

Municipal Standards for the City of Durand Shiawassee County, Michigan

Construction Specifications

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SECTION 01410

SOILS COMPACTION AND TESTING

PART 1 GENERAL

- 1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials in connection with SOILS COMPACTION AND TESTING.
- 1.02 RELATED WORK: The Contractor shall compact all bedding, backfill, fills, and embankments to the percentage of maximum unit weight specified herein. All compaction operations shall be performed utilizing suitable methods and equipment specifically designed for earth compaction. Rollers shall be of a standard design and in general shall be vibratory, rubber tire or smooth steel drum for granular materials and kneading type (sheep's foot) for non-granular materials. All operations shall be performed such that they do not damage or displace any pipes, utilities or structures. Compaction by flooding or jetting shall not be allowed. Attention is directed to SECTION 01560-SPECIAL CONTROLS.
- 1.03 DEFINITIONS
- A. GRANULAR MATERIALS: Soils having a loss by washing of 15 percent or less.
 - B. NON-GRANULAR MATERIALS: Soils having a loss by washing of more than 15 percent.
 - C. LOSS BY WASHING: Materials finer than a No. 200 sieve as determined by ASTM C117.
 - D. MAXIMUM UNIT WEIGHT: Maximum dry pounds per cubic foot at the optimum moisture content as determined by the following standards tests:
 - 1. Modified Proctor: AASHTO 180, Method C, shall be used for granular and non-granular materials at structures as noted in Part D of the appended table.
 - 2. Standard Proctor: AASHTO T-99 as modified by MDOT shall be used for soils having a loss by wash greater than 15%.
 - 3. Michigan Cone: The MDOT "Method of Test for the Compaction and Density of Soils (Granular)" shall be used for granular materials.
 - E. OPTIMUM MOISTURE CONTENT: Shall be the percent moisture of the soil at which the maximum unit weight is obtained by the above tests.
 - F. LIFT: Shall be the vertical measure of a soil layer when measured loose.

PART 2 PRODUCTS

- 2.01 MATERIALS - Shall be as specified herein, and as noted on the plans. The Contractor shall notify the Engineer of the source of materials at least three days prior to their use to allow for testing of samples.

3.01 COMPACTION AND TESTING

A. MOISTURE CONTENT: All material shall be at or near the optimum moisture content when compacted. Unless modified by the Engineer, the allowable moisture range shall be as follows:

1. Granular soils: -3% to +2% above the optimum
2. Non-granular soils: -1% to +3% above the optimum

In the event the moisture content of the material exceeds these limits, the material shall be allowed to dry or dried by disking or harrowing. In the event that the moisture content is too low to obtain the required densities when compacted, water shall be added to increase the moisture content to the optimum.

B. TESTING: Moisture and in-place density tests will be made on the compacted fill in locations and at times as selected by the Engineer. The costs of tests which meet the specifications will be paid by the Owner. The costs of failing tests will be paid by the Contractor and said costs will be deducted from sums due the Contractor. The Contractor may elect to perform additional testing at his own expense for his own purposes, however, the Engineer's decision of the suitability of materials and compliance with specifications shall be final.

C. TABLE OF COMPACTION OPERATIONS AND REQUIREMENTS: The appended table lists requirements for minimum in-place densities and maximum lifts for various compaction operations, material classifications, and locations. The lift thickness, moisture content, type of equipment, number of passes, and weight and speed of equipment shall be adjusted to produce the required compaction density with consistent results.

D. SUBSIDENCE AND SETTLEMENT: The Contractor shall be responsible to conduct all compaction operations in such a manner to avoid objectionable soil settlement. Irrespective of compaction tests results, excessive soil settlement and any resulting structure or pavement damage shall be repaired by the Contractor for a period of one (1) year from the date of acceptance by the City.

TABLE OF COMPACTION OPERATIONS AND REQUIREMENTS

| COMPACTION OPERATION | MATERIAL CLASSIFICATION (1) | MAX. LIFT LOOSE MEAS. | MIN. IN-PLACE DENSITY % MAX UNIT WEIGHT |
|----------------------|-----------------------------|-----------------------|---|
|----------------------|-----------------------------|-----------------------|---|

A. BACKFILL FOR UTILITY SYSTEMS-

| | | | |
|--|------------------------|---------|----------|
| 1. Undercut below plan grade to 4" below pipe | Granular Crushed Stone | 6" 12" | 95% N.A. |
| 2. Bedding (From 4 inches below pipe to 1 foot above pipe) | Granular | 4" (2) | 95% |
| 3. Backfill over bedding-open field | Trench Material | 12" (6) | 90% |
| 4. Backfill under permanent pavements | Granular | 12" (6) | 95% |

| COMPACTION OPERATION | MATERIAL CLASSIFICATION (1) | MAX. LIFT LOOSE MEAS. | MIN. IN-PLACE DENSITY % MAX. UNIT WEIGHT |
|--|-----------------------------|-----------------------|--|
| 5. Backfill under existing utilities | Granular | 6" (6) | 95% |
| 6. Backfill around manholes and other structures | Granular | 12" (6) | 95% |
| B. EMBANKMENTS - | | | |
| 1. General | (3) | 9"-12" (4)(6) | 95% |
| 2. Under utility structures | Granular | 12" (6) | 97% |
| C. STREETS AND ROADWAYS - | | | |
| 1. Subgrade | Existing Matrl. | 9"-18" (5) | 95% |
| 2. Aggregate Base Course | As Specified | 3"-6" | 98% |
| 3. Aggregate Surface Course | As Specified | 3"-6" | 98% |
| D. STRUCTURES | | | |
| 1. Adjacent to walls | Granular | 12" (6) | 95% |
| 2. Under floor and foundation slabs and footings (Structural Fill) | Granular | 9" | 97% |

NOTES:

- (1) Specific material requirements shall be as specified herein or shown on the drawings.
- (2) For pipes of 8 inch OD and less, maximum lift shall be one-half of the pipe OD
- (3) Material as designated on the drawings or as approved by the Engineer, with exception that frost heave material, as defined in MDOT Specification 2.08.10d may not be used in top 3 feet of embankment below subgrade.

- (4) 9" for non-granular, 12" for granular materials.

- (5) Depth of lift indicated is below excavation at which compaction is required provided a base course is required. If base course is not required, compacted depth shall be 18”.
- (6) The maximum depth of lift for hydraulic compactors which may be allowed by the Engineer will vary depending upon the compaction equipment utilized by the Contractor. The maximum depth of lift shall not exceed 50% (percent) of the maximum compaction lift stated in the compaction equipment manufacturers data sheet, provided the Contractor can demonstrate that the required density has been achieved throughout the depth of the lift.

END OF SECTION

Durand

01410-4
SECTION 01560
SPECIAL CONTROLS

5-29-98

PART 1 GENERAL

- 1.01 WORK INCLUDED: The work covered by this section of the specifications pertains to SPECIAL CONTROLS.
- 1.02 SPECIFICATIONS BY REFERENCE: Where reference is made in the specifications to standards of any technical society, association, governmental agency, etc., said specifications or standards shall apply and be binding as though fully repeated therein and are to be considered as a part of these specifications.
- 1.03 RELATED WORK: The Contractor shall conduct his work in a manner to prevent air, water, and noise pollution by establishing adequate controls during the construction operations. All controls shall be in accordance with the applicable laws of the State of Michigan.
- A. AIR POLLUTION: The open burning of combustible wastes from clearing and grubbing operations and of waste construction materials will not be permitted. The Contractor shall dispose of all such wastes at sanitary landfill(s) licensed by the Michigan Department of Environmental Quality.
1. Dust Control: The Contractor shall maintain all traveled areas in a safe, dust-free condition at all times. To accomplish this, the Contractor shall remove any tracked materials such as mud, dirt, etc., from construction and haul roads, furnish and apply chloride treatment to temporary roads, furnish and install temporary road patches or surfaces, or any other approved methods or systems.
- B. WATER POLLUTION: The Contractor will be required to perform all construction operations in a manner that will conform to the requirements of Act 347, Soil Erosion and Sedimentation Control Act. Methods to be used are indicated herein (Items No. 1 thru No. 46) and referenced with numbers and symbols to the plans when special details are designated. The Contractor shall also be required to perform all work in conformance with the requirements of Act 346, Inland Lakes and Streams. The permits for the construction will be obtained by the Owner.
- C. NOISE POLLUTION: The Contractor shall exercise judgment in the conduct of operations which by nature result in excessive noise. All such operations shall take place during reasonable daylight periods, which are defined as 7:00 a.m. through 6:00 p.m. unless otherwise stated in the governing municipal ordinance, or authorized by the Owner.
- D. CONSTRUCTION DEBRIS: All construction debris shall be removed from the construction site(s) at regular intervals and disposed of at sanitary landfill(s) licensed by the Michigan Department of Environmental Quality.
- E. HOUSEKEEPING: The project work areas shall be maintained in a neat and clean condition and all debris and waste materials shall be removed from work areas on a daily basis.
- 1.04 VEHICULAR AND PEDESTRIAN TRAFFIC CONTROL: The Contractor shall be responsible for providing, installing, and maintaining vehicular and pedestrian traffic control signs, lights, and barricades in conjunction with construction operations. Vehicular traffic control measures shall be in accordance with the Michigan Manual of Uniform Traffic Control Devices.
- A. STREET CLOSING: No street or roadway may be closed to traffic without prior written permission of the governing body having jurisdiction over the street or roadway.
- B. EXISTING TRAFFIC CONTROL SIGNS: Existing traffic control signs which conflict with construction operations may be temporarily removed. The Contractor shall provide traffic control for the duration of the sign displacement and signs shall be replaced in the proper location immediately after construction operations adjacent to the sign locations are completed.

END OF SECTION

Durand

01560-1

5-29-98

SECTION 02100

STANDARD CASTINGS, VALVES AND HYDRANTS

PART 1 GENERAL

- 1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing Standard Castings, Valves and Hydrants in accordance with the City of Durand Standards.
- 1.02 RELATED WORK:
 - A. REQUIREMENTS: Standard castings, valves, and hydrants shall be installed in accordance with the details indicated on the plans and in these specifications.
 - B. RELATED SECTIONS: Including, but not limited to:
 - 1. SECTION 02665 - WATER MAINS
 - 2. SECTION 02715 - CONCRETE UTILITY MANHOLES AND CATCH BASINS
 - 3. SECTION 02717 - SEWAGE FORCE MAINS
 - 4. SECTION 02722 - STORM SEWERS
 - 5. SECTION 02732 - SANITARY SEWER

PART 2 PRODUCTS

- 2.01 SANITARY/STORM SEWER SYSTEM:
 - A. SANITARY MANHOLE CASTINGS EJIW 1040 A
 - B. STORM MANHOLE CASTINGS EJIW 1040 B
 - C. STORM CATCH BASIN CASTINGS
 - 1. Curb Type EJIW 7045
 - 2. Ditch Type EJIW 6508
 - 3. Gutter Type EJIW 7066
 - 4. Alleys EJIW 5105
 - 5. Parking Lots EJIW 1690, Type M

- A. VALVES
 - 1. Valves Resilient wedge, open left.

1. Valve Box Tyler 6860 Series, Three Piece

B. SERVICES

1. Service Lead Type K annealed seamless coppers

2. Corporation Stop Ford F600-3 flange
Compression curb stop Ford

3. Service Clamp Ford FSI stainless
Mueller 500 1104 stainless
Smith Blair Type 261 stainless

All Repair Clamps are Double Band

4. Curb Valve or Stop Ford Compression, flare corp.

5. Curb Box Ford Minneapolis Base with Bushing
Lid 27/32 Brass Pentagon
Head Plug

C. VALVE MANHOLE CASTINGS

1. 6", 8" and 10" Valves EJIW 1040 A, Marked "Water"

2. 12" Valve and Larger EJIW 1370 A, Marked "Water"

D. FIRE HYDRANTS

1. Type East Jordan Model 5-BR with breakable flange

2. Hose Connection Two-2 1/2" National Standard Hose Connections

3. Pumper Connection One 4" National Standard Pumper Connection

4. Nut National Standard, 1 1/2" Pent.

5. Open Left

PART 3 EXECUTION - This section not used.

END OF SECTION

Durand

02100-2
SECTION 02110
SITE PREPARATION

5-29-98

PART 1 GENERAL

- 1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials in connection with SITE PREPARATION.
- 1.02 RELATED WORK:
 - A. REQUIREMENTS: All work shall be carried on in a neat and satisfactory manner an interference with flow of traffic shall be kept to a minimum.
 - B. RELATED SECTIONS: Including, but not limited to:
 - 1. SECTION 01410 - SOILS COMPACTION AND TESTING
 - 2. SECTION 01560 - SPECIEAL CONTROLS
 - 3. SECTION 02223 - BEDDING AND BACKFILLING FOR UTILITY SYSTEMS

PART 2 PRODUCTS - This section not used.

PART 3 EXECUTION

- 3.01 CLEARING: Shall consist of cutting, removing from the ground, and disposing of trees, stumps, brush, shrubs, and other vegetation occurring within the project site which interfere with excavation, embankment or clear vision, or are otherwise noted on the construction drawings to be removed and includes the preservation from injury or defacement of all vegetation and objects designated to remain. Any trees or shrubs that are designated to be saved but are damaged by the Contractor's operations shall be repaired or replaced by the Contractor, as directed by the Engineer, at no additional cost to the Owner.
- 3.02 TREE AND STUMP REMOVAL: Shall consist of removing trees or stumps where called for on the plans or directed by the Engineer, or of removing stumps which are shown on the plans as trees occurring within the project site and shall include cutting such trees, removing their stumps and roots from the ground or chipping the stumps and properly disposing of the material. Where removal of a stump may result in damage to existing utilities, the stump shall be removed by chipping to a depth of at least one foot below the finished ground surface. Other stumps may be removed by chipping when approved by the Engineer. The Contractor shall comply with requirements of the Michigan Act 72 of the Public Act of 1945 and regulations of the Michigan Department of Agriculture in regard to Dutch Elm diseased trees.
- 3.03 REMOVING MISCELLANEOUS STRUCTURES: Shall consist of removing pavement surface and base course, curb and gutter, sidewalk, manholes and catch basins, salvaging or disposing of the resulting materials, and backfilling the resulting excavations.
 - A. PAVEMENT, CURB AND GUTTER, SIDEWALK REMOVAL: Shall be to existing joints or a sawed joint. The sawed joint shall be cut with a concrete saw to a depth sufficient to cut the steel or, if the concrete is unreinforced, at least 3 inches. If the concrete has been covered with bituminous material, the depth of cut shall be sufficient to cut the steel or penetrate at least 3 inches into unreinforced concrete. The use of a crane and ball type pavement breaker will not be permitted within 50 feet of the pavement or other concrete structure that is to remain in place. Sufficient removal shall be made to provide for proper grades and connections in the new work.

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- B. MANHOLE, CATCH BASIN, AND INLET REMOVAL: In removing manholes, catch basins and inlets, any live sewers connected to them shall be rebuilt and properly reconnected through the removal areas, and service shall be maintained, as directed by the Engineer during such construction operations. If the plans call for abandoning manholes, catch basins or inlets, the covers shall be removed and the masonry broken down to an elevation at least 3 feet below the pavement surface, within the area of the roadbed, and elsewhere to an elevation at least one foot below the pavement surface. Existing live sewer connections shall be rebuilt and properly reconnected through the abandoned area, and service shall be maintained during such construction operations. Unless otherwise noted,

removal of the structure shall include the cost of removing the connecting pipes or sewers. Where the existing sewer or pipe are to be abandoned in place, the existing sewer or pipe shall be bulkheaded at the trench or structure wall. The cost of the bulkhead(s) shall be included in the cost of the structure removal or abandonment.

- 3.04 ADJUSTING UTILITY CASTINGS AND COVERS: Shall include all manholes, catch basins, valve vaults, valve boxes, etc., publicly or privately owned, which are located in the project site. All work shall be done in accordance with the structure Owner's requirements.
- A. MANHOLE OR CATCH BASIN CASTING: Adjusting the casting shall apply where the elevation of the casting is lowered by the height of the available adjusting brick or rings or raised to a maximum of 15 inches of brick and block adjustment. This adjustment shall be done by one of the following methods:
1. Masonry Adjustment: Existing castings shall be adjusted to the proper elevation by removing the castings, and setting them to the required elevation by supporting them on a concrete collar or on masonry, so constructed as to hold them firmly in place. The adjacent pavement, curb, or curb and gutter shall be replaced to the original elevation, condition and kind of construction, unless otherwise provided.
 2. Adjusting Rings: Existing covers may be adjusted to the proper elevation by inserting an Engineer approved, variable adjustable casting into the existing frame. The adjustable casting shall be capable of diameter adjustment as well as height adjustment.
- B. WATER VALVE BOXES: Shall be adjusted by chipping sufficient adjacent pavement or other material, adjusting the casting, and replacing pavement or other material. Water valve boxes which cannot be adjusted properly shall be replaced with a new screw type adjustable valve box to be furnished and installed by the Contractor.
- C. MONUMENT BOXES: Shall be adjusted to the proper elevation by placing an approved cast iron ring to support the cover at the correct elevation, or by removing or chipping sufficient adjacent pavement or other material to remove the casting, raising it to the proper elevation, and supporting it on Class B concrete.
- 3.05 REMOVE AND REPLACE MANHOLE OR CATCH BASIN CASTINGS: Shall be where called for on the plans or in the specifications. The Contractor shall remove existing castings, install new castings of the style noted on the plans or in the specifications, and adjust the new castings to the proper elevation. The old castings remain the property of the City and shall be delivered by the Contractor to a location designated by the City.
- 3.06 RECONSTRUCTING MANHOLES OR CATCH BASINS: Reconstruction of manholes or catch basins shall apply where castings cannot be adjusted to the proper elevation due to the absence or presence of sufficient adjusting brick or rings on the manhole structure. The manhole or catch basin structure shall be constructed by one of the following methods.
- A. PRECAST STRUCTURE: If the manhole is constructed of precast concrete sections, the top sections(s) shall be removed and replaced with a precast concrete section(s) of such height as to allow for the proposed casting adjustment.
- B. MANHOLE BLOCK OR BRICK: If the manhole is constructed of manhole block or brick, remove sufficient rows of block or brick in order to construct the manhole to the proper grade for casting adjustment.

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- 3.07 BITUMINOUS SURFACE REMOVAL: Shall consist of removing a bituminous surface from a rigid base or removing a bituminous surface from an aggregate base without the removal of the aggregate base. The surface and the aggregate base will be classed as Earth Excavation, except that when the bituminous surface is more than 5 inches in thickness, the removal of the bituminous surface will be paid for as Removing Pavement.
- 3.08 DISPOSAL OF MATERIALS: Materials salvaged during the construction of the project shall become the property of the Contractor unless otherwise shown on the plans or in the proposal. Materials reserved for use by the City shall be removed without damage to the material and stored outside the limits of construction at the location and in the manner approved by the City. Materials that become the property of the Contractor shall be removed from the

project before acceptance of the project. Broken concrete which is matted together by steel reinforcement and all other waste material shall be disposed in conformance with SECTION 01560 - SPECIAL CONTROLS.

