEW

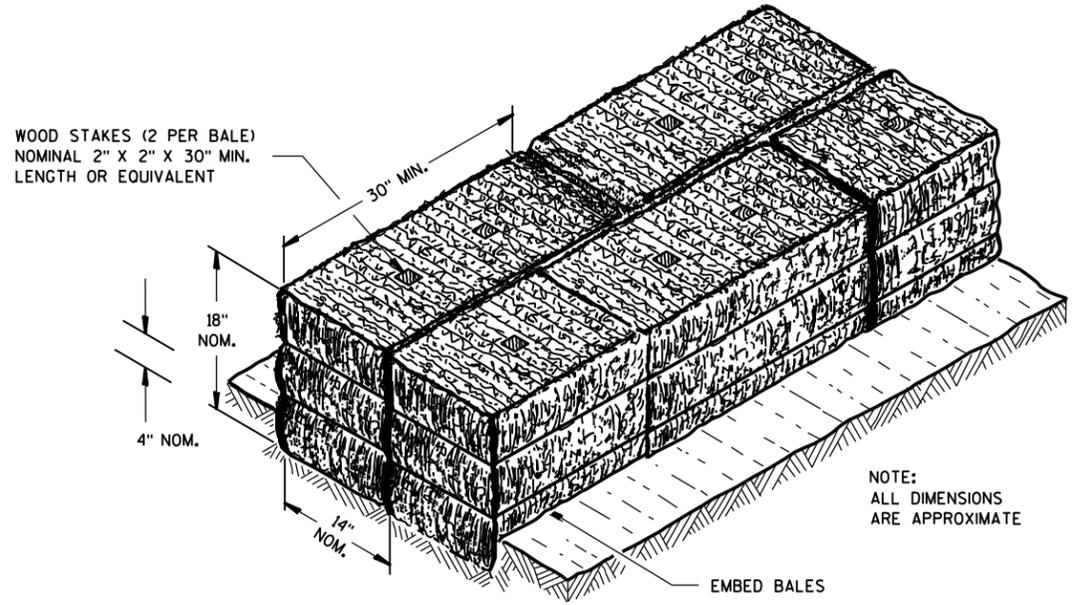
**CULVERT PIPE CHECK**  
(INSTALL ON INLET END ONLY)