- 3.09 RESTORATION OF DISTURBED STRUCTURES: Existing structures, including pavement, curb and gutter, sidewalk and other miscellaneous structures, disturbed or damaged as a result of site preparation operations shall be restored or replaced to their original condition by the Contractor at no cost to the City
- 3.10 BACKFILLING: All trenches, holes and pits resulting from the breaking down or removal of foundations and miscellaneous structures within the project site shall be backfilled in conformance with SECTION 02223 Paragraph 2.02 BACKFILL MATERIAL and compacted in conformance with SECTION 01410 - SOILS COMPACTION AND TESTING.

END OF SECTION

Durand

02110-3
SECTION 02161
SHEETING AND BRACING

5-29-98

PART 1 GENERAL

- 1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials in connection with SHEETING AND BRACING.
- 1.02 RELATED WORK: Certain sections of the work may be specifically designated on the plans to be sheeted. This designation was made in order to limit trench width and protect parallel utilities or adjacent property. In such

areas, so designated on the plans, the Contractor may excavate in conformance with State and Federal regulations by electing to shore or by widening the trench at the top to provide the required slopes.

- 1.03 REQUIREMENTS: The Contractor shall comply with all Federal, State, and local laws and regulations governing the furnishing and use of safeguards, safety devices, and protective equipment. In addition, the Contractor shall take any other needed actions on his own responsibility to protect the life and health of all persons and property during construction. The Michigan Department of Labor, Bureau of Safety and Regulations is the enforcing agencies to insure compliance with Federal and State safety regulations.

PART 2 PRODUCTS - This section not used.

PART 3 EXECUTION

- 3.01 INSTALLATION: The Contractor shall furnish and place all sheeting or shoring and bracing as may be required for the protection of the work, personnel, the public, and the adjacent property.
- A. STRUCTURES: Sheeting including steel sheet piling, and prone bracing thereof, shall be installed for the protection of adjacent paving, structures, and other properties, including existing utilities and structures, as may be required in the prosecution of the work.
- B. UTILITIES: Sheeting, including steel sheet piling, shall be installed above the elevation of the top of the pipe or utility being installed to protect personnel and permit proper installation of the work. Existing utilities being crossed by trenches shall be adequately supported to prevent misalignment and damage. The method of support shall meet the requirements of the applicable utility company.
- C. ALTERNATIVE METHODS: The Contractor may, in lieu of tight steel sheeting, utilize special high trench boxes or other acceptable means to protect the trench so long as applicable State and Federal safety regulations are met, or unless sheeting is required as outlined under paragraph 1.02. In no event shall a trench, which is shown on the drawings to be specifically sheeted, be wider at the top than one-half the depth of the trench, or 20 feet, whichever is less.
- D. RELATION OF TRENCH WIDTH TO SEWER STRENGTH: The Contractor shall be aware that the strength class of sewer pipe or the pipe bedding may be influenced by the width of trench at the top of the pipe. In general, the Engineer has designed for the worst condition assuming a wide trench at the top of the pipe so that the so called "transition width" determines the load on the pipe.
- 3.02 CONTRACTOR RESPONSIBILITY: All paving, structures, and other properties including existing utilities, which are damaged as a result of the lack of sheeting or shoring, and bracing, or the adequate installation thereof, shall be repaired by the Contractor at his expense. In addition, where the Contractor is required to install sheeting or shoring, or elects to do so, he shall provide a certification in writing from a qualified registered professional engineer attesting to the adequacy of the proposed sheeting or shoring system(s) for each and every area or condition where sheeting or shoring is to be used. No sheeting or shoring shall be constructed without such certification.

END OF SECTION

Durand

02161-1
SECTION 02211
SITE EARTHWORK

5-29-98

PART 1 GENERAL

- 1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials in connection with SITE EARTHWORK.
- 1.02 RELATED WORK:

- A. REQUIREMENTS: All work shall be carried on in a neat and satisfactory manner and interference with flow of traffic shall be kept to a minimum.
- B. RELATED SECTIONS: Including, but not limited to:
 - 1. SECTION 01410 - SOILS COMPACTION AND TESTING
 - 2. SECTION 01560 - SPECIAL CONTROLS
- C. COORDINATION WITH OTHER CONTRACTORS: Certain portions of the work may require completion of construction under other contracts prior to commencing work under this section. The Contractor shall coordinate his work and schedule with other contractors to result in complying with the contract completion date.

PART 2 PRODUCTS

- 2.01 SUBBASE AND SUBGRADE UNDERCUTTING: Shall conform to MDOT Granular Material Class II.
- 2.02 EMBANKMENT MATERIAL: Materials utilized for embankment construction shall be approved by the Engineer. In general, any natural material which can be compacted to the required density, contains no organic material, and has a maximum unit weight of at least 95 pounds per cubic foot may be used. Materials containing more than 50 percent silt or any frozen material will not be allowed. Silt is defined as material having a particle size of 0.074 to 0.0005 mm.

PART 3 EXECUTION

- 3.01 SITE EARTHWORK: Work performed under this section shall consist of constructing earth grades by excavating soil or rock and by placing embankments of fills. This work shall include the salvaging and stockpiling of selected material, disposing of surplus or unsuitable material, trimming the earth grade, and maintaining the work in a finished condition until acceptance.
 - A. SITE PREPARATION: Undesirable material shall be removed from the grading limits and salvaged or disposed of as specified herein or as shown on the plans.
 - 1. Removing Topsoil: Before removing topsoil, all vegetation of a height greater than one foot shall be reduced to a height of approximately 6 inches and all such vegetation and all brush, stones, rocks, and any other objectionable litter or foreign materials shall be removed from the site and disposed of in conformance with SECTION 01560 - SPECIAL CONTROLS. Equipment and methods of operations shall be such as to avoid the lifting of subsoil. If soil or weather conditions are unsuitable, the Contractor shall cease removing topsoil.
 - a. Embankment Areas: Where the embankment is to be 5 feet or less in height to the pavement surface, the topsoil shall be stripped from the area within limits of 1 on 1 slopes spreading outward from the finished shoulders. For embankments upon which a structure is to be built, the topsoil shall be stripped from an area within limits of 1 on 1 slopes spreading outward in all directions from the bottom of structure footings. The depth of the topsoil to be removed shall be shown on the plans or as directed by the Engineer.
 - b. Cut Areas: Topsoil shall be removed within the grading limits.
 - 2. Salvaging Topsoil: The topsoil may be stockpiled outside the limits of construction or used as shown on the plans. Topsoil stockpiles shall be located and shaped so as to avoid placing around trunks and over root areas of trees to be preserved or in drainage courses. The topsoil shall be kept separate from other excavated materials.
 - 3. Salvaging Other Materials: If provided on the plans or in the proposal, old road surfacing of gravel, crushed stone, or selected excavated materials, shall be removed from the designated areas for use in such items as earth shoulders, salvaged approaches, temporary roadway surfacing or other items requiring the use of such materials. Reasonable care shall be exercised in removing and handling the designated

materials to prevent incorporation of foreign or undesirable material. When the salvaged material cannot be placed directly in the contemplated construction, the material shall be stored in stockpiles.

- B. **SUBGRADE UNDERCUTTING:** Including backfilling, shall be performed to replace material susceptible to frost heaving or differential frost action and unstable soil conditions, as determined by the Engineer. Removing topsoil will not be part of subgrade undercutting. Excavation below subgrade in cut sections, at the transition from cut to fill sections, and any excavation other than peat excavation that may be required below the topsoil in fill sections will be classified as Subgrade Undercutting.
1. **Limits of Subgrade Undercutting:** After the subgrade has been constructed to the approximate grade, the Engineer will promptly inspect the grade to determine if any subgrade undercutting is required and determine the limits of such undercutting. Where shallow fills are to be placed, the Engineer will inspect the fill area before any embankment is placed and determine the limits of the subgrade undercutting if any before placing any embankment. All deposits of frost heave material within lines 2 feet outside the proposed surface shall be removed to a depth as directed by the Engineer. Subgrade undercutting shall be performed within the limits established by the Engineer, and the excavated material shall become the property of the Contractor.
 2. **Backfilling of Subgrade Undercut Sections:** Undercut sections shall be backfilled to the subgrade elevation with MDOT Granular Material Class II. The degree of compaction shall be in conformance with SECTION 01410 - SOILS COMPACTION AND TESTING.
- C. **WASTE MATERIAL AND DEBRIS:** Of whatever nature shall be removed from the site at the Contractor's expense.
1. **Excess Material:** From excavation operations which is not required for fill or backfill may be spread at the site in spoil areas as shown on the plans.
 2. **Hazardous Waste:** Should such waste material as defined by MDNR be encountered during construction, the Contractor shall immediately notify the Engineer. Removal and disposal of such materials from the site shall be considered a changed condition.
- D. **CONSTRUCTING EMBANKMENTS:** Shall be completed with approved materials as specified in paragraph 2.02. In addition, embankments shall be constructed with the maximum allowable lift and degree of compaction conforming to SECTION 01410 - SOILS COMPACTION AND TESTING. In general, embankment construction at outside air temperatures below 35°F. will not be allowed. If embankment construction is allowed under such conditions, the Contractor shall exclude frozen material from any portion of the embankment. Any frozen material on a partially completed fill shall be removed and disposed of prior to placing additional fill on the embankment.
- E. **BORROW:** Material secured from locations outside the project site will be considered as borrow excavation. The Contractor shall perform all work and provide all materials and equipment necessary to excavate, haul, and place the borrow material. The Contractor will be held liable for all damages caused by his hauling operations and will be required to pay for such damages.

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- F. **PREPARATION OF SUBGRADE SURFACE:** Where the natural soils form the subbase, the subgrade shall be scarified and blended to a minimum depth of 6 inches to obtain uniformity across all lines of change in soil types. The subgrade shall be compacted in conformance with SECTION 01410 - SOILS COMPACTION AND TESTING.

END OF SECTION

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SECTION 02222
EXCAVATION FOR UTILITY SYSTEMS

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PART 1 GENERAL

- 1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials in performing all operations in connection with the EXCAVATION FOR UTILITY SYSTEMS.
- 1.02 RELATED WORK:
- A. REQUIREMENTS: All work shall be carried on in a neat and satisfactory manner and interference with flow of traffic shall be kept to a minimum.
 - B. RELATED SECTIONS: Including, but not limited to:

1. SECTION 01410 - SOILS COMPACTION AND TESTING
2. SECTION 01560 - SPECIAL CONTROLS
3. SECTION 02161 - SHEETING AND BRACING
4. SECTION 02223 - BEDDING AND BACKFILLING FOR UTILITY SYSTEMS
5. SECTION 02227 - BORING, JACKING AND TUNNELING FOR UTILITY SYSTEMS
6. SECTION 02901 - RESTORATION AND CLEAN-UP

- C. DEVIATIONS: Wherever obstructions not shown on the plans are encountered during the progress of the work and interfere to such an extent that an alteration in the plan is required, the Engineer shall have the authority to change the plans and order a deviation from the line and grade or arrange with the owners of the structures for the removal, relocation reconstruction of the obstructions. If the change in plans results in a change in the amount of work by the Contractor, such altered work shall be done on the basis of payment to the Contractor for the extra work or credit.
- D. SUBSURFACE EXPLORATIONS: Whenever, in the opinion of the Engineer, it is necessary to explore and excavate to determine the location of the existing underground structures, the Contractor shall make explorations and excavations for such purposes at no cost to the Owner. All apparent underground conflicts shall be excavated in advance of excavation for utility systems to determine any actual interference.

PART 2 PRODUCTS

- 2.01 BACKFILL FOR UNDERCUTTING: Shall conform to MDOT Granular Material Class II Granular Material or other material approved by the Engineer.
- 2.02 FLEXIBLE PIPE REQUIREMENTS: When undercutting exceeds 12" for flexible pipe (PVC or corrugated pipe) backfill for undercutting shall conform to MDOT requirements for 31 A aggregate.

PART 3 EXECUTION

3.01 EXCAVATION AND PREPARATION OF TRENCH

- A. CAUTION IN EXCAVATION: The Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures, both known and unknown, may be determined. The Contractor shall be held responsible for the repair of such structures if broken or otherwise damaged as a result of excavation at no additional cost to the City.

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- B. EXCAVATION TO GRADE: The trench shall be excavated to the depth required so as to provide a uniform and continuous bearing and support for the pipe per details shown in SECTION 02223 - BEDDING AND BACKFILLING FOR UTILITY SYSTEMS.

C. EXCAVATION BELOW GRADE

1. Contractor's Fault: If the Contractor undercuts the trench below plan grade, the trench shall be restored to plan grade with compacted granular material or stone (at the option of the Engineer).
2. Unstable Ground Conditions: If unstable ground conditions are encountered at the plan grade,, the Engineer will direct the Contractor to excavate the unstable material to a stable base. The Contractor shall then place and compact crushed stone, granular materials or other suitable material, approved by the Engineer, to establish the plan grade.
3. Compaction of Granular Material: Shall conform to SECTION 01410 - SOILS COMPACTION AND TESTING.

- D. WIDTH OF TRENCH: The width of the trench shall be ample enough to permit the pipe to be laid and joined properly. In general, the Engineer has designed for the worst condition assuming a wide trench at the top of the pipe so that the so called "transition width" determines the load on the pipe.
1. Bedding Requirements: When sand bedding is used, the trench width shall be as required to allow specified compaction of the bedding. If stone bedding is used, a minimum of 6 inches clearance shall be provided on each side of the pipe.
 2. Safety: The trench width shall be such that safety is provided at all times. In this regard, it shall be the responsibility of the Contractor to provide a safe trench for working at all times. Trench width and excavation shall meet all requirements of the State of Michigan Safety Inspector, the Department of Labor and MI-OSHA. Sheeting and bracing shall conform to SECTION 02161-SHEETING AND BRACING.
- E. REMOVAL AND DISPOSAL OF WATER: The Contractor shall provide adequate pumping, bailing, or other drainage facilities for removal and disposal of water from the excavation. These facilities shall consist of pumping, dewatering wells, well points or any other system designed and operated to remove ground waste to provide a dry and stable trench.
- F. BORING, JACKING, AND TUNNELING: At certain permanent pavement and railroad crossings, the Contractor shall bore and jack, or tunnel utilities in conformance with SECTION 02227 - BORING, JACKING AND TUNNELING FOR UTILITY SYSTEMS.
- G. OPEN CUTTING OF PERMANENT PAVEMENT
1. General: Where utilities are to be constructed within the rights-of-way of county, State or Federal highways or railroads, an application will be applied for by the City with the respective agency/agencies and shall be executed by the City upon fulfillment of requirements by the Contractor. The Developer and Contractor shall provide any bonds or assurances required by the agency/agencies. Whenever the specifications and plans conflict with the requirements of the permit, the requirements of the permit shall govern.
 2. Pavement Removal: Prior to excavation through all hard surface pavement, including sidewalks, the pavement shall be saw cut at such places to allow approximately 12 inches of undisturbed earth between the cut and the top edge of the trench. In lieu of saw cuts the pavement may be removed to a clean line at construction joints or contraction joints as approved by the Engineer.

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H. OPEN CUTTING AND TUNNELING OF TREES

1. Open Cutting: Where noted on the drawings, trees up to two inches (2") in diameter, may be balled, removed, and reinstalled after backfilling operations, or replaced in conformance with SECTION 02901 - RESTORATION AND CLEANUP. Trees between two inches (2") and eight inches (8") may be removed and replaced by approved tree spade if acceptable to the Engineer. Trees eight inches (8") in diameter and smaller shall not be open cut closer than four feet (4') and shall be tied back to a deadman. Trunks or limbs shall be protected from damage. Trees eight inches (8") in diameter and larger shall not be open cut closer than the radius in inches multiplied by one foot; i.e., a twelve inch tree shall not be open cut closer than six feet (6') and shall be tunneled within that radius.
2. Tunneling: Tunneling operations adjacent to or under trees shall begin and end at points which fall outside a radius designated above.

END OF SECTION

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SECTION 02223

BEDDING AND BACKFILLING FOR UTILITY SYSTEMS

PART 1 GENERAL

1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials and performing all operations in connection with BEDDING AND BACKFILLING FOR UTILITY SYSTEMS.

1.02 RELATED WORK:

A. REQUIREMENTS: All work shall be carried on in a neat and satisfactory manner and interference with flow of traffic shall be kept to a minimum. Special attention shall be made to the interrelationship between types of bedding and class of pipe material.

B. RELATED SECTIONS: Including, but not limited to:

1. SECTION 01410 - SOILS COMPACTION AND TESTING
2. SECTION 01560 - SPECIAL CONTROLS

- 3. SECTION 02222 - EXCAVATION FOR UTILITY SYSTEMS
- 4. SECTION 02901 - RESTORATION AND CLEANUP
- 5. SECTION 03001 - CONCRETE

PART 2 PRODUCTS

- 2.01 PIPE BEDDING MATERIAL: Includes all specified bedding material from 4 inches below the pipe to 12 inches above the top of the pipe.
 - A. GRANULAR BEDDING: Shall be well graded granular materials conforming to MDOT granular material Class II.
 - B. STONE BEDDING:
 - 1. Rigid Pipes: Shall be stone conforming to MDOT Specification 8.02 for 6A coarse aggregate.
 - 2. Flexible Pipes (PVC or corrugated pipe): Shall conform to MDOT Specification 8.02 for 31A aggregate.
 - C. CONCRETE: Shall be Class B wet mix concrete conforming to SECTION 03001 - CONCRETE.
 - D. FLEXIBLE PIPE BEDDING (PVC or corrugated pipe): Shall be approved by the Engineer and graded to provide adequate side wall support, compactibility, and to prevent loss of support through migration of trench wall material into the bedding or migration of bedding material into the trench wall or bottom. Where in place trench materials are clay, silt, fine sand or a mixture thereof, the bedding material shall contain sufficient fines and be graded such that there are essentially no voids when compacted.
 - 2.02 BACKFILL MATERIAL: Includes all trench material above the pipe bedding material to the topsoil, aggregate base course, or grade.
 - A. BACKFILL MATERIAL FOR AREAS OUTSIDE PERMANENT PAVEMENT AREAS: When the type of backfill material is not indicated on the plans or in the specifications, the Contractor may backfill with excavated material, provided that the excavated material consists of loam, clay, sand, gravel or other materials approved by the Engineer. All backfill material shall be free from cinders, ashes, refuse, vegetable or organic material, boulders, rocks or stones, or other material which in the opinion of the Engineer is unsuitable. However, from one foot above the top of the pipe to grade, suitable material containing stones up to 6 inches in their greatest dimension may be used. Backfill shall be placed to the level required for final restoration in conformance with SECTION 02901 - RESTORATION AND CLEANUP.
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- B. BACKFILL MATERIAL UNDER PERMANENT PAVEMENTS OR SIDEWALK: Shall be sand, gravel, or other granular material conforming to SECTION 01410 paragraph 1.03 A - GRANULAR MATERIALS approved by the Engineer. Use of excavated trench material will be allowed only if it conforms to SECTION 01410 paragraph 1.03 A - GRANULAR MATERIALS. Backfill shall be placed to the level required for final restoration in conformance with SECTION 02901 - RESTORATION AND CLEANUP.