**CULVERT PIPE CHECK**

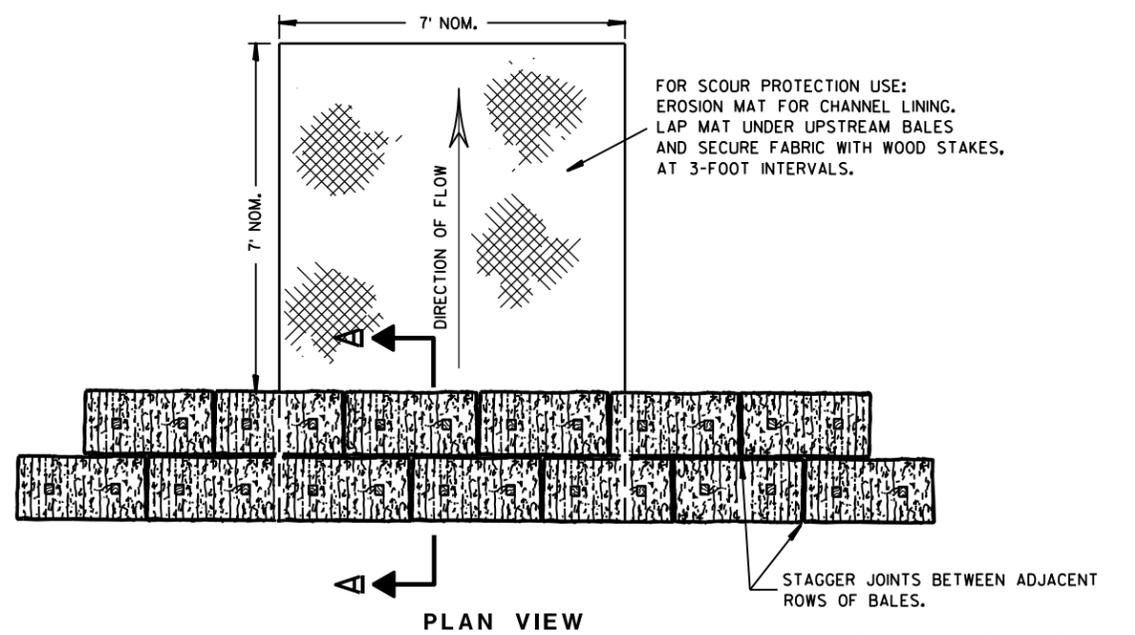
STATE OF WISCONSIN  
DEPARTMENT OF TRANSPORTATION

APPROVED  
May 2019 /S/ Daniel Schave  
DATE EROSION CONTROL ENGINEER

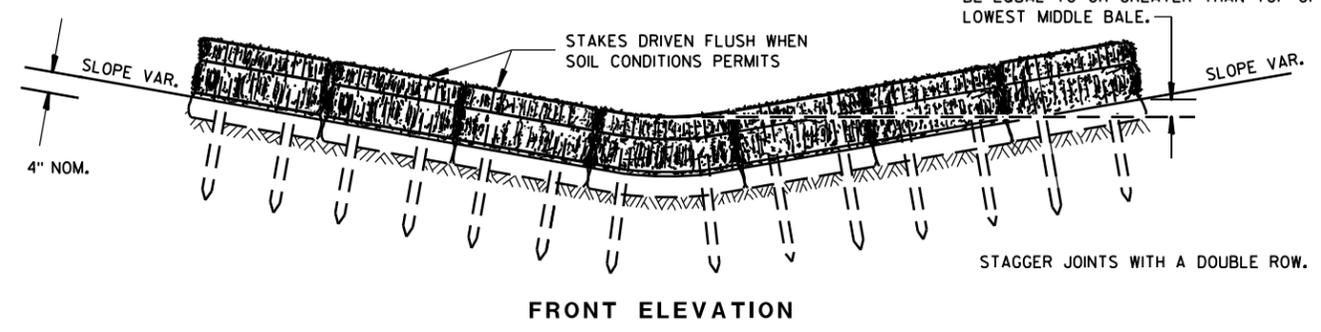
FHWA



SECTION A-A



PLAN VIEW



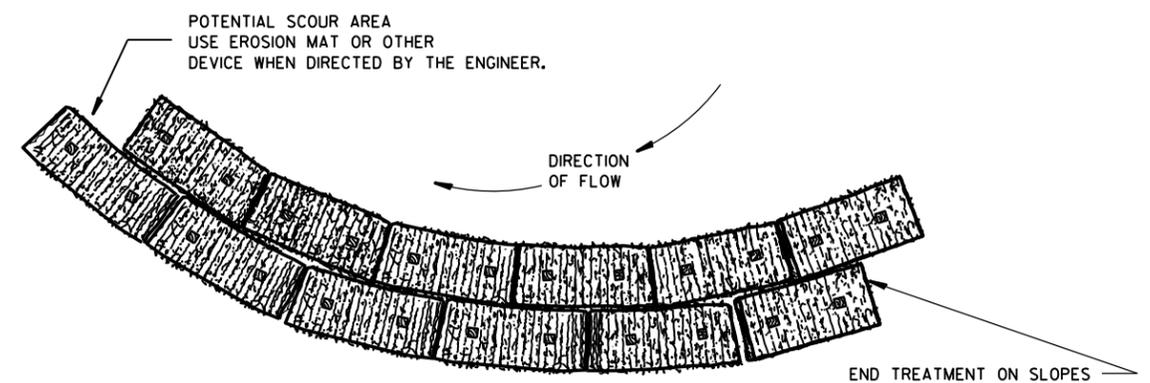
FRONT ELEVATION

TEMPORARY DITCH CHECK USING EROSION BALES ①

GENERAL NOTES

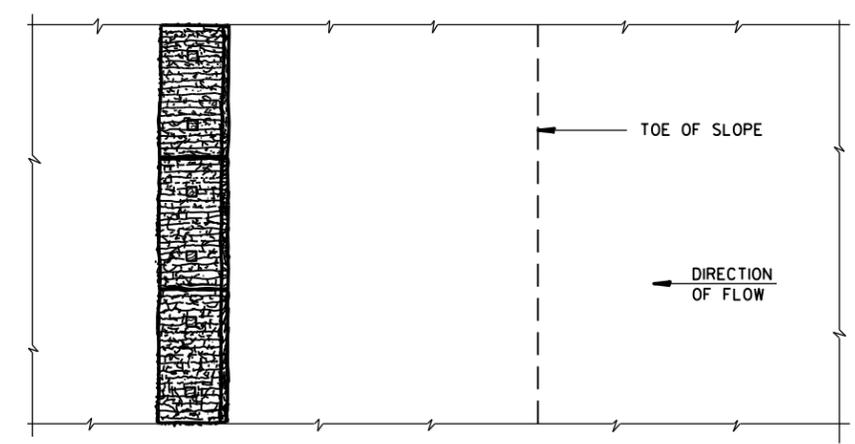
DETAILS OF CONSTRUCTION, MATERIALS AND WORKMANSHIP NOT SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE STANDARD SPECIFICATIONS AND THE APPLICABLE SPECIAL PROVISIONS.