PART 3 EXECUTION

- 3.01 GENERAL: Excavation, undercutting trench widths, and dewatering shall conform to SECTION 02222 EXCAVATION FOR UTILITY SYSTEMS. Installation of pipes and structures shall be in accordance with the applicable sections of this specification.
- 3.02 OPEN TRENCH: The length of trench allowed to be left open before backfilling shall be a maximum of 100 feet, or as directed by the Engineer. The trench, if bedded to one foot above the top of the pipe, shall still be considered as an open trench.
- 3.03 PIPE SUPPORT IN UNSTABLE SOIL: Where the bottom of the trench at subgrade is found to consist of material which is unstable to such a degree that it cannot be removed and replaced with an approved material thoroughly compacted in place to support the pipe properly, the Contractor shall construct supports as directed by the Engineer.

- 3.04 CONSTRUCTION IN FILL SECTIONS: Where it is necessary to lay pipe in a fill area, all unstable or unsuitable material shall be removed and slopes steeper than 1 to 2 shall be stepped before fill material is placed. The embankment shall be of suitable material on 1 to 2 fill slopes and shall be not less than five diameters plus four feet wide at the invert of the pipe and shall be continued up to provide not less than one foot of cover over the pipe. Compaction shall conform to SECTION 01410 - SOILS COMPACTION AND TESTING.
- 3.05 PIPE BEDDING: All trenches shall be bedded by hand, from the bottom of the trench to one foot above the pipe with approved material and compacted by tamping. Bedding material shall be deposited in the trench for its full width on each side of the pipe, fittings, and appurtenances. Special care shall be taken to assure that there are no voids under the pipe haunches and that the pipe line and grade is not disturbed. Bedding dimensions and details shall conform to the appended tables.
- A. CONCRETE BEDDING: The pipe and fittings shall be adequately blocked and otherwise supported to maintain line and grade during concrete placement. Following concrete placement, no subsequent bedding or backfill operations shall be performed until the concrete has obtained adequate strength, which is 48 hours unless an accelerating admixture is used wherein the time may be reduced to 24 hours with the consent of the Engineer. Concrete bedding shall conform to the dimensions as given in the appended tables and reinforcement if require, shall be as detailed on the drawings.
- B. FLEXIBLE PIPE BEDDING: Due to side wall support requirements, flexible pipe bedding shall be placed with extreme care. Wherever trench undercut with porous stone with a high void ratio is used for dewatering, special methods and materials for bedding shall be used as detailed on the appended sheets.
- 3.06 BACKFILL: Backfill shall be carefully placed and compacted in lifts. From the top of the pipe bedding material to four feet above the pipe. Compaction shall be with small vibrating plate compactors and heavy wheel driven compactors shall not be used.
- A. BACKFILLING UNDER PERMANENT PAVEMENTS: Permanent pavements include gravel, bituminous concrete, and concrete surfaced streets, curbs, sidewalks, driveways, or similar structures. Where the excavation for utilities cuts through permanent pavements, the entire backfill to subgrade shall consist of granular material approved by the Engineer. Granular backfill shall be placed to the outside edges of shoulders or two feet outside the back of curb.

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1. Maintenance of Street Cuts: If replacement of permanent pavement will not be completed within 5 days of excavation, the Contractor shall construct and maintain a 4 inch bituminous base patch on all street cuts until the original type of surfacing is replaced.
2. Maintenance of Sidewalk Cuts: In sidewalks, sand backfill shall be constructed to the existing sidewalk grade, and maintained until the sidewalk can be poured. If replacement of the sidewalk will not be completed within 5 days of excavation, the Contractor shall construct and maintain a 4 inch bituminous base patch on all sidewalk cuts until the original type of surfacing can be replaced.
- B. BACKFILLING AT STRUCTURES: All backfill placed within three (3) feet of manholes or other underground structures shall be approved sand compacted in conformance with SECTION 01410 - SOILS COMPACTION AND TESTING.
- C. BACKFILL AT EXISTING UTILITIES: Existing utilities shall be protected during backfilling operations and backfilled in accordance with the requirements and standards of the company or municipality having jurisdiction over the utility. When backfill requirements under utilities are not set forth by the company or municipality, the Contractor shall backfill in conformance with paragraph 3.04. Existing utility lines damaged during or as a result of backfilling operations shall be repaired by the Contractor at his expense.
- 3.07 BEDDING AND BACKFILLING IN FREEZING WEATHER: Bedding and backfilling shall not be constructed in freezing weather, except by permission of the Engineer. Bedding and backfill shall not consist of frozen material and no fill shall be made where the material already in the trench is frozen.

3.08 **COMPACTION:** Compaction lifts and required densities for bedding and backfilling shall conform to SECTION 01410 SOILS COMPACTION AND TESTING.

3.09 **RESTORATION AND CLEAN-UP:** Shall conform to SECTION 02901 - RESTORATION AND CLEAN-UP.

END OF SECTION

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SECTION 02227

BORING, JACKING AND TUNNELING FOR UTILITY SYSTEMS

PART 1 GENERAL

1.01 **WORK INCLUDED:** The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials in performing all operations in connection with the BORING, JACKING AND/OR TUNNELING FOR UTILITY SYSTEMS.

1.02 **RELATED WORK:**

A. **REQUIREMENTS:** All work shall be carried on in a neat and satisfactory manner and interference with flow of traffic shall be kept to a minimum.

- B. 1. SECTION 01410 - SOILS COMPACTION AND TESTING
2. SECTION 01560 - SPECIAL CONTROLS
3. SECTION 02161 - SHEETING AND BRACING
4. SECTION 02222 - EXCAVATION FOR UTILITY SYSTEMS
5. SECTION 02223 - BEDDING AND BACKFILLING FOR UTILITY SYSTEMS
6. SECTION 02901 - RESTORATION AND CLEAN-UP

C. **PERMITS FOR BORING, JACKING, OR TUNNELING OPERATIONS:** Applications for such permits have been filed by the City with the respective Agency/Agencies and shall be executed by the City and Contractor upon

fulfillment of the Administrative requirements contained herein. Whenever the specifications and plans conflict with the requirements of the permit, the requirements of the permit shall govern.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. DRAWINGS TO BE FURNISHED: The Contractor shall furnish a drawing of the jacking pit showing size, proposed location, details of sheeting and bracing, and the type and capacity of jacking and excavating equipment to be used to install the pipe for approval of the agency having jurisdiction.
- B. SCHEDULE OF OPERATIONS: The Contractor shall submit, with the drawings required above, a schedule of proposed operations showing dates he proposes to start work, daily and weekly work schedules and his estimated time to complete work for each crossing called for under this Contract.
- C. SPECIAL INSURANCE, BONDS AND PERMITS: The governing authority may require special insurance coverage and a performance bond. The Contractor shall comply with the requirements of the permit and agency, to furnish satisfactory evidence if this special insurance and/or bonding before proceeding with any work on or within such right-of-way.
- D. GENERAL: Inspection costs incurred by the City shall be paid by the Contractor when so indicated in the supplemental technical specifications.

1.04 DEVIATIONS: Wherever utility obstructions not shown on the plans are encountered during the progress of the work and interfere to such an extent that an alteration in the plan is required, the Engineer shall have the authority to change the plans and order a deviation from the line and grade or arrange with the owners of the structures for the removal, relocation or reconstruction of the obstructions. If the change in plans results in a change in the amount of work by the Contractor, such altered work shall be done on the basis of payment to the Contractor for extra work or credit.

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PART 2 PRODUCTS

- 2.01 BACKFILL FOR UNDERCUTTING: Shall conform to SECTION 02223, paragraph 2.01 - BACKFILL FOR UNDERCUTTING.
- 2.02 CASING PIPE: Shall be the size, type and class, including steel yield strength, as shown on the plans and noted herein, except as may be modified by the permit issued by the jurisdictional agency.
- 2.03 CASING PIPE VOID: Shall be filled using either stone, sand or grout in accordance with the specifications or as required by the permit agency.

PART 3 EXECUTION

- 3.01 BORING, JACKING AND TUNNELING: At certain permanent pavement and railroad crossings, the Contractor shall bore and jack, or tunnel utilities in accordance with the regulations of the municipality, county, MDOT, or transportation agency having jurisdiction.
 - A. EXCAVATION OF BORING AND TUNNELING PITS: Shall conform to SECTION 02222 - EXCAVATION FOR UTILITY SYSTEMS.
 - B. SAFETY: The boring and tunneling pit trench width shall be such that safety is provided at all times. In this regard, it shall be the responsibility of the Contractor to provide a safe trench for working at all times. Trench width and excavation shall meet all requirements of the State of Michigan Safety Inspector, the Department of

Labor and MI-OSHA. Sheeting and bracing shall conform to SECTION 02161 - SHEETING AND BRACING of these specifications.

3.02 JACKING:

- A. JACKING OPERATION: Bracing, backstops, and jacks shall be so designed and of sufficient rating so that the jacking operation can be progressed without stoppage until the leading edge of the pipe has at least reached the limit specified in the permit. This operation shall be conducted without hand-mining ahead of the pipe or use of any type of boring or auguring equipment. Excavated material shall be removed from the pipe as excavation progresses, and no accumulation of such material within the pipe will be permitted.
- B. PILOT TUNNEL: When jacking the larger diameters of pipe, a pilot tunnel may be constructed first to insure accuracy of grade and alignment. The dimensions and support of the pilot tunnel will be optional with the Contractor subject to the approval of the Engineer but such approval shall in no way relieve the Contractor of the responsibility for damage of any nature which might occur as a result of the method used or relieve the Contractor of the responsibility for maintaining proper line and grade.
- C. PIPE SECTION JOINTING: Concrete pipe joints shall be protected from crushing by placing a ½ inch rope or other approved material in the joints. Welded steel plate pipe sections shall be field welded together as recommended by the manufacturer and approved by the Engineer.

3.03 TUNNELING: Care shall be exercised in trimming the surface of excavated sections in order that the liner pipe fits snugly against undisturbed earth. The top of the tunnel excavation shall be supported by a cutting shield, and the excavation shall not be advanced ahead of such support. The vertical face of the excavation shall be supported as necessary to prevent sloughing. At any interruption of the tunneling operation, the liner shall be completely bulkheaded. As soon as the liner pipe has been placed and the alignment approved, a uniform mixture of 1:6 cement to sand grout shall be placed under pressure between the liner and the surrounding earth. Grout holes for 1 ½ inch pipe spaced at approximately 3 feet around the periphery, and every five feet of liner shall be provided. Grouting shall start at the lowest hole and proceed upwards progressively and simultaneously on both sides of the liner.

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- 3.04 BORING - This method employs the use of a rock roller type bit or a plate bit made up of individual roller cutter units which are solidly welded to the pipe sleeve being installed and which turns as it is advanced. The pipe shall be turned for its entire length from the boring machine to the head to give the bit the necessary cutting action against the ground being bored. A high density slurry (drilling mud) shall be injected through a small supply line to the head which acts as cutter lubricant and as a liquid carrier to bring back the spoil to the boring pits. This slurry shall be injected at the rear of the cutter unit to prevent any jetting action ahead of the pipe. The boring machine shall run on a set of steel rails and be advanced (thus advancing the pipe) by a set of hydraulic jacks. All machine operations are to be carried out from a pit constructed to the requirements of the permit. The method shall be the same whether earth or rock is being bored. Methods of a similar nature may be approved but are subject to review by the authority granting the permit.
- 3.05 OBSTRUCTIONS: If an obstruction is encountered during installation that stops the forward action of the pipe, and it becomes evident that it will be impossible to advance the pipe, operations shall cease, and the pipe will be abandoned in place and filled with grout.
- 3.06 MAINTENANCE OF TRAFFIC: When work is done in highway rights-of-way, all work shall be as previously specified. When work is done in railroad rights-of-way, the Contractor shall contact the local or State authorities having jurisdiction over such area regarding protection required to maintain traffic. All required protective devices and services shall be provided and maintained by the Contractor.
- 3.07 BACKFILLING OF BORING AND TUNNELING PITS: Shall conform to SECTION 02223 - BEDDING AND BACKFILLING FOR UTILITY SYSTEMS. Compaction shall be as specified under SECTION 01410 - SOILS COMPACTION AND TESTING.

END OF SECTION

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SECTION 02231
AGGREGATE BASE COURSE

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PART 1 GENERAL

1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials in connection with the construction of AGGREGATE BASE COURSE.

1.02 RELATED WORK:

A. REQUIREMENTS: All work shall be carried on in a neat and satisfactory manner and interference with flow of traffic shall be kept to a minimum.

B. RELATED SECTIONS: Including, but not limited to:

1. SECTION 01410 - SOILS COMPACTION AND TESTING
2. SECTION 01560 - SPECIAL CONTROLS

PART 2 PRODUCTS

2.01 AGGREGATE: Aggregate base materials shall conform to MDOT Specification 22A Series aggregate.

A. SINGLE SOURCE: It is the intent of these specifications to secure materials from a single source and to avoid repetitive testing of various sources of aggregate for the convenience of the Contractor.

- B. AGGREGATE PRODUCTION: Prior to any request to the Engineer for approval of aggregate base material, the Contractor or his supplier shall create a stockpile of an appropriate amount for the project.
 - C. TESTING OF SOURCE: Prior to approval and placement of the aggregate base course material, an independent testing laboratory, selected by the Engineer, shall take representative samples of aggregate base course materials from the stockpile and test said samples for compliance with the specified aggregate gradation.
- 2.02 CHEMICAL ADDITIVES: Chemical additives may be calcium chloride or calcium-magnesium chloride solution.

PART 3 EXECUTION

- 3.01 PREPARATION OF SUBGRADE: The subgrade shall be smoothed and trimmed to the required line, grade and cross section within a tolerance of $-\frac{3}{4}$ to $\frac{3}{4}$ of an inch to receive the base course and shall be compacted in conformance with SECTION 01410 - SOILS COMPACTION AND TESTING. The subgrade thus formed shall be maintained in a smooth and compacted condition until the base course has been placed. No base course shall be placed on the subgrade until it has been approved by the Engineer.
- 3.02 CHEMICAL ADDITIVE: A chemical additive may be added to the aggregate base course material in conformance with MDOT Specification 3.01.05 upon approval by the Engineer.
- 3.03 AGGREGATE BASE COURSE PLACEMENT
- A. EQUIPMENT: The use of motor graders and other approved equipment will be allowed during spreading, depositing and compacting operations.

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- B. PLACEMENT: Where the required thickness of the aggregate base course is 6 inches or less, the material may be spread and compacted in layers of approximately equal thickness with no layer exceeding 6 inches. Each layer shall be spread and compacted in a similar manner. The aggregate base shall have a moisture content sufficient to obtain optimum moisture content. Aggregate base shall not be placed during freezing or other unfavorable weather conditions.
 - C. COMPACTION: The spreading work shall be followed by vibrating compactors or pneumatic tired rollers until required density has been attained. Special care shall be exercised to secure proper compaction adjacent to curb lines. Compaction shall conform to SECTION 01410 - SOILS COMPACTION AND TESTING.
 - D. GRADING TOLERANCE: The finished surface shall be shaped to the specified crown and established grade to within a tolerance of $-\frac{3}{4}$ to $\frac{3}{4}$ of an inch. Twenty-four hours prior to placing of any surface course on the prepared base, the Contractor shall notify the Engineer, who will check the grade and crown at proper intervals to verify compliance with the grading and shaping tolerance. Any section not meeting tolerance shall be reshaped before the Engineer grants approval to place surface material.
 - E. MAINTENANCE: The Contractor shall, without additional cost to the Owner, be required to regrade and reshape the finished surface if the surface becomes damaged during any interval between completion of base course and placing of bituminous surface material.
- 3.04 TESTING: After placement of the aggregate base course, the finished base course shall be tested for compliance with the compaction requirements of SECTION 01410 - SOILS COMPACTION AND TESTING.

END OF SECTION

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SECTION 02512
BITUMINOUS BASE COURSE

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PART 1 GENERAL

1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials in connection with the construction of BITUMINOUS BASE COURSE.

1.02 RELATED WORK

A. REQUIREMENTS: All work shall be carried on in a neat and satisfactory manner and interference with flow of traffic shall be kept to a minimum.

B. COORDINATION WITH OTHER CONTRACTORS: Certain portions of the work may require completion of construction under other sections prior to commencing work under this section. The Contractor shall coordinate his work and schedule with other contractors to result in successful completion by the contract completion date.

C. RELATED SECTIONS: Including, but not limited to:

1. SECTION 01410 - SOILS COMPACTION AND TESTING
2. SECTION 01560 - SPECIAL CONTROLS
3. SECTION 02231 - AGGREGATE BASE COURSE

PART 2 PRODUCTS

2.01 MATERIALS: The composition of the bituminous base course mix shall conform to the following aggregate and asphalt cement specifications.

- A. BASE COURSE: Shall be an MDOT stabilization mix as indicated on the plans or in the specifications.
 - B. ASPHALT CEMENT: 85-100 penetration grade asphalt cement.
- 2.02 PROPORTIONS: The Contractor shall submit to the Engineer, for review, a laboratory Marshall mix design representative of the mixture to be placed by the Contractor. The bituminous mixture shall conform to "Composition of Bituminous Mixtures" Subsection 7.10.06 of the MDOT Standard Specifications.
- 2.03 LABORATORY TESTING: Representative samples of the bituminous base material will be taken at the job site and submitted to an independent testing laboratory, selected by the Engineer, for determination of aggregate gradation and asphalt cement content.

PART 3 EXECUTION

- 3.01 SUBBASE: The aggregate subbase must be approved by the Engineer prior to placement of the bituminous base course. Placement of aggregate subbase shall conform to SECTION 02231 - AGGREGATE BASE COURSE. Compaction of the subbase shall conform to SECTION 01410 - SOILS COMPACTION AND TESTING.
- 3.02 EQUIPMENT: The bituminous base course shall be placed by means of an approved self-propelled mechanical paver or other suitable spreading equipment approved by the Engineer prior to commencement of work.
- 3.03 PLACEMENT: Placement of the bituminous base course shall conform to MDOT Specifications.
- 3.04 SMOOTHNESS REQUIREMENTS: Shall conform to MDOT Specifications.

END OF SECTION

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SECTION 02513
BITUMINOUS LEVELING/SURFACE COURSES

PART 1 GENERAL

- 1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials in conjunction with the construction of BITUMINOUS LEVELING/SURFACE COURSES.
- 1.02 RELATED WORK
- A. REQUIREMENTS: All work shall be carried on in a neat and satisfactory manner and interference with flow of traffic shall be kept to a minimum.
 - B. RELATED SECTIONS: Including, but not limited to:
 - 1. SECTION 01410 - SOILS COMPACTION AND TESTING
 - 2. SECTION 01560 - SPECIAL CONTROLS
 - 3. SECTION 02110 - SITE PREPARATION
 - 4. SECTION 02231 - AGGREGATE BASE COURSE
 - 5. SECTION 02512 - BITUMINOUS BASE COURSE

PART 2 PRODUCTS

- 2.01 MATERIALS: The composition of the bituminous leveling/surface course shall conform to one of the following MDOT asphalt mixture specifications except modified where indicated.
- A. LEVELING COURSE: Shall be an MDOT mix as indicated on the plans or in the specifications.

- B. SURFACE (TOP) COURSE: Shall be an MDOT mix as indicated on the plans or in the specifications.
 - C. BOND COAT: Shall be an MDOT Specification SS-1h asphalt emulsion.
 - D. ASPHALT CEMENT: Shall have a penetration grade index of 85-100, unless otherwise indicated on the plans or in the specifications. In general, the asphalt cement content for leveling mixtures shall be 5.0 to 6.0 percent based upon percent asphalt by weight of the total mix. The bitumen content of the top course shall be designed to have up to 0.5 percent more bitumen than the optimum specified for the leveling course.
- 2.02 PROPORTIONS: The Contractor shall submit to the Engineer for review a laboratory Marshall mix design representative of the mixture to be placed by the Contractor. The bituminous mixture shall conform to "Composition of Bituminous Mixtures" Subsection 7.10.06 of the MDOT Standard Specifications.
- 2.03 LABORATORY TESTING: Representative samples of the bituminous material will be taken at the job site and submitted to an independent testing laboratory, selected by the Engineer, for determination of aggregate gradation and asphalt content.

PART 3 EXECUTION

- 3.01 ADJUSTING UTILITY CASTING AND COVERS: Shall conform to SECTION 02110 - SITE PREPARATION.
- 3.02 PLACEMENT OF BITUMINOUS MIXTURE(S) ON AN AGGREGATE BASE COURSE
- A. CONDITIONING AGGREGATE SURFACE: Prior to placement of the bituminous mixture(s), the aggregate surface shall be shaped to the required grade and cross section in conformance with SECTION 02231 AGGREGATE BASE COURSE. Where the aggregate surface is irregular, the use of a scarifier may be required. Additional aggregate shall be placed as directed by the Engineer when it is required to shape or consolidate the

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surface. Unless otherwise noted, the shaped surface shall be rolled to provide thorough compaction. Wetting may be required to facilitate shaping the surface and to assist in compaction of the subbase in conformance with SECTION 01410 - SOILS COMPACTION AND TESTING. The surface thus formed shall be maintained in a smooth and compacted condition until it is paved. Immediately before paving, all excess loose material remaining on the surface shall be removed to the shoulder. The length of existing road which is prepared and conditioned for paving shall be determined by the Engineer.

- B. PLACEMENT: Placement of the bituminous mixture(s) shall conform to MDOT Specifications.
- 3.03 PLACEMENT OF BITUMINOUS MIXTURE(S) ON EXISTING BITUMINOUS OR CONCRETE SURFACE
- A. PREPARING EXISTING PAVEMENT
 - 1. Removing Bituminous Patching: Existing bituminous patches of ¾ inch thickness, or more, and bituminous patches of less than ¾ inch thickness with a high bitumen content which may cause bleeding or instability, shall be removed and patched in accordance with the following paragraph, Wedging and Patching.
 - 2. Wedging and Patching: All holes and depressions in the pavement section and all spaces caused by removing old surface material shall be wedged with a Bituminous Mixture as determined by the Engineer, placed and thoroughly compacted by tamping or rolling in layers of not more than 2 ½ inches in thickness before constructing the full width of bituminous pavement.
 - 3. Pavement Joints: The existing joint fillers shall be removed to an elevation ¾ inch below the surface of the pavement by mechanical or hand methods. Where existing transverse and longitudinal pavement joints and cracks are repaired, the existing bituminous surface and any loose or spalled concrete around the joint shall be filled with Bituminous Patching Mixture (MDOT No. 1100L) and compacted with a machine vibrator or approved roller. The prepared pavement shall be approved by the Engineer and the Contractor before placing any bituminous concrete mixture.

- B. BOND COAT: Prior to application of the bond coat, all existing surfaces shall be swept clean. The bond coat shall be applied at a rate of 0.10 gallons per square yard. The material shall be applied immediately ahead of paving operations for distances of 1,000 feet to 1,500 feet, depending upon traffic conditions.
 - C. PLACEMENT: Placement of bituminous mixture(s) shall conform to MDOT Specifications.
- 3.04 THICKNESS: The required bituminous material and thickness shall be shown on the plans or in the specifications. Pavement course thickness in excess of 2 ½ inches shall be placed in two or more courses.
- 3.05 SMOOTHNESS REQUIREMENTS: Shall conform to MDOT Specifications.

END OF SECTION

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SECTION 02525
CONCRETE CURB AND GUTTER

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PART 1 GENERAL

- 1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials in connection with the construction of CONCRETE CURB AND GUTTER.
- 1.02 RELATED WORK
- A. REQUIREMENTS: All work shall be carried on in a neat and satisfactory manner and interference with flow of traffic shall be kept to a minimum.
 - B. RELATED SECTIONS: Including, but not limited to:
 - 1. SECTION 01560 - SPECIAL CONTROLS
 - 2. SECTION 03001 - CONCRETE
 - 3. SECTION 03600 - GROUT

PART 2 PRODUCTS

- 2.01 CONCRETE: Shall be Class A with a 28 day compressive strength of 3,500 psi. Materials, mixing, placing and curing shall conform to SECTION 03001 - CONCRETE.
- 2.02 REINFORCING STEEL: Shall conform to ASTM A615 Grade 40. The size and location shall be as noted on the plans.
- 2.03 PREFORMED BITUMINOUS JOINT FILLERS: Shall consist of a bituminous mastic composition formed and encased between layers of felt, conforming to ASTM D2475.

PART 3 EXECUTION

- 3.01 BASE PREPARATION: The Contractor shall excavate or fill, as required, to within six inches of the proposed curb and gutter base. The Contractor shall place and compact a bed of sand, bank run gravel or other material equal to MDOT Granular Material Class II to bring the base to the desired grade. All tree roots 2 inches or more in diameter which are cut in conjunction with the base preparation shall be painted with Bartlett's Tree Paint, Tanglefoot Tree Paint, or equal.
- 3.02 LINE AND GRADE: All curbs are to slope uniformly to the catch basins so that no standing water forms in the finished gutter. Grades are shown on the plans.
- 3.03 FORMS: Shall be of such design of steel or wood as to insure the accurate maintenance of lines and grades and shall extend for the full depth of the required concrete. Flexible strips may be used where necessary on curves.
- 3.04 JOINTS: Expansion joints shall be 1 inch thick and placed at 400 foot intervals along the curb, at all street returns, within 20 feet each side of structures, and at the end of each day's pour. Contraction joints shall be placed at 40 foot maximum intervals. For both expansion and contraction joints the reinforcing steel shall be broken each side of the joint at a distance of 6 inches minimum to 18 inches maximum. Joint filler shall extend to the full depth of the joint, and the top shall be recessed $\frac{1}{4}$ to $\frac{1}{2}$ inch from the finished surface of the structure. Plain or weakness joints shall be placed every 10 feet.
- 3.05 PLACING CONCRETE: No concrete shall be placed until the subgrade and forms have been reviewed by the Engineer. The subgrade shall be wetted and the concrete deposited to the proper depth and spaded or vibrated sufficiently to insure the satisfactory consolidation prior to finishing.

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- A. FINISHING: The curb and gutter shall be rounded with an approved finishing tool having a radius of $\frac{1}{4}$ inch to the dimensions shown on the standard details. Patching, when necessary, shall be with concrete from the mixture used in the curb. The finished surface shall not vary more than $\frac{1}{8}$ inch in 10 feet from the established grade when checked with a 10 foot straightedge. Voids in the curb back shall be patched with a grout mixture conforming to SECTION 03600 - GROUT.
- B. CURING: Sufficient tarps or plastic sheets shall be stored on the job to prevent rain damage to the newly placed curb. Immediately after the free water has left the concrete surface, the curb shall be coated with a uniform coat of white membrane curing compound at the rate of one gallon per 200 square feet. No vehicle or foot travel shall be allowed in the new curb for 96 hours.

END OF SECTION

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SECTION 02528
CONCRETE SIDEWALKS

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PART 1 GENERAL

- 1.01 WORK INCLUDED: The work covered by this section of the specification consists of furnishing all plant, labor, equipment, and materials in connection with constructing CONCRETE SIDEWALKS.
- 1.02 RELATED WORK
- A. REQUIREMENTS: All work shall be carried on in a neat and satisfactory manner and interference with flow of traffic shall be kept to a minimum.
- B. RELATED SECTIONS: Including, but not limited to:
1. SECTION 01560 - SPECIAL CONTROLS
 2. SECTION 03001 - CONCRETE

PART 2 PRODUCTS

- 2.01 CONCRETE: Shall be Class A with a 28 day compressive strength of 3,500 psi. Materials, mixing, placing, and curing shall conform to SECTION 03001 - CONCRETE.
- 2.02 PREFORMED BITUMINOUS JOINT FILLERS: Shall consist of a bituminous mastic composition formed and encased between layers of felt, conforming to ASTM D2475.

PART 3 EXECUTION

- 3.01 BASE PREPARATION: The sidewalk base shall consist of a minimum of four inches of compacted sand or other materials equal to MDOT granular material Class III. In areas of existing granular subbase, the natural base may be used. In areas of existing unstable base material, the Contractor shall excavate the unstable material, as directed by the Engineer and place and compact sand or other material equal to MDOT Granular Material Class II. All tree roots 2 inches or more in diameter which are cut in conjunction with the base preparation shall be painted with Bartlett's Tree Paint, Tanglefoot Tree Paint, or equal.

- 3.02 FORMS: Shall be clean and straight, composed of wood or metal. The forms shall be staked to line and grade in a manner that will prevent deflection or settlement. Forms shall be clean and oiled before placing concrete. Removal shall not take place in less than 12 hours after placement of concrete.
- 3.03 JOINTS: 0.50 inch transverse expansion joint shall be placed every 50 feet the full depth of the sidewalk, at driveways, and where the new walk abuts existing concrete structures. Contraction joints shall be formed every 5 feet or as requested by the Owner. All joints shall be constructed at right angles to the centerline of the sidewalk.
- 3.04 PLACING CONCRETE: The subgrade shall be thoroughly wetted and the concrete deposited thereon to the proper depth (10" thick at commercial driveways, 6" thick at residential driveways, 4" thick elsewhere). Concrete shall be spaded along the forms, compressed and struck off flush with the top of the forms. The surface shall be floated with a steel float, edges and joints properly tooled, and then finished with a wood float or brush as required to provide a non-slip surface.

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3.05 CURING: Sufficient tarps or plastic sheets shall be stored on the job to prevent rain damage to the newly placed sidewalk. Immediately after the free water has left the concrete surface, the sidewalk shall be coated with a uniform coat of white membrane curing compound at a rate of one gallon per 200 square feet. No vehicular or pedestrian traffic shall be allowed on the new sidewalk for 96 hours after pouring.

3.06 REPAIR AND REPLACEMENT:

A. PREPARING THE AREA:

1. Sidewalk must be 4" thick and match length and width of walk on either side.
2. In residential driveway areas, sidewalks must be a minimum of 6" thick, in commercial driveway areas, sidewalks must be a minimum of 10" thick. THERE MUST BE A MINIMUM OF 4" OF SAND. The cement mix must be a minimum of 3500 pounds. Where tree roots are involved, roots must be cut off below the sand grade and shall be painted with Bartlett's Tree Paint, Tanglefoot Tree Paint, or equal.
3. Where ½ of the lot frontage or more of the sidewalk is to be replaced, the grade must be set by the City Engineer, where a lesser amount is involved, grade should match other adjacent walk area unless ordered otherwise by the City Engineer.

B. GUIDELINES FOR REPAIR:

1. Missing pieces or holes in walk may be patched if no more than ¼ of the square is involved, otherwise the whole square must be replaced.
2. Cracked Walks: In cases where cracks are considered unsafe by the Inspector or where more than ½ of the square is in cracked condition, the square must be replaced.
3. Walks Not Leveled: Where one square is higher or lower by one half inch (½"), or more, walk must be leveled or replaced.
4. The Inspector will mark walks needing repair or replacement and notify the property owner. Whenever more than 50 square feet of sidewalk must be replaced on any one building lot, a permit is required and may be obtained at the City Hall.

5. If the property owner does not make necessary repairs within 30 days of notification, the City will have the work done and expenses will be charged to the property owner.

END OF SECTION

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SECTION 02529

CONCRETE DRIVES AND APPROACHES

PART 1 GENERAL

- 1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials in connection with constructing CONCRETE DRIVES AND APPROACHES.
- 1.02 RELATED WORK:
- A. REQUIREMENTS: All work shall be carried on in a neat and satisfactory manner and interference with flow of traffic shall be kept to a minimum.
 - B. RELATED SECTIONS: Including, but not limited to:
 - 1. SECTION 01560 - SPECIAL CONTROLS
 - 2. SECTION 03001 - CONCRETE
 - C. PERMITS: Driveway permit shall be applied for by the Contractor performing any work to a proposed, or existing driveway approach. The driveway approach and curb and gutter forms shall be inspected by the City prior to placement of concrete.
 - D. ORIENTATION: Refer to Construction Detail Section for the typical curb break details.

PART 2 PRODUCTS

- 2.01 CONCRETE: Shall be Class A with a 28 day compressive strength of 3,500 psi. Materials, mixing, placing, and curing shall conform to SECTION 03001 - CONCRETE.
- 2.02 STEEL REINFORCING: Welded wire fabric conforming to ASTM A185 or A497 shall be used where noted on the plans.
- 2.03 PREFORMED BITUMINOUS JOINT FILLERS: Shall consist of a bituminous mastic composition formed and encased between layers of felt, conforming to ASTM D2475.

PART 3 EXECUTION

- 3.01 BASE PREPARATION: The drive and/or approach base shall consist of a minimum of four inches of compacted sand or as shown on the plans. In area of existing granular subbase, the natural base may be used. In areas of existing unstable base material, the Contractor shall excavate the unstable material, as directed by the Engineer and place and compact sand or other material equal to MDOT Granular Material Class II. All tree roots 2 inches or more in diameter which are cut in conjunction with the base preparation shall be painted with Bartlett's Tree Paint, Tanglefoot Tree Paint, or equal.
- 3.02 FORMS: Shall be clean and straight, composed of wood or metal. The forms shall be staked to line and grade in a manner that will prevent deflection or settlement. Forms shall be clean and oiled before placing concrete. Removal shall not take place in less than 24 hours after placement of concrete.
- 3.03 JOINTS: 0.50 inch transverse expansion joint shall be placed full depth every 50 feet, at the sidewalk, and at the back curb. Contraction joints shall be formed at the drive or approach centerline. All joints shall be constructed at right angles to the centerline of the drive or approach.
- 3.04 PLACING CONCRETE: The subgrade shall be thoroughly wetted and the concrete deposited thereon to the proper depth. Concrete shall be spaded along the forms, compressed and struck off flush with the top of the forms. The surface shall be floated with a steel float, edges and joints properly tooled, and then finished with a wood float or brush as required to provide a non-slip surface.

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- 3.05 CURING: Sufficient tarps or plastic sheets shall be stored on the job to prevent rain damage to the newly placed approach or drive. Immediately after the free water has left the concrete surface, the surface shall be coated with a uniform coat of white membrane curing compound at a rate of one gallon per 200 square feet. No vehicular or pedestrian traffic shall be allowed on the new drive or approach for 96 hours after pouring.

END OF SECTION

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SECTION 02665
WATER MAINS

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PART 1 GENERAL

1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials in connection with installation of WATER MAINS.

1.02 RELATED WORK:

A. REQUIREMENTS: All work shall be carried on in a neat and satisfactory manner and interference with flow of traffic shall be kept to a minimum.

B. RELATED SECTIONS: Including, but not limited to:

1. SECTION 01410 - SOILS COMPACTION AND TESTING
2. SECTION 01560 - SPECIAL CONTROLS
3. SECTION 02100 - STANDARD CASTINGS, VALVES AND HYDRANTS
4. SECTION 02222 - EXCAVATION FOR UTILITY SYSTEMS
5. SECTION 02223 - BEDDING AND BACKFILLING FOR UTILITY SYSTEMS
6. SECTION 02901 - RESTORATION AND CLEAN-UP
7. SECTION 02715 - CONCRETE UTILITY MANHOLES AND CATCH BASINS
8. SECTION 03001 - CONCRETE

1.03 SUBMITTALS: Detailed material lists and specifications for all materials furnished under this section of the specification shall be submitted to the Engineer for review.

PART 2 PRODUCTS

2.01 MATERIALS: Shall be new and of the type as specified herein.

A. DUCTILE IRON WATER MAIN PIPE: Shall conform to ANSI/AWWA C15/A21,51 and the following:

1. Class and Size: Unless otherwise noted on the plans, pipe wall thickness shall be a minimum of Class 54. Ductile iron may be used for three inch (3") and larger diameter pipe.
2. Exterior Coating: Bituminous, 1 mil thick.
3. Lining: Standard thickness cement-mortar conforming to ANSI/AWWA C104/A21.4.

4. Polyethylene Encasement: ANSI/AWWA C105/A21.5.
 5. Flanged Joints: ASA Class 125.
 6. Mechanical Joints and Push-on Joints: ANSI/AWWA C111/A21.11, bolts and nuts shall be high strength corrosion resistant alloy with hex head nuts.
 7. Fittings: Shall conform to ANSI/AWA C153/A21.53-88 and paragraph 2.01 A.2 above.
 8. Electrical Continuity: Bronze wedges or continuity straps.
- B. VALVES AND VALVE BOXES: Shall be in accordance with Section 02100 - Standard Castings, Valves and Hydrants.

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- C. HYDRANTS: Shall be in accordance with Section 02100 - Standard Castings, Valves and Hydrants.
 - D. SERVICE LEAD, CORPORATION STOP, CURB VALVE, CURB BOX: Shall be in accordance with Section 02100 Standard Castings, Valves and Hydrants.
- 2.02 BEDDING MATERIAL: Shall conform to SECTION 02223 - BEDDING AND BACKFILLING FOR UTILITY SYSTEMS.
- 2.03 MANHOLES: Shall be precast concrete conforming to SECTION 02715 - CONCRETE UTILITY MANHOLES AND CATCH BASINS.