- ① TEMPORARY DITCH CHECKS EITHER EROSION BALES OR MANUFACTURED SHALL BE PAID FOR UNDER THE BID ITEM OF TEMPORARY DITCH CHECK. THE DEPARTMENT WILL NOT PAY FOR TEMPORARY DITCH CHECKS CONSTRUCTED OF A SINGLE ROW OF EROSION BALES.

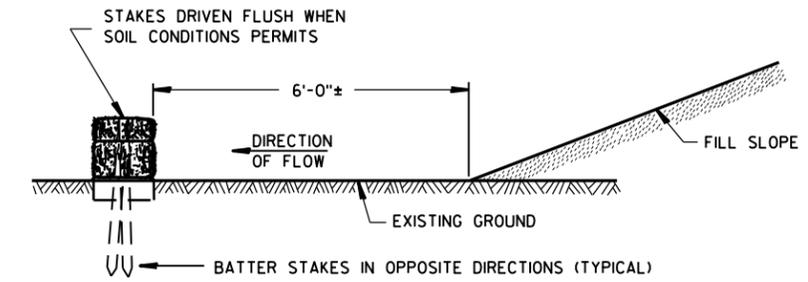


PLAN VIEW

WHEN ALTERING THE DIRECTION OF FLOW



PLAN VIEW



FRONT ELEVATION

WHEN EXISTING GROUND SLOPES AWAY FROM FILL SLOPE

EROSION BALES FOR SHEET FLOW

<b>TYPICAL INSTALLATIONS OF EROSION BALES / TEMPORARY DITCH CHECKS</b>	
STATE OF WISCONSIN DEPARTMENT OF TRANSPORTATION	
APPROVED 6/04/02 DATE	/S/ Beth Cannestra CHIEF ROADWAY DEVELOPMENT ENGINEER
FHWA	

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6

S.D.D. 8 E 8-3

S.D.D. 8 E 8-3

**GENERAL NOTES**

DETAILS OF CONSTRUCTION, MATERIALS AND WORKMANSHIP NOT SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE STANDARD SPECIFICATIONS AND THE APPLICABLE SPECIAL PROVISIONS.

TRACKING PAD SHALL BE INSPECTED DAILY. DEFICIENT AREAS SHALL BE REPAIRED OR REPLACED IMMEDIATELY.