PART 3 EXECUTION

- 3.01 WATER MAIN INSTALLATION:
- A. GENERAL: Installation shall be in accordance with ANSI/AWWA C600 for ductile iron pipe.
 - B. LAYING PIPE: Pipe shall be laid with the bell ends facing the direction of laying, unless otherwise directed or allowed by the Engineer.
 - C. LOCATION: As indicated on the plans. Maintain at least a ten feet separation from any sewer, unless specifically indicated on the plans.
 - D. GRADE AND ALIGNMENT: Provide cover of six (6) feet, unless otherwise indicated on the plans.
 - E. WET TRENCH LAYING: When the trench contains water, open ends o the pipe shall be closed by a watertight plug. This provision shall apply during the noon hour as well as overnight.
 - F. PIPE BEDDING: Shall conform to SECTION 02223 - BEDDING AND BACKFILLING FOR UTILITY SYSTEMS.
 - G. PIPE ENCASEMENT: Ductile iron pipe, bedded in an area of aggressive soil such as peat, shall be encased in a polyethylene encasement.
 - H. ELECTRICAL CONTINUITY: Unless otherwise noted on the plans, electrical continuity shall be provided for ductile iron pipe.
 - I. THRUST BLOCKS: Shall be made of Class B, poured-in-place concrete, placed at all bends, dead ends, tees, reducers, hydrants and valves, as required.

1. Thrust Table: Shall be used for sizes noted. For larger sizes, the details will be shown on the plans. Area in square feet of concrete thrusting against undisturbed earth shall be computed by dividing the total thrust by the safe bearing load of the soil.

| Thrust Main Size | Tee or Plug | 90° Bend | 45° Bend | 22 ½° Bend | 11 ¼° Bend |
|---------------------|----------------|-------------|-------------|---------------|---------------|
| 4" | 2,840 | 4,000 | 2,100 | 1,100 | 600 |
| 6" | 5,800 | 8,200 | 4,300 | 2,300 | 1,100 |
| 8" | 8,900 | 14,000 | 7,400 | 3,900 | 2,000 |
| 10" | 14,800 | 21,000 | 11,000 | 5,800 | 2,900 |
| 12" | 20,900 | 30,000 | 15,500 | 8,200 | 4,100 |
| 14" | 28,000 | 40,000 | 21,000 | 11,000 | 5,500 |
| 16" | 36,200 | 51,000 | 27,000 | 14,200 | 7,100 |
| 18" | 45,400 | 64,000 | 34,000 | 17,800 | 8,900 |
| 20" | 55,800 | 79,000 | 37,500 | 21,800 | 11,000 |

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2. Safe Bearing Loads for Soils (Horizontal Thrust)

| Soil | Safe Bearing Load Lbs. Per Sq. Ft. |
|---------------------------------|---------------------------------------|
| Muck, Peat, etc. | 0 |
| Soft Clay | 1,000 |
| Sand | 2,000 |
| Sand | 3,000 |
| Sand and Gravel cemented w/clay | 4,000 |
| Hard compacted clay | 5,000 |

3. THRUST BLOCKS IN UNSTABLE SOIL CONDITIONS: Thrust shall be resisted by piling driven to solid foundations or by removal of unstable soil material and replacement with ballast of sufficient stability to resist thrust. Thrust block size and method of thrust resistance shall be approved by the Engineer before construction.

4. SPECIAL THRUST CONTAINMENT: Use of joint ties and containing thrust within the pipe will be considered by the Engineer upon a definite proposal of methods submitted by the Contractor. Only methods retaining the freedom of joint to bend will be considered.

5. Hydrant Restraint: Refer to standard Construction Detail for hydrant restraint requirements.

3.02 VALVE AND HYDRANT INSTALLATION

- A. VALVE VAULTS: Precast concrete valve vaults shall be provided for valves twelve (12) inches in diameter or larger, unless otherwise indicated on the plans.
- B. HYDRANT BASE: Hydrants shall be placed upon a poured-in-place or precast concrete base (Class B, 4 inches thick) of at least 2 square feet, on a 4 inch crushed stone base, or as indicated on the plans. Suitable solid stone or salvage slab may be used for the concrete base as approved by the Engineer.
- C. DEPTH OF BURY: Hydrant leads shall have a 6 foot minimum cover, including crossing through ditch sections.
- D. HYDRANT DRAIN PORTS: Shall remain plugged.
- E. HYDRANT THRUST RESTRAINT: Shall conform to paragraph 3.01.I. of this specification.

3.03 SERVICE LEAD INSTALLATION

- A. GENERAL: Open cutting of existing hard surfaced pavement will not be allowed. Service leads may be bored, drilled or jacked; jetting of water or air will not be allowed. Under normal conditions, casings will not be required except where probable damage to the roadbed or the service lead exists. Service leads shall be installed in a separate trench from the sewer lead with a minimum separation of four feet and a depth of cover of at least 6 feet.
- B. INSTALLATION WITHOUT CASING: In stable soils, the diameter of the auger head shall not exceed the diameter of the service lead by more than one inch. Service lead pipe shall be pushed or pulled through after the hole has been augured. Pipe ends shall be examined after installation for damage. If damaged, the service pipe shall be replaced.

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- C. INSTALLATION WITH CASING: In unstable soils, as determined by the Project Manager, the combination of boring and jacking simultaneously shall be utilized providing the cutting edge of the auger does not advance ahead of the casing. Casing diameter shall not exceed the diameter of the service lead by more than one inch. Casing pipe may be removed at the Contractors option.
- D. BORING INSTALLATION: Shall conform to the requirement of the local agency/utility.
- E. CONNECTION TO EXISTING SERVICES: Connections to existing water services with like material shall be made with standard couplings; connections of dissimilar materials shall be made with appropriate couplings complete with Nylon dielectric bushings.

3.05 HYDROSTATIC TESTING:

- A. GENERAL: Upon completion of installation of the water main and appurtenances, the Contractor shall furnish all apparatus, materials, labor and water required to perform the pressure tests in accordance with Section 4 Hydrostatic Testing, ANSI/AWWA C600 and the following:
- B. PRE-TEST PROCEDURES: The Contractor shall open all valves, including hydrant auxiliary valves, and then completely fill the line with water with a special emphasis upon removing all air from the pipe, valves or hydrants. If necessary, the Contractor shall install additional corporation stops at high points to allow the air to be expelled.
- C. PRELIMINARY TEST: A preliminary pressure test by the Contractor shall be accomplished. Any leaks encountered shall be corrected and the test shall be rerun until results are satisfactory.
- D. FINAL PRESSURE AND LEAKAGE TEST: Shall conform to ANSI/AWWA C600 - Hydrostatic Testing, in the presence of the Engineer, who shall receive 24 hours notice prior to testing. If it is necessary for the Engineer to observe more than one test on any section of mainline, the Contractor shall be liable for the additional cost involved for observation of subsequent tests.
- E. LEAK REPAIR: The Contractor shall provide all labor and materials, etc. as required to repair any leaks, or otherwise required to meet these tests; all leaks shall be repaired, regardless of the amount of leakage. Water damage resulting from flushing or testing procedures shall be the responsibility of the Contractor.

3.06 DISINFECTION:

- A. GENERAL: Procedures shall conform to ANSI/AWWA C651, and the following:
- B. PRELIMINARY FLUSHING: After the pressure test and before disinfecting, the Contractor shall flush out the new pipe lines until the water runs clear. Each valved section of the newly laid pipe shall be flushed separately with potable water from the public supply.

- C. DISINFECTION: The Contractor shall disinfect the new mains in increments designated by the Engineer. samples shall be taken from corporation stops only. If mains dead end at hydrants, with no adjacent valve, the Contractor shall install an additional corporation stop for sampling.
- D. BACTERIOLOGICAL WATER SAMPLES: Shall be collected by an Authorized City employee in conformance with ANSI/AWWA C651. Two (2) successive safe tests taken 24 hours apart are required; analysis shall be made by a State approved laboratory.
- E. FAILING TESTS: In the event of an unsafe test, the test shall be repeated as described above; the Contractor shall be responsible for the tests.

END OF SECTION

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SECTION 02715

CONCRETE UTILITY MANHOLES AND CATCH BASINS

PART 1 GENERAL

- 1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials in connection with CONCRETE UTILITY MANHOLES AND CATCH BASINS.
- 1.02 RELATED WORK
 - A. REQUIREMENTS: The concrete utility manholes, including catch basins and valve vaults, shall be installed in accordance with the details indicated on the drawings and these specifications.
 - B. RELATED SECTIONS: Including, but not limited to:
 - 1. SECTION 01410 - SOILS COMPACTION AND TESTING
 - 2. SECTION 01560 - SPECIAL CONTROLS
 - 3. SECTION 02100 - STANDARD CASTINGS, VALVES AND HYDRANTS
 - 4. SECTION 02222 - EXCAVATION FOR UTILITY SYSTEMS
 - 5. SECTION 02223 - BEDDING AND BACKFILLING FOR UTILITY SYSTEMS
 - 6. SECTION 02665 - WATER MAINS
 - 7. SECTION 02722 - STORM SEWERS
 - 8. SECTION 02732 - SANITARY SEWER
 - 9. SECTION 02901 - RESTORATION AND CLEAN-UP
 - 10. SECTION 03001 - CONCRETE
- 1.03 SUBMITTALS: Detailed material lists and specifications for all materials furnished under this section of the specification shall be submitted to the Engineer for review.

PART 2 PRODUCTS

- 2.01 PRECAST SECTIONS: Precast sections shall conform to ASTM C478. Sewer pipe opening connections to precast concrete manholes shall conform to the following specifications:
 - A. SANITARY SEWERS: Manhole pipe connections shall be furnished with an integrally cast seal system, such as "A-Lok", "Kor-N-Seal", "Lock Joint Flexible Manhole Sleeves", or equal. Sanitary manhole shall have integral concrete manhole bases. Manhole section joints shall be of the O-ring rubber joint type or performed type of butyl sealant material. All pipe openings shall be cast in the precast section or cored in the finished wall. Broken and patched connections will not be accepted.
 - B. STORM SEWER: Manhole pipe connections shall be with a non-shrink grout. Manhole section joints shall be of the mastic joint type or butyl rubber sealant type unless otherwise shown on the drawings.

- C. VALVE MANHOLES AND OTHER STRUCTURES: Details and joints shall conform to the drawings.
- 2.02 MANHOLE ADJUSTING BRICK: Shall be concrete units conforming to ASTM C55.
- 2.03 MANHOLE ADJUSTING RING: Shall be standard precast reinforced concrete rings with a minimum of two inch height and a maximum of 6 inch height.
- 2.04 MANHOLE STEPS: Shall be furnished in all manholes unless otherwise noted in the plans, and shall be Co-Polymer Polypropylene Plastic manhole steps reinforced with 3/8" deformed reinforced bar. Manhole steps shall be of the press-fit type with serrated type tread and lugs. Steps shall not be cast in wall. Steps shall be spaced at sixteen inches on center in a true vertical alignment unless shown otherwise on the drawings.

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- 2.05 FRAMES AND COVERS: Shall be in accordance with Section 02100 - Standard Castings, Valves and Hydrants. Cover lettering shall be included when specified.
- 2.06 CONCRETE: Concrete shall conform to Section 03001 - CONCRETE

PART 3 EXECUTION

- 3.01 INSTALLATION: Utility manholes shall be constructed of precast concrete sections including risers, adjusting rings and precast tops of eccentric cone or flat slab type, as indicated on the drawings.
 - A. UTILITY MANHOLE AND CATCH BASIN BASES
 - 1. Precast Concrete: Precast bottoms or bases shall be set on uniform bedding of 8 inches of compacted sand or existing granular material as approved by the Engineer. When water is encountered in the trench, bases shall be set on a minimum of 12 inches of stone fill conforming to MDOT 6A.
 - 2. Integral Base: The Contractor at his option may use integral cast base and riser sections conforming to ASTM C478, except that integral bases shall be used on all sanitary sewer manholes.
 - B. PRECAST CONCRETE RISERS: Shall be set plumb and manhole steps shall be aligned to form a continuous ladder. Joints between manhole sections shall utilize rubber O-rings or performed butyl rubber sealant material for sanitary sewer manholes and shall utilize mastic or performed butyl rubber sealant for storm manholes, catch basins and valve vaults unless otherwise shown on the drawings.
 - C. CASTINGS: Shall be installed as specified below:
 - 1. Sanitary Sewer Manholes and Valve Vaults: Castings shall be set on precast concrete adjusting rings with a minimum adjustment of 4 inches and a maximum of 12 inches. Casting and rings shall be set in grout unless otherwise called for on the drawings.
 - 2. Storm Sewer Manholes and Catch Basins: Castings shall be set on precast concrete adjusting rings with a minimum adjustment of 4 inches and a maximum of 12 inches or, if allowed on the drawings, adjusting brick may be used.
 - 3. Casting Elevations: Where castings are to be flush with permanent pavements, the Contractor shall adjust the frame to the proper grade. Where castings are on flat slab tops in non-paved areas, they shall extend approximately one inch (1") above finish earth grade unless shown otherwise.
 - 4. Finish: The interior and exterior surface of adjustment rings or bricks shall be tooled to give a smooth finish coat of grout.
 - E. DROP PIPES: Shall be constructed at sanitary manholes wherever the difference in elevation between any inlet and outlet sewer is more than two vertical feet or as noted in the plans. All drop pipes shall be encased in 6A

stone and shall conform to the Construction Detail. All drop pipes shall be exterior unless otherwise noted on the plans.

- F. FLOW CHANNELS: Shall be constructed in manhole bottoms with mechanically mixed concrete. Flow channel depth shall be a minimum of ½ the pipe diameter and concrete thickness shall be a minimum of 4 inches measured from the top of the base to the bottom of the flow channel. Where the grade of sewer is continuous through the manhole, the Contractor may lay the pipe through the manhole, fill around the pipe with concrete and carefully break out or cut out the top of the sewer pipe.
- 3.02 TESTING: All sanitary sewer manholes shall be tested in conformance with SECTION 02732 - SANITARY SEWERS. The Contractor shall repair any leaks, flaws, or irregularities in any manholes or catch basins.

END OF SECTON

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SECTION 02717
SEWAGE FORCE MAINS

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PART 1 GENERAL

- 1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials in connection with installation of SEWAGE FORCE MAINS.
- 1.02 RELATED WORK: All items herein specified shall be adjusted to be compatible with the standard units used by the Owner in his present system. The items shall be of a quality level specified herein, and may be modified as called for herein or on the plans.
- A. REQUIREMENTS: All work shall be carried on in a neat and satisfactory manner and interference with flow of traffic shall be kept to a minimum.
- B. RELATED SECTIONS: Including, but not limited to:
1. SECTION 01410 - SOILS COMPACTION AND TESTING
 2. SECTION 01560 - SPECIAL CONTROLS
 3. SECTION 02100 - STANDARD CASTINGS, VALVES AND HYDRANTS
 4. SECTION 02222 - EXCAVATION FOR UTILITY SYSTEMS
 5. SECTION 02223 - BEDDING AND BACKFILLING FOR UTILITY SYSTEMS
 6. SECTION 02715 - CONCRETE UTILITY MANHOLES AND CATCH BASINS
 7. SECTION 02901 - RESTORATION AND CLEAN-UP
 8. SECTION 03001 - CONCRETE
- 1.03 SUBMITTALS: Detailed material lists and specifications for all materials furnished under this section of the specification shall be submitted to the Engineer for review.

PART 2 PRODUCTS

- 2.01 PIPES AND JOINTS: Shall be of the type as listed herein meeting the specifications noted. Unless specifically shown on the plans or listed in the form of proposal to be a specific material, the Contractor may elect to utilize any of the following materials subject to specifications and size limitations herein specified. Unless specifically approved by the Engineer, a single material shall be used for the total of each size main in the Contract. All pipe delivered to the job site shall bear the marks required by the ANSI/AWWA specification.
- A. DUCTILE IRON (D.I.): Shall conform to ANSI/AWWA C151/A21.51. Unless otherwise noted on the plans, pipe wall thickness shall be a minimum of Class 52. Pipe shall be standard thickness cement-mortar per ANSI/AWWA C104/A21.4, with the standard exterior bituminous coating. Ductile iron may be used for four inch (4") and larger diameter pipe.
1. Flanged Joints: Shall conform to ASA Class 125.

2. Mechanical Joints and Push-On Joints: Shall conform to ANSI/AWWA C111/A21.11. Bolts and nuts shall be of high strength corrosion resistant alloy with hex head nuts.
3. Fittings and Specials: Shall conform to ANSI/AWWA C110/A21.10 and may be either ductile or cast iron and shall be standard thickness cement-mortar lined per ANSI/AWWA C104/A21.4.
4. Polyethylene Encasement: Shall conform to ANSI/AWWA C105/A21.5.

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- B. POLYVINYL CHLORIDE (PVC): Shall conform to ANSI/AWWA C900, Pressure Class 150. Minimum pipe wall thickness shall be DR 18. All pipe shall have a "home" mark. PVC may be used for four inch (4") through twelve inch (12") diameter pipe.
 1. Joints: Shall be of the elastomeric gasket, push-on type conforming to ASTM D3139.
 2. Fittings and Specials: Shall conform to ANSI/AWWA C110/A21.10 for ductile iron, mechanical joint fittings with suitable adapters or gaskets as required by the pipe manufacturer. Fittings and specials shall be standard thickness cement mortar lined per ANSI/AWWA C104/A21.4
 - C. POLYETHYLENE (PE) PIPE AND FITTINGS: Shall be manufactured from a high density, high molecular weight polyethylene base resin conforming to ASTM D1248 Type III, Class C, Category 5, Grade P34. Polyethylene may be used for one inch (1") and larger diameter pipe.
 1. Minimum Cell Classification Values: As referenced to ASTM D-3350 shall be 345434C: Minimum pipe wall thickness shall be SDR 11.0, rated at not less than 150 psi.
 2. Joints: Shall be made by thermal butt-fusion conforming to ASTM D2657. All joints shall be made in accordance with the procedures and joining equipment recommended by the pipe manufacturer and approved by the Engineer.
 3. Joint and Equipment Testing: Prior to the installation of the pipe, a specimen of a butt-fusion pipe joint, made with the joining equipment to be used on the project, shall be submitted to an independent testing laboratory selected by the Engineer and tested in conformance with ASTM D638, or certified standard data sheets indicating acceptable test results have been made on similar joints.
 - D. LOCATING PROVISIONS: A suitable means for magnetically locating PVC or PE forcemain shall be installed with the PVC or PE forcemain and shall be approved by the Engineer in writing prior to construction.
- 2.02 BEDDING: Shall conform to SECTION 02223 - BEDDING AND BACKFILLING FOR UTILITY SYSTEMS.
- A. DUCTILE IRON (D.I.): Shall be Type 1 Bedding for Rigid Pipe unless otherwise specified on the plans.
 - B. POLYVINYL CHLORIDE (PVC) AND POLYETHYLENE (PE): Shall conform to SECTION 02223, paragraph 3.05.B FLEXIBLE PIPE BEDDING.
- 2.03 VALVES
- A. VALVES: Shall be resilient wedge gate valves in accordance with Section 02100 - Standard Castings, Valves and Hydrants.
 - B. VALVE BOXES: Shall be in accordance with Section 02100 - Standard Castings, Valves and Hydrants.
 - C. AIR RELEASE VALVES: Shall be designed to operate under pressure and open to vent entrapped air and gases from the sewage force main. After entrapped air and gases are vented, the valve shall close to prevent clogging of the valve mechanism. The body and cover shall be cast iron with all internal parts of stainless steel or other acceptable material to prevent corrosion. The valve shall be complete with accessories necessary for installation

including an inlet shut off valve, 1" clean out valve, and an 1/2" shut off valve for back flushing with quick disconnect couplings and back flushing hose. The inlet shall be 2" unless otherwise noted on the plans. Valves shall be rated for not less than 150 psi working pressure and be APCO, Val-Matic Corp., or equal, specifically designed for use on sewage force mains.

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PART 3 EXECUTION

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- 3.01 HANDLING OF PIPE: Proper and suitable tools and appliances shall be used for the safe and careful handling, conveying and laying of the pipe. Care shall be taken to prevent the coating of pipe from being damaged. Dropping material directly from a truck or platform will not be permitted. All pipes and castings shall be carefully examined for defects. If any materials are found to be defective, they shall be removed from the site.
- A. CLEANING PIPE AND FITTINGS: All lumps, blisters and excess coal tar or other material shall be removed from the bell and spigot end of each pipe and fitting. The outside of the spigot and the inside of the bell shall be brushed and wiped clean, dry and free from oil or grease prior to laying. The inside of the pipe shall be brushed in order to remove all dirt and debris. Any damage to exterior pipe coating shall be repaired with an approved coating before the pipe is laid.
- B. LAYING PIPE: Pipe shall be laid with the spigot ends facing the direction of flow. Under no circumstances shall pipe be dropped directly into the trench. Precautions shall be taken to prevent foreign material from entering the pipe while it is being placed. After placing a length of pipe in the trench, the spigot end shall be centered in the bell, and the pipe forced home to correct line and grade. At all times, the open ends of the cut end shall be trimmed, beveled or otherwise prepared for jointing as recommended by the pipe manufacturer. Only lubricants recommended by the pipe manufacturer shall be used as recommended in joint assembly.
- 3.02 GRADE AND ALIGNMENT: All force mains shall be installed to provide an overall cover of 5 feet, unless otherwise indicated on the drawings. The location of the force main is indicated on the drawings. Special care shall be taken to avoid any air pockets within the forcemain. If high points are constructed in the forcemain other than those shown on the plans or authorized by the Engineer, the Contractor shall install an air release valve at each high point at no additional cost to the Owner.
- A. PIPE DEFLECTION: Where curved lines, laid without fittings, are shown on the plans, or are necessary to avoid obstructions, the pipe may be deflected horizontally or vertically at each joint within the published recommended limits recommended by the pipe manufacturer. Deflections in excess of the allowable deflection shall be made by using standard fittings.
- B. WET TRENCH LAYING: When the trench contains water, the open ends of pipe shall be closed by a watertight plug. This provision shall apply during the noon hour as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.
- 3.03 PIPE BEDDING: Shall conform to SECTION 02223 - BEDDING AND BACKFILL FOR UTILITY SYSTEMS. Ductile iron pipe, bedded in an area of aggressive soil such as peat, shall be encased in a polyethylene encasement.
- 3.04 THRUST BLOCK: Shall be made of Class B, poured-in-place concrete, and placed at all bends noted below. Area in square feet of concrete thrusting against undisturbed earth shall be computed by dividing the total thrust by the safe bearing load of the soil. Thrust and safe bearing loads for soils are shown in the following tables:

- A. THRUST TABLE: Shall be used for sizes noted. For larger sizes, the details will be shown on the plans.

| Thrust Main Size | 90° Bend | 45° Bend | 22 ½° Bend | 11 ¼° Bend |
|---------------------|-------------|-------------|---------------|---------------|
| 4" | 4,000 | 2,100 | 1,100 | 600 |
| 6" | 8,200 | 4,300 | 2,300 | 1,100 |
| 8" | 14,000 | 7,400 | 3,900 | 2,000 |
| 10" | 21,000 | 11,000 | 5,800 | 2,900 |
| 12" | 30,000 | 15,500 | 8,200 | 4,100 |
| 14" | 40,000 | 21,000 | 11,000 | 5,500 |
| 16" | 51,000 | 27,000 | 14,200 | 7,100 |
| 18" | 64,000 | 34,000 | 17,800 | 8,900 |
| 20" | 79,000 | 37,500 | 21,000 | 11,000 |

- B. SAFE BEARING LOADS FOR SOILS (HORIZONTAL THRUST)

| Soil | Safe Bearing Load Lbs. Per Sq. Ft. |
|---------------------------------|---------------------------------------|
| Muck, Peat, etc. | 0 |
| Soft Clay | 1,000 |
| Sand | 2,000 |
| Sand and Gravel | 3,000 |
| Sand and Gravel cemented w/clay | 4,000 |
| Hard compacted clay | 5,000 |

- C. THRUST BLOCKS IN PEAT: In muck or peat, all thrust shall be resisted by piling driven to solid foundations or by removal of muck or peat and replacement with ballast of sufficient stability to resist thrusts. In all cases, thrust block size and method of thrusting must be approved by the Engineer before the thrust block is poured.

1. Special Thrust Containment: Using joint ties and containing thrust within the pipe will be considered by the Engineer upon a definite proposal of methods submitted by the Contractor. Only methods restraining the freedom of joints to bend will be considered.

- D. GENERAL: A detail of standard thrust blocks is included at the back of this specification section showing typical blocks for a 2,000 psi safe bearing capacity. If the soil capacity is different than 2,000 psi, the bearing area will be varied accordingly, but the general arrangement shall be as shown.

- 3.05 AIR RELEASE AND CLEANOUT STRUCTURES: The Contractor shall install air release and cleanout structures as indicated on the drawings. Structures shall conform to SECTION 02715 - CONCRETE UTILITY MANHOLES AND CATCH BASINS.
- 3.06 RESTORATION AND CLEAN-UP: Shall conform to SECTION 02901 - RESTORATION AND CLEAN-UP.
- 3.07 PRESSURE AND LEAKAGE TESTING: The Contractor shall furnish all apparatus and water required to perform the pressure and leakage tests, and shall outline this equipment to the Engineer for his approval prior to any testing.

- A. PRE-TEST PROCEDURES: The Contractor shall provide any temporary plugs and blocking as required for the test, and then completely fill the line with water, with a special emphasis on removing all air from the pipe.
- B. PRELIMINARY TEST: Lines shall be given a preliminary pressure test by the Contractor to ascertain if there are any major leaks. After any leaks are corrected, the test shall be rerun until results are satisfactory.

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- C. FINAL PRESSURE AND LEAKAGE TEST: Shall conform to ANSI/AWWA C600 - Hydrostatic Testing in the presence of the Engineer, who shall receive 24 hours notice prior to testing. The test pressure shall be at least 150 psi measured at the highest point in the line. If it is necessary for the Engineer to observe more than one test, the Contractor shall be liable for the additional cost involved for observation of subsequent tests.
- D. GENERAL: The Contractor shall provide all labor and materials, etc. as required to repair any leaks, or otherwise required to meet these tests. All visible leaks shall be repaired, regardless of the amount of leakage. Any excavation or construction required shall be done as previously required herein.
 - 1. Water: For filling and testing will be supplied by the Contractor.

PART 1 GENERAL

- 1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials in connection with installation of STORM SEWERS.
- 1.02 RELATED WORK
- A. REQUIREMENTS: All work shall be carried on in a neat and satisfactory manner and interference with flow of traffic shall be kept to a minimum.
- B. RELATED SECTIONS: Including, but not limited to:
1. SECTION 01410 - SOILS COMPACTION AND TESTING
 2. SECTION 01560 - SPECIAL CONTROLS
 3. SECTION 02100 - STANDARD CASTINGS, VALVES AND HYDRANTS
 4. SECTION 02222 - EXCAVATION FOR UTILITY SYSTEMS
 5. SECTION 02223 - BEDDING AND BACKFILLING FOR UTILITY SYSTEMS
 6. SECTION 02715 - CONCRETE UTILITY MANHOLES AND CATCH BASINS
 7. SECTION 02901 - RESTORATION AND CLEAN-UP
 8. SECTION 03001 - CONCRETE
- 1.03 SUBMITTALS: Detailed material lists and specifications for all materials furnished under this section of the specification shall be submitted to the Engineer for review.
- 1.04 CERTIFICATIONS OF MATERIALS: When requested, the Contractor shall furnish certification that all materials meet the requirements set forth in the plans and specifications. Source of the certification shall be determined by the Engineer.

PART 2 PRODUCTS

- 2.01 SEWER PIPE AND JOINTS: Shall be new unless noted on the plans and shall be stored and handled as recommended by the manufacturer. The size, type, and class shall be as shown on the plans or noted in the specifications. All pipe shall be marked with the class and date of manufacture by the manufacturer.
- A. NON-REINFORCED CONCRETE PIPE (CSP): Shall conform to ASTM C14, Class 3 unless otherwise noted on the plans with acceptance on the basis of plant load bearing tests, material tests, and inspection of manufactured pipe for visual defects and imperfections.
- B. REINFORCED CONCRETE PIPE (RCP): Shall conform to ASTM C76 with acceptance on the basis of plant load bearing tests, material tests, and inspection of manufactured pipe for visual defects and imperfections.
- C. CORRUGATED PIPE: Shall be either corrugated metal or polyethylene as specified herein.
1. Corrugated Metal Pipe (CMP) - Shall be standard 2 2/3" x 1/2" pipe unless otherwise specified on the plans. The pipe shall conform to AASHTO M-36 galvanized CMP. All buried pipe shall have a suitable bituminous coating.
 2. Corrugated Polyethylene Pipe - Shall conform to AASHTO M0294. Corrugated polyethylene pipe shall be ADS N-12 or equal.

- D. END SECTIONS: Shall be suitable design for the pipe and adjoining grades to provide a smooth transition from the pipe to the rectangular stream cross section. The section shall be of material at least as heavy as the pipe, shall be reinforced on all edges, and have a toe plate. End sections shall be manufactured and furnished by the pipe supplier.
- E. JOINTS: Joints shall conform to one of the following specifications:
1. Rubber "O" Ring: Rubber "O" ring joints shall be "Tylox", "Ring-Tite", or equal.
 2. Bituminous Mastic Joints: Shall be made when the joint surfaces are clean and dry, using DeWitt #10, "Sewertite", by Philip Carey Company, or equal. Cold weather joint compound may be used only with approval of the Engineer. All excess material shall be removed from the inside of the pipe.
 3. Butyl Rubber Sealant: May be used in lieu of rubber "O" ring or bituminous mastic joints. Butyl rubber sealant shall be "RUB'R-NEC LTM" by K. T. Snyder Company or equal.
 4. Band Couplings: Bolted corrugated metal couplings shall be used at all connections of corrugated metal pipe.
 5. Polyethylene Pipe Joints: Shall consist of a sleeve and gasket to provide a water tight joint. Components shall be supplied by the same manufacturer and shall be factory installed on one end of the pipe.
- F. LUBRICANTS: For the making of pipe joints shall strictly conform to the recommendations of the pipe manufacturer.
- G. GROUT FOR POINTING PIPE JOINTS: Shall conform to SECTION 03600 - GROUT.
- H. UNDERDRAINS: Shall be perforated high density polyethylene corrugated tubing wrapped in filter conforming to AASHTO M252 requirements. The filter wrap shall conform to MDOT requirements for geotextiles.
- 2.02 MANHOLES AND CATCH BASINS: Shall be precast concrete conforming to SECTION 02715 - CONCRETE UTILITY MANHOLES AND CATCH BASINS.
- 2.03 BEDDING AND BACKFILL MATERIALS: Shall conform to SECTION 02223 - BEDDING AND BACKFILLING FOR UTILITY SYSTEMS.
- A. CONCRETE PIPE BEDDING: Shall be Type 1.
 - B. CORRUGATED PIPE BEDDING: Shall conform to flexible pipe bedding.

PART 3 EXECUTION

- 3.01 GENERAL: Handling, storage, installation and the making of joints shall strictly follow the manufactures' recommendations. Rubber materials affected by ultraviolet rays shall be protected from direct sunlight.
- 3.02 GRADE AND ALIGNMENT: All sewer shall be laid utilizing an "in-line" laser for vertical and horizontal control. Vertical and horizontal alignment of the invert shall, at any point, be within plus or minus 0.04 feet (1/2 inch) of plan of elevation and line.
- 3.03 LAYING OF SEWER: Each pipe shall be inspected for possible defects before being placed in the trench. Joint surfaces shall be free of earth or frozen matter. All pipe shall be laid from the low end of the sewer upgrade with bell ends upgrade to line and grade as called for on the plans and each pipe as laid shall be checked by the Contractor. The use of brick, lumps of clay, wood, etc., to bring the pipe to grade will not be permitted.

- A. JOINTS: Shall be made in strict accordance with the manufacturers' recommendations utilizing the recommended lubricant. Wood blocks or other approved materials shall be used to protect the pipe ends from pry bars, chains, etc. Pipe shall be pushed closed to the "home" position and if joints do not remain tightly closed the pipes shall be replaced.
 - B. FINAL LINE AND GRADE: After the pipe is laid, care in backfilling and other operations shall be taken so as not to disturb its line, grade, or joint. Misalignment shall be cause for rejection of the sewer.
- 3.04 PIPE BEDDING AND BACKFILL: Shall conform to SECTION 02223 - BEDDING AND BACKFILL FOR UTILITY SYSTEMS.
- 3.05 POINTING: Concrete pipe joints on sewers 30 inches in diameter and larger shall be pointed up with grout on the inside after backfilling is complete.
- 3.06 CONNECTIONS TO LIVE SEWERS: When connections are made with sewers carrying storm water, special care must be taken that no part of the work is built underwater; a flume or dam must be installed and pumping maintained if necessary and the new work kept dry until completed and any concrete or grout has set up.
- 3.07 REMOVAL OF UNSUITABLE MATERIAL: Whenever any pipe section, fitting or appurtenance is found to be unsuitable for installation due to specification non-conformance, poor workmanship, damage, or any other reason, it shall be removed from the construction site during the working day by the Contractor. Any material not so removed shall be painted or otherwise marked by the Engineer to prevent its subsequent use.
- 3.08 RESTORATION AND CLEAN-UP: Shall conform to SECTION 02901 - RESTORATION AND CLEAN-UP.
- 3.09 TV INSPECTION: The Owner or his representative shall have the option of performing a TV inspection of any section of sewer for signs of structural damage, misalignment or improper joints. The costs of the inspection shall be paid by the Owner unless the inspection reveals faulty construction or materials wherein the costs shall be paid by the Contractor.
- 3.10 CORRECTION OF DEFECTIVE WORK: Whenever any inspection indicates defective material or installation, the Contractor shall repair the section to the satisfaction of the Engineer. Any pipe or fitting structural damage shall require the removal and replacement of the damaged section.

END OF SECTION

PART 1 GENERAL

- 1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all labor, equipment, and materials in connection with the cleanout of existing and the excavation of new OPEN DRAINS.
- 1.02 RELATED WORK
- A. REQUIREMENTS: All work shall be carried out in a neat and satisfactory manner and shall be under the jurisdiction of the Owner. The Contractor shall comply with all state and local regulations governing soil erosion control, burning, and all other construction operations.
- B. RELATED SECTIONS: Including, but not limited to:
1. SECTION 01410 - SOILS COMPACTION AND TESTING
 2. SECTION 01560 - SPECIAL CONTROLS
 3. SECTION 02722 - STORM SEWERS
 4. SECTION 02901 - RESTORATION AND CLEANUP
 5. SECTION 02936 - TOPSOILING AND SEEDING

PART 2 PRODUCTS

- 2.01 CULVERT PIPE: Shall be of the size, type and class shown on the plans, and/or specified under SECTION 02722 STORM SEWERS.
- 2.02 RIPRAP: Shall be individual stone or broken concrete free from projecting reinforcement, measuring at least 8 inches in one dimension, with a volume not less than 1/3 cubic foot.

PART 3 EXECUTION

- 3.01 CLEARING AND GRUBBING: The Contractor shall remove all trees and brush entirely within the limits of the top of the outside slopes. This removal shall precede the excavation by a minimum of 500 feet. All dead trees within the right-of-way shall be removed.
- 3.02 SPOIL AREAS: For rights-of-way where soil is to be spread, trees and other material shall be cut off not more than 3 inches above the existing ground. Fruit trees shall be removed only with written permission of the land owner and land owner shall have first call for the timber to be removed.
- 3.03 DRAIN EXCAVATION
- A. GRADE AND CROSS SECTION: The Contractor shall excavate the drain to the elevations and cross-sections indicated on the plans. Unless noted otherwise on the plans, side slopes shall be constructed two feet horizontal to one foot vertical. No change in grade or cross section shall be made without prior written authorization from the Engineer.
- B. EXCAVATION IN UNSTABLE SOILS: Where unstable soils are encountered, the Contractor shall notify the Engineer who will specify the changes necessary to provide stability for the slopes and grade. Any additional excavation required as a result of changes will be paid for at a price agreed upon prior to resumption of drain excavation.
- C. INTERSECTING WATERCOURSES: The Contractor shall grade back all intersecting watercourses, roadside ditches, and side ditches as required in the plans and at a non-erosive grade. Protective measures required will be noted on the plans.