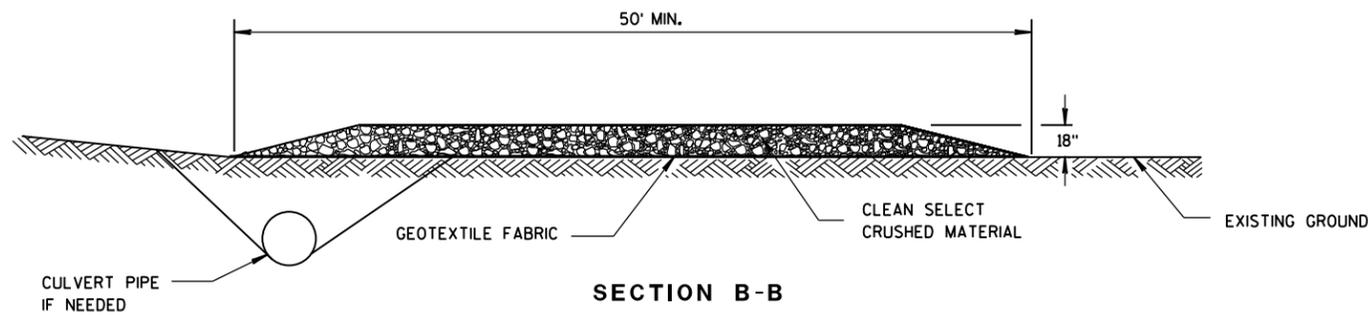
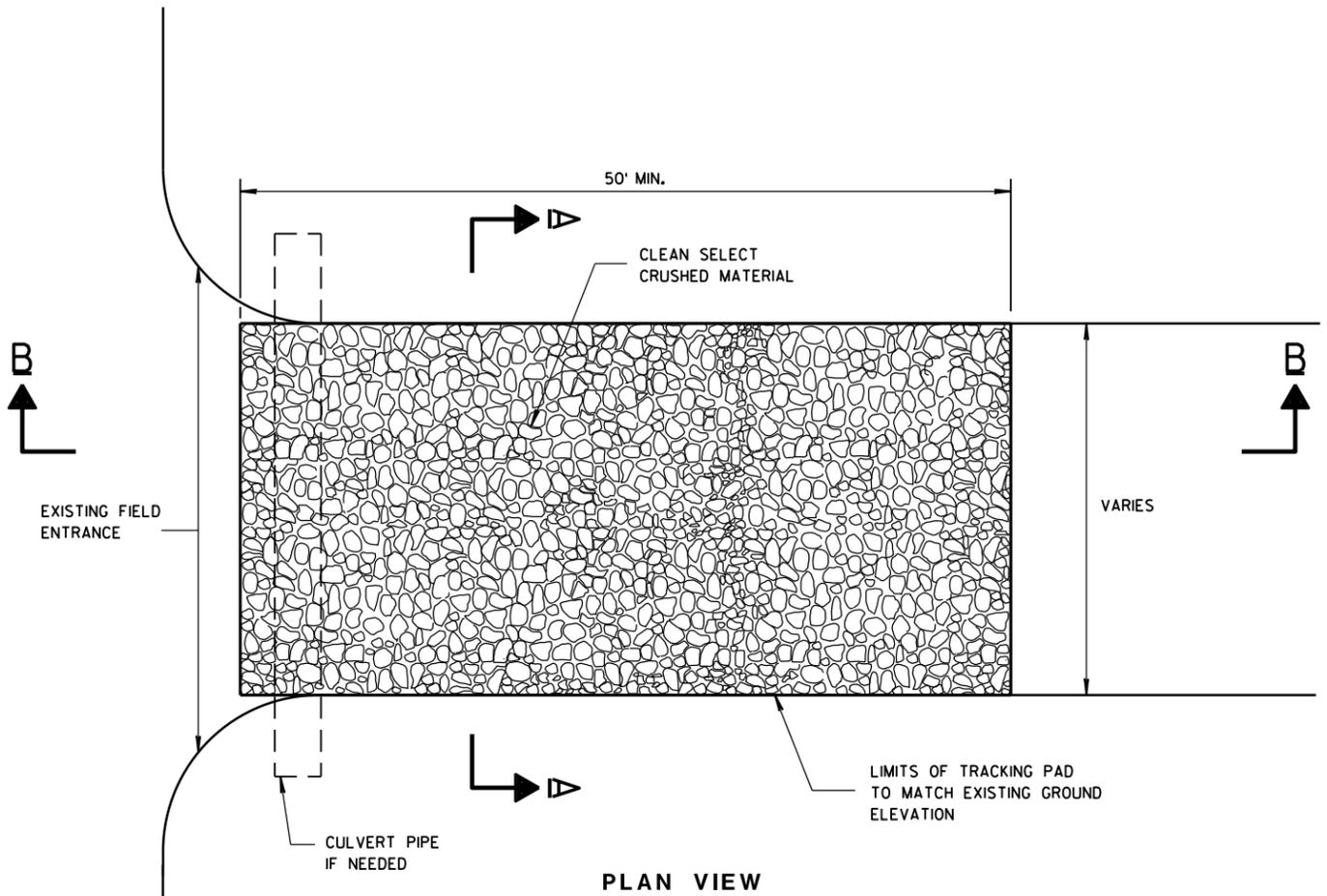
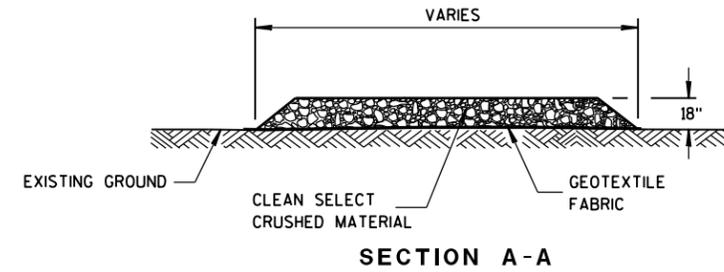
TRACKING PAD TO BE REMOVED AFTER CONSTRUCTION IS COMPLETED.

TRACKING PAD SHALL BE THE FULL WIDTH OF THE EGRESS POINT.

SURFACE WATER MUST BE PREVENTED FROM PASSING THROUGH THE TRACKING PAD. FLOWS SHALL BE DIVERTED AWAY, AROUND OR CONVEYED UNDER THE TRACKING PAD.

CULVERT PIPE OR OTHER BMP USED TO DIVERT WATER AWAY, AROUND OR UNDER THE TRACKING PAD SHALL BE DESIGNED TO CONVEY THE 2 YEAR - 24 HOUR EVENT.

THE COST OF ADDITIONAL BMP TO DIVERT WATER ARE INCIDENTAL TO THE TRACKING PAD BID ITEM.



**TRACKING PAD**

**TRACKING PAD**

STATE OF WISCONSIN  
DEPARTMENT OF TRANSPORTATION

APPROVED  
DATE 3-24-2011 /s/ Jerry H. Zogg  
ROADWAY STANDARDS DEVELOPMENT ENGINEER  
FHWA