- D. EXISTING TILE OUTLETS: Existing lateral tile outlets shall be left open and in good working condition. When called for on the plans, new corrugated pipe outlets shall conform to SECTION 02722 - STORM SEWERS. The connection between existing tiles and new outlets shall be made watertight. Suitable rodent guard shall be placed on the ends of new outlet pipes. When it is apparent that a tile is carrying wastewater, the Contractor shall inform the Engineer, and shall reconnect the drain only as directed by the Engineer.
 - E. DRAIN CONSTRUCTION PARALLEL TO ROADWAYS: Drain excavation parallel and immediately adjacent to roadways shall be made from the field side of the drain.
- 3.04 LEVELING OF SPOIL: Excavated material shall be leveled within the drain right-of-way or easement to a minimum average height of one foot above the surrounding ground, unless otherwise noted on the plans or in the specification. Berm shall be back edge feathered out to field elevations. Leveling shall be done with a bulldozer or other suitable equipment in such a manner that the ground can be worked or tilled by the land owner with normal farm equipment. In heavily wooded areas, spoil banks shall be leveled and left in a condition suitable for use by trucks or farm equipment. Under no circumstances shall brush and/or debris be covered with excavated material. No excavation shall be leveled in any existing tributary watercourses or drains. Special attention shall be given to getting the water through the spoil banks to avoid ponding. Openings shall be installed at such places as the general ground surface indicates that an opening is necessary or as shown on the plans. In no case is spoil to be deposited on landscaped areas. Spoil from landscaped areas shall be deposited and leveled on unlandscaped right of-way, or as directed by the Engineer.
- 3.05 EXCESS SPOIL: Excess spoil material which cannot be placed within the drain right-of-way shall be removed from the work site by the Contractor.
- 3.06 SLOPE PROTECTION RIPRAP: Plain riprap construction shall commence in a trench below the toe of the slope and progress upward, firmly bedding in the slope. The riprap shall be thoroughly compacted and the finished surface shall present an even, tight surface.
- 3.07 DISPOSAL OF MATERIALS OTHER THAN SPOIL
- A. DISPOSAL OF COMBUSTIBLE MATERIALS: Burning shall be in accordance with all applicable regulation regarding open fires. Burning will not be allowed when brush is piled on areas of organic soils. The Contractor shall obtain the required burning permits.
 - B. DISPOSAL OF NON-COMBUSTIBLE MATERIALS: Non-combustible materials shall be either buried with a minimum of 24 inches of cover within the right-of-way or removed from the site. When piling is herein specified or noted on the plans, such debris piles shall be at intervals greater than 100 feet and neatly piled upon the leveled spoil. Brush shall not be piled under power lines or in any other location where burning would be deemed hazardous.
- 3.08 RESTORATION AND CLEANUP
- A. TOPSOILING AND SPEEDING: The drain slopes, spoil leveling areas, and other areas disturbed by construction shall be topsoiled as required and seeded with MDOT Roadside Mixture and seed in conformance with SECTION 02936 TOPSOILING AND SEEDING.
 - B. RESTORATION: Shall conform to SECTION 02901 - RESTORATION AND CLEANUP.
- 3.09 FINAL INSPECTION AND ACCEPTANCE: Final inspection and measurement surveys on open drain projects will be made only after all items of work have been completed by the Contractor. The minimum reach that will be considered for substantial completion at any one time shall be one thousand (1,000) feet. If it is found that sediments have accumulated in the reach being inspected during the period of time from initial excavation to final inspection, the Contractor will be required to reexcavate the drain to the grades shown on the plans. No additional payment will be made for this work. The Contractor shall give the Owner advance notice of the approximate dates he proposes to submit a minimum reach as ready for substantial completion.

END OF SECTION

SANITARY SEWER

PART 1 GENERAL

- 1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials in connection with installation of SANITARY SEWERS.
- 1.02 RELATED WORK
- A. REQUIREMENTS: All work shall be carried on in a neat and satisfactory manner and interference with flow of traffic shall be kept to a minimum.
- B. RELATED SECTION: Including, but not limited to:
1. SECTION 01410 - SOILS COMPACTION AND TESTING
 2. SECTION 01560 - SPECIAL CONTROLS
 3. SECTION 02100 - STANDARD CASTINGS, VALVES AND HYDRANTS
 4. SECTION 02222 - EXCAVATION FOR UTILITY SYSTEMS
 5. SECTION 02223 - BEDDING AND BACKFILLING FOR UTILITY SYSTEMS
 6. SECTION 02715 - CONCRETE UTILITY MANHOLES AND CATCH BASINS
 7. SECTION 02901 - RESTORATION AND CLEAN-UP
- 1.03 SUBMITTALS: Detailed material lists and specifications for all materials furnished under this section of the specification shall be submitted to the Engineer for review.
- 1.04 CERTIFICATION OF MATERIALS: When requested, the Contractor shall furnish certification that all materials meet the requirements set forth in the plans and specifications. Source of the certification shall be determined by the Engineer.

PART 2 PRODUCTS

- 2.01 PIPE AND JOINTS: All materials shall be new. Manufactures' recommendations for storage, handling, and installation shall be strictly adhered to. Materials shall be of the type as listed herein meeting the specifications noted. Unless specifically shown on the plans and/or listed in the form of proposal to be a specific material, the Contractor may elect to utilize any of the following materials subject to specifications and size limitations herein except that sewer pipe materials may be changed only at manholes.
- A. PIPE
1. Ductile Iron (D.I.): Shall conform to ANSI/AWWA C151/A21.51. Pipe wall thickness will vary with depth of cover and shall conform to SECTION 02223 - BEDDING AND BACKFILLING FOR UTILITY SYSTEMS. Pipe shall be standard thickness cement-mortar lined per ANSI/AWWA C104/A21.4. Pipe joints shall be mechanical joints or push-on joints conforming to ANSI/AWWA C111/A21.11. Ductile iron may be used for six inch (6") and larger diameter pipe.
 2. Reinforced Concrete Pipe (RCP): Shall conform to ASTM C76. Pipe class will vary with depth of cover and type of bedding and shall conform to SECTION 02223 - BEDDING AND BACKFILLING FOR UTILITY SYSTEMS. Pipe joints shall conform to ASTM C443 for rubber gasket joints. RCP may be used for eighteen inch (18") and larger diameter pipe.
 3. Polyvinyl Chloride (PVC): Shall conform to ASTM D3033 or ASTM D3034. Minimum pipe wall thickness shall be SDR 35. All pipe shall have a "home" mark. Joints shall be of the elastomeric gasket push-on type conforming to ASTM D3212. PVC may be used for six inch (6") through fifteen inch (15") diameter pipe.

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- B. FITTINGS: All piping connections and pipe size and/or direction changes shall be made with standard manufactured fittings conforming to the following:

1. Ductile Iron Fittings: Shall be standard manufactured fittings of ductile iron or cast iron conforming to ANSI/AWWA C110/A21.10 for mechanical joints and push-on joints. Fittings shall be cement-mortar lined per ANSI/AWWA 104/A21.4 and shall have the standard exterior bituminous coating. Service lateral fittings shall be tees. Plugs shall be iron or plastic suitable for air testing.
 2. Reinforced Concrete Pipe Fittings: Service lateral connections shall be made using standard manufactured components. Holes in the pipe barrel shall be cored. The connection shall be made utilizing a system of 300 series stainless steel bands and an elastomeric molded boot conforming to ASTM C443. Epoxy coated aluminum bands may be used in lieu of stainless steel upon written approval of the Engineer.
 3. Polyvinyl Chloride Fittings: Shall be fittings conforming to ASTM 3034 for pipe wall thickness of SDR 35. Joints shall conform to ASTM D3212. Service lateral connections shall be made with standard wye fittings. Tees, tee-wyes, or saddles shall not be used.
- C. CONNECTIONS OF DISSIMILAR PIPE MATERIALS: Shall not be made using Donuts, oversize gaskets, etc. Connections shall be made utilizing one of the following methods:
1. Standard Adapters: Shall be a manufacturer's standard adapter with joints conforming to the above specifications.
 2. Couplings: Shall be an elastomeric coupling complete with 300 series stainless steel tension bands conforming to ASTM C425. Couplings shall be Clow Band-Seal Couplings, Fernco Flexible Couplings or equal.
- D. CHANGES IN PIPE SIZES: Shall be made using standard smooth flow increasers or reducers.
- E. LUBRICANTS: All lubricants for the making of pipe joints shall strictly conform to the recommendations of the pipe manufacturer.
- F. GROUT FOR POINTING PIPE JOINTS: Shall conform to SECTION 03600 - GROUT.
- G. POLYETHYLENE ENCASEMENT: For ductile iron pipe shall conform to ANSI/AWWA C105/A21.5.
- 2.02 SANITARY SEWER MANHOLES: Sanitary sewer manholes shall be precast concrete conforming to SECTION 02715 CONCRETE UTILITY MANHOLES CATCH BASINS. Joints between the pipe and the manhole shall be specified therein.
- 2.03 CHEMICAL GROUT: For sealing minor joint leaks shall be an EPA approved type.
- 2.04 MARKING: All pipe, fitting and appurtenant items furnished to the job site shall be marked in accordance with the applicable specification. Any unmarked materials are subject to rejection by the Engineer.
- 2.05 BEDDING AND BACKFILL MATERIALS: Shall conform to SECTION 02223 - BEDDING AND BACKFILLING FOR UTILITY SYSTEMS as applicable to sanitary sewers where in pipe class and bedding requirements are given for various depth of cover.

- 3.01 GENERAL: Handling, storage, installation, and the making of joints shall strictly follow the manufacturer's recommendations. Plastic and rubber materials affected by ultraviolet rays including all PVC products shall be

protected from direct sunlight. Material handling during cold weather shall take into account increased brittleness of plastic materials. Pipe which is warped or bowed due to temperature variations such that the deviation from straightness is greater than one inch shall not be installed.

- 3.02 GRADE AND ALIGNMENT: All sewer shall be laid utilizing an “in-line” laser for vertical and horizontal control. Vertical and horizontal alignment of the invert shall, at any point, be within plus or minus 0,04 feet (1/2 inch) of plan elevation and line.
- 3.03 CUTTING OF PIPE: Full lengths of pipe shall be used whenever feasible. Cutting of pipe where required shall be done only using methods as recommended by the manufacturer, utilizing tools and equipment as required to provide a neat, perpendicular cut without damage to the pipe or coatings.
- 3.04 LAYING OF SEWER: Each pipe shall be inspected for possible defects before being placed in the trench. Joint surfaces shall be free of earth or frozen matter. All pipe shall be laid with bell ends upgrade to line and grade as called for on the plans and each pipe as laid shall be checked by the Contractor. Pipe shall be laid from the low end of sewer upgrade. The use of brick, lumps of clay, wood, etc., to bring the pipe to grade will not be permitted.
 - A. JOINTS: Shall be made in strict accordance with the manufacturer’s recommendations utilizing the recommended lubricant. Wood blocks or other approved materials shall be used to protect the pipe and fitting ends from pry bars, chains, etc. with particular care taken with plastic materials. Pipe shall be pushed closed to the “home” position and if joints do not remain tightly closed, the pipes shall be replaced.
 - B. FINAL LINE AND GRADE: After the pipe is laid, care in backfilling and other operations shall be taken so as not to disturb its line, grade, or joint. Misalignment shall be cause for rejection of the sewer.
 - C. POINTING: Pipe joints on RCP sewer 30 inched in diameter and larger shall be pointed with grout on the inside after backfilling is complete.
- 3.05 PIPE BEDDING AND BACKFILL: Shall conform to SECTION 02223 - BEDDING AND BACKFILL FOR UTILITY SYSTEMS.
- 3.06 CONNECTIONS TO LIVE SEWERS: When connections are made with sewers carrying sewage or water, special care must be taken that no part of the work is built underwater; a flume or dam must be installed and pumping maintained if necessary and the new work kept dry until completed and any concrete or grout has set.
- 3.07 SERVICE LATERALS: Shall be installed to the property line or length as shown on the construction drawings. The location of the service lateral shall be as shown, or when serving an existing building, to the location designated by the building owner. Where an existing service lead is to be connected, the Contractor shall locate the lead.
 - A. SERVICE LATERAL END: Shall be capped and blocked sufficiently to withstand all required acceptance test pressures.
 - B. MARKING: The Contractor shall mark the end of each service lateral with a 4 x 4 of sufficient length to extend from the service lateral to 3 inches below grade. The top of each 4 x 4 shall have four 16 penny common nails driven into it for subsequent location with a magnetic locator.

- C. RECORD OF LOCATIONS: The Contractor shall record and submit to the Owner and the Engineer a location sketch of the service lateral fitting measured upstream from the nearest manhole and shall record the location of the terminus of the service lateral with a minimum of two witness measurements to permanent physical features, building corners, etc. Any services not readily located within one year after date of final payment due to inaccurate as-built measurements shall be field located by the Contractor at no expense to the Owner.

- D. RISERS: Where sanitary sewers are constructed deeper than 12 feet, service risers shall be constructed as shown in the standard detail. VCP tees shall be encased in concrete as shown on the plan details. Risers shall be constructed such that the service lateral is 10 feet deep at the property line. When main sanitary sewers are less than 12 feet deep, no riser is required and the lateral shall be constructed at a slope such that the service lead is 10 feet deep at the property line, if feasible. The six inch service laterals shall be constructed at a minimum slope of 0.60%. Lateral fittings shall be installed with the branch connection tilted up 45 degrees. Wyes shall be placed every 50 feet and all risers will be a minimum of 6" in diameter.
 - E. SERVICE LATERAL INSPECTION: All service lateral pipes shall be left with at least the top of the pipe exposed until inspected by the Owner or his representative and authorization for backfill given.
- 3.08 REMOVAL OF UNSUITABLE MATERIAL: Whenever any pipe section, fitting or appurtenance is found to be unsuitable for installation due to specification non-conformance, poor workmanship, damage, or any other reason, it shall be removed from the construction site during that working day by the Contractor. Any material not so removed shall be painted or otherwise marked by the Engineer to prevent its subsequent use.
- 3.09 RESTORATION AND CLEAN-UP: Shall conform to SECTION 02901 - RESTORATION AND CLEAN-UP.
- 3.10 SANITARY SEWER TESTING: In general, the sanitary sewers shall be tested by applying an air pressure test described in the following paragraphs. Methods of testing and measurement other than specified herein shall be approved by the Engineer. The Contractor shall be responsible for furnishing all equipment and labor for the air testing. The Engineer may, as an alternative to or in addition to air testing, require an infiltration test of the sanitary sewers in certain instances. All testing shall be performed in the presence of the Engineer.
- A. AIR TESTING: Is required to be performed on all sanitary sewers. The following described test procedure shall be used.
 - 1. Equipment Required: Portable air compressor, standard air hose and connections, minimum of 50 feet of single and triple air hose, one single and one triple connection pneumatic sewer plug, one hand air pump, stopwatch, and one air gauge, range 0-30 psig graduated in tenths from 0 to 10 psig.
 - 2. Preliminary Requirements: After all sewer, lateral, and manhole construction and backfilling operations have been completed, the sewer shall be cleaned by the Contractor as follows:
 - a. Inflatable Balls: The Contractor shall furnish an inflatable rubber ball of a size that will inflate to fit snugly into the pipe to be tested. The ball may, at the option of the Contractor be used without a tag line or a rope may be fastened to the ball to enable the Contractor to know and control its position at all times. The ball shall pass through the pipe with only the force of the water impelling it. All debris flushed out ahead of the ball shall be removed at the first manhole. In the event cemented or wedged debris, or damaged pipe shall stop the ball, the Contractor shall remove the obstruction.
 - b. Pneumatic Plug Test: The pneumatic plugs shall pass the following qualifying test in the presence of the Engineer and Contractor prior to the line testing. One length of sewer pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked; air shall be introduced into the pipe until the pipe pressure reaches 15 psig. The pneumatic plugs being checked shall hold against this pressure without bracing being needed, and without movement of the plugs out of the pipe. All pneumatic plugs shall pass the aforementioned qualifications before being used to test the actual installation.
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- 3. Test Procedures: Immediately following the pipe cleaning described, low pressure air shall be introduced into the sealed line until the internal air pressure reaches 4.0 psig greater than the average back pressure of any groundwater pressure, as determined by the Engineer, that may be over the pipe. At least two (2) minutes shall be allowed for the air pressure to stabilize.
 - a. Acceptance: The portion of the line being tested shall be accepted if the portion under the test meets or exceeds the requirements of ASTM C 828. These requirements shall be accomplished by performing the test as follows: The time required in minutes for the pressure of any

groundwater that may be over the pipe shall not be less than the time shown for the given diameters in the table following this paragraph. If the system does not meet the foregoing requirements, the Contractor will be required to locate and repair the leaks at no extra cost to the Owner and repeat the tests until the allowable leakage is obtained.

AIR TEST TABLE

NOTE: If the section of line to be tested includes more than one pipe size (i.e. lateral connections), calculate the test time for each size and add the test times to arrive at the total test time for the section.

ASTM C828
MINIMUM TEST TIME FOR VARIOUS PIPE SIZES

| PIPE SIZE (INCHES) | TIME-PER 100' MIN SEC. | | PIPE SIZE (INCHES) | TIME-PER 100' MIN SEC. | |
|-----------------------|------------------------------|-----|-----------------------|------------------------------|-----|
| 4 | 0.3 | 18 | 21 | 3.0 | 180 |
| 6 | 0.7 | 42 | 24 | 3.6 | 216 |
| 8 | 1.2 | 72 | 27 | 4.2 | 252 |
| 10 | 1.5 | 90 | 30 | 4.8 | 288 |
| 12 | 1.8 | 108 | 33 | 5.4 | 324 |
| 15 | 2.1 | 126 | 36 | 6.0 | 396 |
| 18 | 2.14 | 144 | 39 | 6.6 | 396 |
| | | | 42 | 7.3 | 438 |

- B. INFILTRATION TEST: An infiltration test may be conducted on a sanitary sewer only where the groundwater table is at least two feet above the invert of the sewer. The Engineer will measure the amount of infiltration at the sanitary manholes utilizing V-notch weirs or other measurement apparatus. The maximum allowable infiltration shall be 200 gallons per mile per inch of diameter of sewer per 24 hour day at any time for any individual run between manholes.

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- C. MANHOLE EXFILTRATION TEST: An exfiltration test shall be performed by the Contractor of each manhole. All pipes shall be plugged and the manhole filled with water to the bottom of the casting. After a stabilization period, the fall of water will be measured to determine the exfiltration rate. The maximum allowable exfiltration shall not exceed 0.5 gallons per foot of depth per foot of diameter per 24 hour day. All materials, labor, and water shall be furnished by the Contractor and the cost thereof shall be incidental to the cost of construction.
- D. PVC DEFLECTION TESTS: The completed installation of PVC sewers shall at no point have out-of-round pipe deflections greater than 5.0%. Deflectometer or go no-go gauging tests shall be performed prior to acceptance of sewers. The test shall be conducted after the final backfill has been in place at least 30 days.

- E. POST CONSTRUCTION INFILTRATION: Following complete construction and prior to connection of services to the sewer, the Engineer shall have the option of requiring retesting of any section of sewer where excessive infiltration is observed or suspected. Any of the above tests may be utilized per the Engineer's requirements. The costs of the tests shall be paid for by the Owner unless the test fails wherein the costs shall be paid by the Contractor.
- F. TV INSPECTION: The Owner or his representative shall have the option of performing a TV inspection of any section of sewer for signs of structural damage, joint leaks or infiltration. The costs of the inspection shall be paid by the Owner unless the inspection reveals faulty construction or materials wherein the costs shall be paid by the Contractor.
- G. CORRECTION OF DEFECTIVE WORK: Whenever any of the above tests or inspections indicate defective material or installation, the Contractor shall repair and retest the section to the satisfaction of the Engineer. The use of chemical grouts shall be limited to the repair of minor joint leaks and shall not be used without the specific written approval of the Engineer. Any pipe or fitting having structural damage shall be removed and replaced. Any PVC sewer with deflection in excess of the 5.0% limitation shall be re-excavated, inspected for structural damage, repaired as required, and retested to the satisfaction of the Engineer.

END OF SECTION

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SECTION 02901
RESTORATION AND CLEAN-UP

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PART 1 GENERAL

- 1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials in connection with RESTORATION AND CLEAN-UP.
- 1.02 RELATED WORK

- A. REQUIREMENTS: The Contractor shall restore all areas disturbed by his construction operations to a condition equal to or better than that existing prior to construction and shall clean up and haul away all construction debris and litter caused by his operation.
 - B. RELATED SECTIONS: Including, but not limited to:
 - 1. SECTION 01560 - SPECIAL CONTROLS
 - 2. SECTION 02231 - AGGREGATE BASE COURSE
 - 3. SECTION 02513 - BITUMINOUS LEVELING/SURFACE COURSES
 - 4. SECTION 02525 - CONCRETE CURB AND GUTTER
 - 5. SECTION 02528 - CONCRETE SIDEWALKS
 - 6. SECTION 02936 - TOPSOILING AND SEEDING
 - 7. SECTION 02938 - SODDING
 - 8. SECTION 03001 - CONCRETE
- 1.03 CLEANUP: General rough grading and cleanup shall follow immediately after installation of utilities so that no more than 1,000 lineal feet of cleanup shall remain to be completed at any time during construction. The Contractor shall remove all equipment, debris, and waste material from the construction site and material and equipment storage areas prior to final inspection and after restoration.

PART 2 PRODUCTS - This section not used.

PART 3 EXECUTION

- 3.01 PERMANENT PAVEMENT: All street surfaces, driveways, curb and gutter and sidewalks removed or disturbed by construction operations shall be restored to their original condition, or better unless otherwise shown on the plans and/or details. Street base course and surfacing shall conform with SECTION 02231 - AGGREGATE BASE COURSE and SECTION 02512 - BITUMINOUS LEVELING/SURFACE COURSE. All concrete for restoration shall be air entrained Class A concrete conforming to SECTION 03001 - CONCRETE. All street, driveway, and sidewalk crossings shall be restored immediately after completion of the crossing to accommodate vehicular and pedestrian traffic. Temporary patching of pavements of bituminous base will be required in the event the final restoration is not anticipated within 5 days of the crossing construction,
- 3.02 MISCELLANEOUS STRUCTURES: Mail boxes, culverts, ditches and other existing structures shall be restored or replaced, as required, to original or better condition in a manner acceptable to the Engineer.

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- 3.03 BOUNDARY MARKER REPLACEMENT: The Contractor shall have replaced by a Registered Land Surveyor, at his own expense, all section corners, property corners or boundary markers of any type or material that may be damaged or destroyed by his construction operation.
- 3.04 SEEDING: Lawn areas disturbed by the Contractor's construction operations shall be topsoiled and seeded in conformance with SECTION 02936 - TOPSOILING AND SEEDING. Prior to topsoil or seeding, rocks, sticks, roots (larger than 2" in diameter), and other debris shall be removed from areas to be seeded. In general, lawn areas shall be all areas back of the curb unless otherwise designated on the plans or noted in the specifications.
- 3.05 SODDING: Areas designated on the drawings to be sodded shall be sodded in conformance with SECTION 02938 SODDING. The Contractor at his option may sod areas required or designated to be seeded.

- 3.06 PLANTINGS: Shrubs, other plantings, and trees removed during construction, other than those specifically designated to be removed, shall be replaced with new material equal to that removed. Replacement shall be with approved stock from a State-inspected nursery and shall carry a one year replacement guarantee.

END OF SECTION

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SECTION 02936
TOPSOILING AND SEEDING

5-29-98

PART 1 GENERAL

- 1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials in connection with TOPSOILING AND SEEDING.
- 1.02 RELATED WORK
- A. REQUIREMENTS: The Contractor shall topsoil, grade, fertilize, seed and mulch lawn and other designated areas disturbed by construction operations. Attention is directed to SECTION 01560 - SPECIAL CONTROLS.

PART 2 PRODUCTS

- 2.01 TOPSOIL: Any topsoil necessary to complete the work over and above the topsoil stockpiled during construction operations shall be furnished by the Contractor. Topsoil shall be free from brush, objectionable weeds or other litter, and approved by the Engineer prior to spreading.
- 2.03 FERTILIZERS: Chemical fertilizer shall be standard commercial grade with packaging clearly marked in accordance with applicable Federal laws. Bulk fertilizer may be used when certified delivery slips are furnished by the Contractor.
- 2.04 MULCH: Straw, hay, and marsh hay used for mulching of grass seeded areas shall meet the approval of the Engineer.
- 2.05 MULCH ADHESIVE: Mulch adhesive shall be a latex-base adhesive conforming to MDOT Specification 8.21.11.

PART 3 EXECUTION

3.01 PREPARATION OF SEED BED

- A. GRADING: Grades on areas to be seeded shall be maintained in a true and even condition. Where the grades are not defined, they shall be established by the Contractor to blend with existing adjacent grades without irregularities and shall provide for proper drainage.
- B. PLACING TOPSOIL: The topsoil shall be evenly spread over the areas by bade graders, or other approved methods, to a depth of at least 3 inches. Any irregularities in the surface resulting from topsoiling or other operations shall be corrected in order to prevent the formation of low places and pockets where water will stand. Topsoil shall not be placed when the subgrade is in a condition detrimental to seeding or proper grading.
- C. APPLICATION OF FERTILIZER: Fertilizer shall be disturbed uniformly over the areas to be seeded at a rate which will provide 240 pounds per acre of chemical fertilizer nutrients, in equal proportions of nitrogen, phosphoric acid and potash and shall be incorporated into the soil to a depth of at least 3 inches by disking, harrowing or other acceptable methods.

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3.02 SEEDING

- A. SEEDING REQUIREMENTS: MDOT Class A seed mixture shall be used on all lawn areas. MDOT Roadside seed mixture shall be used for areas disturbed by construction and not defined as lawn area. No seeding shall be done until the Engineer has inspected the seed containers.
- B. SEEDING: Seed shall be sown by mechanical means, except that areas inaccessible to spreading equipment may be seeded by the broadcast method. Seeding shall be accomplished between the period of April 15 into the fall as long as weather conditions permit seed bed preparation. Seeding rate shall be Class A: 110#/A, Roadside: 100#/A.
- C. COMPACTING: Immediately after seeding, the entire area shall be compacted by means of a cultipacker, roller or approved equipment weighing 60 to 90 pounds per linear foot of roller. The final rolling shall be at right angles to slopes to prevent water erosion.

3.03 MULCHING

- A. STRAW AND HAY MULCH: After seeding and fertilizing operations have been completed, straw, hay, or marsh hay shall be spread over the surface to a uniform thickness at the rate of two tons per acre. The mulch shall be loose enough to allow sunlight to penetrate and air to slowly circulate, but thick enough to shade the ground, reduce rate of water evaporation and prevent or reduce water or wind erosion. Mulch which has become displaced shall be replaced at the Contractor's expense. Cellulose fiber mulch shall be applied at the rate of 200#/Acre with 55 gal Tackifyer/Acre. Cellulose fiber mulch shall not be used in lawn areas.
- B. MULCH ADHESIVE: The mulch shall be held in place by a spray coating of mulch adhesive. The Contractor shall protect all traffic, signs, structures, and other objects from being marked or disfigured by the adhesive material. Adhesive material shall be applied uniformly at a rate of 400 gallons per acre and shall be by spraying simultaneously with the mulch, or by spraying a surface application of adhesive immediately following mulching.

3.04 ESTABLISHMENT OF SEEDED AREAS: The Contractor shall be responsible for the proper care of the seeded area during the period when the grass is becoming established, and shall be responsible for a total grass cover. The acceptance must be demonstrated by the results.

- A. WATERING: The seed bed for lawn areas shall be given one watering immediately after placement sufficient to wet at least two (2) inches of seed bed. Additional watering at the same rate shall be accomplished at five (5) day intervals for a period of five (5) weeks, or a total of eight applications of water. In case of rain, the Contractor shall obtain approval of the Engineer to omit an application of water or re-schedule the watering interval. After the five week period, maintenance of the seeded areas will be assumed by the respective property owners. The Contractor will not be held responsible for any mowing of seeded areas.
- B. REPAIR: If at any time prior to the end of the five (5) week period during which the Contractor is responsible for watering of the seeded areas, the ground is displaced due to subsidence, or sliding or gulying on sloped areas, the Contractor shall repair and re-seed the damaged areas at his expense.
- C. WEEDS: After the grass has become established and it appears to have more than 10% weeds, the Contractor shall spray with an approved herbicide.

END OF SECTION

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SECTION 02938
SODDING

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PART 1 GENERAL

- 1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials in connection with SODDING.
- 1.02 RELATED WORK
 - A. REQUIREMENTS: The Contractor shall grade, topsoil, fertilize and sod areas designated on the plans or in the specifications. Attention is directed to SECTION 01560 - SPECIAL CONTROLS.

PART 2 PRODUCTS

- 2.01 TOPSOIL: Any topsoil necessary to complete the work over and above the topsoil stockpiled during construction operations shall be furnished by the Contractor. Topsoil material shall be free from brush, objectionable weeds, or other litter and approved by the Engineer prior to spreading. Any additional topsoils required shall be fertile, friable, humus soil of mineral origin consisting of black loam, clay loam, or sandy loam.
- 2.02 SOD: The class and blend of sod to be furnished under this specification shall be shown on the plans or noted in the specifications. In general, sod shall be mineral or muck type and shall contain a well developed cover of growing grass. The sod shall be free of undesirable plants, stone, roots, or other material detrimental to the establishment of the sod. The minimum sod mat thickness shall be $\frac{3}{4}$ inch and sod shall be cut to provide an average thickness after laying of not less than 1 $\frac{1}{2}$ ". The Contractor shall provide certificates of sod blends from approved suppliers prior to placement of the sod. Sod containing Merion Bluegrass will not be accepted. Sod shall not be frozen.
- 2.03 FERTILIZERS: Chemical fertilizer shall be standard commercial grade with packaging clearly marked in accordance with applicable Federal laws. Bulk fertilizer may be used when certified delivery slips are furnished by the Contractor. The mix shall be 12-12-12.
- 2.04 PEGS FOR SODDING: Pegs shall be at least 10 inches long of a size sufficient to hold the sod.

PART 3 EXECUTION

3.01 PREPARATION OF SOD BED

- A. GRADING: Grades on areas to be sodded shall be maintained in a true and even condition. Where the grades are not defined, they shall be established by the Contractor to blend with existing adjacent grades without irregularities and shall provide for proper drainage.
- B. PLACING TOPSOIL: The topsoil shall be evenly spread over the areas by blade graders, or other approved methods, to a depth of at least 3 inches. Any irregularities in the surface, resulting from topsoiling or other operations, shall be corrected in order to prevent the formation of low places and pockets where water will stand. Topsoil shall not be placed when the subgrade is in a condition detrimental to sodding or proper grading.
- C. APPLICATION OF FERTILIZER: Fertilizer shall be distributed uniformly over the areas to be sodded at a rate which will provide 240 pounds per acre of chemical fertilizer nutrients in equal proportions of nitrogen, phosphoric acid and potash and shall be incorporated into the soil to a depth of at least 3 inches by disking, harrowing, or other acceptable method. An additional 100 pounds per acre of chemical fertilizer nutrients shall be applied over the completed sod immediately prior to the first watering.

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- D. CLEAN-UP: After completion of the above operations, the surface shall be cleared of stones, roots, brush, wire, grade stakes, and other objects that might be a hindrance to maintenance operations.
- 3.02 PLACEMENT OF SOD: The sod within 24 hours of cutting shall be laid smoothly, edge to edge with staggered joints. The sod shall immediately be pressed firmly into contact with the sod bed by tamping or rolling with approved equipment to provide a true and even surface. Following compaction, screened loam or topsoil shall be used to fill any cracks between sod pieces in a manner which will prevent smothering of the grass.
- A. FINISHING: After sodding operations have been completed, the edges of the area shall be smooth. On slopes steeper than, or equal to, 3 and 1, the sod shall be fastened in place with suitable wooden stakes placed 2' on center or by other approved methods.
- B. WATERING: The sod shall be given one watering immediately after placement sufficient to wet the sod through completely and to wet at least two (2) inches of the sod bed. Additional watering at the same rate shall be accomplished at three (3) day intervals for a period of three (3) weeks, or a total of eight applications of water. In case of rain, the Contractor shall obtain approval of the Engineer to omit an application of water or re-schedule

the watering interval. After the three week period, maintenance of the sod will be assumed by the respective property owners. The Contractor will not be held responsible for nay mowing of sodded areas.

- C. REPAIR: If at any time prior to the end of the three (3) week period during which the Contractor is responsible for watering of the sodded areas, the sod is displaced due to subsidence, or sliding or gullyng on sloped areas, the Contractor shall repair and re-sod the damaged areas at his expense.

END OF SECTION

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SECTION 03001
CONCRETE

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PART 1 GENERAL

- 1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials in connection with furnishing CONCRETE.
- 1.02 RELATED WORK: The Contractor shall notify the Engineer in writing of the name and address of the ready mix concrete supplier to be used one week prior to placement of any concrete. The Engineer will then determine the competency of the supplier and notify the Contractor if the concrete supplier is approved or rejected. Attention is directed to SECTION 01560 - SPECIAL CONTROLS.

PART 2 PRODUCTS

- 2.01 CEMENT: Shall be ASTM C150, Type IA or I. Air content shall be 5.5 percent, with a tolerance of +1.5, -0.5, when required.

2.02 AGGREGATE

- A. FINE AGGREGATE: Shall conform to MDOT Specification 2NS fine aggregate.
- B. COURSE AGGREGATE: Shall be gravel and stone conforming to MDOT Specification 6A coarse aggregate.

2.03 WATER: Shall be clean and free from injurious deleterious substances such as oil, alkali and organic matter. If drinking water quality is not used, the Engineer shall approve the water source before use.

2.04 ADMIXTURES

- A. AIR-ENTRAINING AGENT: Shall conform to ASTM C260.
- B. ACCELERATING ADMIXTURES: Shall conform to ASTM C494, Type C, non-chloride and non-corrosive type.
- C. GENERAL-ADMIXTURES: Shall be used only as herein specified. Written approval of the Engineer shall be required to use any other admixtures.

2.05 REINFORCING STEEL BARS: Shall conform to ASTM A615-Grade 60 unless otherwise noted on the plans.

2.06 CURING COMPOUND: For exposed concrete surfaces shall be equal to MDOT Specification 8.24.06 a., "White Membrane Curing Compound". (ASTM C309, Type 2).

2.07 PROPORTIONS

- A. MIXTURE DESIGN: Cement, fine and coarse aggregates shall be mixed in approximately 1:2:3 parts (dry and loose) by volume to achieve the following minimum strengths and cement content.

| Class | Cement Content Sacks Per C.Y. | Min. 28 Day Compressive Strength psi |
|-------|----------------------------------|---|
| AA | 6.5 | 4,000 |
| A | 6.0 | 3,500 |
| B | 5.5 | 3,000 |

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- B. WATER CONTENT: Shall be the minimum amount necessary to provide workability. Slump as measured by ASTM C143 shall be from 2 to 4 inches.
- C. MIXING: Transit mixed concrete conforming to ASTM C94 shall be used unless otherwise approved by the Engineer.
- D. ADMIXTURES
 - 1. Air-Entraining Cement or Admixture: Shall be used for all exposed concrete, but shall not be required for buried concrete.
 - 2. Accelerating Admixtures: Shall be used only for buried concrete to allow the Contractor to proceed sooner with the backfill operations. Use of calcium chloride will not be allowed.

PART 3 EXECUTION

3.01 CONCRETE PLACEMENT: Prior to placement of concrete, all forms and placement of reinforcing steel and embedded items shall be approved by the Engineer. Forms shall be cleaned of all debris and reinforcement secured

in position. Concrete shall be placed as rapidly and continuously as possible without segregation. Concrete shall not be allowed to free fall more than six (6) feet.

- A. TEMPERATURE: No concrete shall be placed in temperature lower than 40° F unless special provisions are made and approved by the Engineer. Admixtures shall not be used to prevent freezing.
- B. BASE: Concrete shall be placed on undisturbed soil, free from water, mud, frost, and ice.
- C. COMPACTION: Each layer of concrete shall be compacted with a mechanical vibrator which shall be supplemented by hand spading, rodding and tamping, as required to consolidate the fresh concrete. Vibrators shall be applied at uniformly spaced points no further apart than 18 inches or the visible effectiveness of the machine. Vibrators shall not be inserted into layers which have begun to set nor shall vibration be continued to a point where objectionable segregation occurs. Form vibrators will not be permitted.
- D. REINFORCING STEEL: Shall be accurately placed and firmly held in place as indicated on the plans. All splices shall have a minimum lap of 36 bar diameters. The minimum cover for concrete placed against earth shall be 3 inches and for surfaces exposed to the weather, shall be 2 inches.
- E. CURING OF CONCRETE: All concrete shall be maintained in a thoroughly wet condition for not less than seven (7) days after placement by adding moisture, or by prevent loss of original moisture, by one of the following methods:
 - 1. Moist Curing: Unformed surfaces shall be covered with burlap, and shall be kept moist. Forms shall be kept wet at all times and when removed, curing shall be continued by wetting concrete with a fine spray from a hose until curing period is completed. Burlap shall not be used for curing exposed surfaces in the finished work. Ponding on slabs on earth may be used.
 - 2. Moisture Barrier Curing: Surfaces shall be covered with a moisture barrier lapped six (6) inches at the edges and ends. Moisture barrier covering shall be weighted to prevent displacement and all holes and tears shall be repaired and moisture added as required to maintain an adequate curing environment.
 - 3. Membrane Curing: Shall be utilized on all exterior slabs, pavements, sidewalks, curbs and gutters.

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3.02 FIELD AND LABORATORY CONTROL TESTS

- A. FIELD TESTING: The Engineer will perform slump tests (ASTM C-143) for each truck load of concrete placed, and air content tests (ASTM C138) when applicable and as required to maintain the air content within the tolerance specified.
- B. LABORATORY TESTING: Compressive strength tests shall be made for each 50 cubic yards of concrete placed. Three molded concrete cylinders will be made (ASTM C31) and delivered to the designated testing laboratory. The testing laboratory shall perform the compressive strength tests in conformance with ASTM C39. The cost of testing will be paid by the Owner.

END OF SECTION

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SECTION 03600
GROUT

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PART 1 GENERAL

- 1.01 WORK INCLUDED: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials in connection with the use of GROUT.
- 1.02 RELATED WORK: Grout used in related work specified elsewhere shall conform with the requirements of this specification.

PART 2 PRODUCTS

2.01 GROUT

- A. PORTLAND CEMENT: Shall be ASTM C150, Type 1 or 1A.
- B. NON-SHRINK GROUT: Shall conform to Corps of Engineers specification CRD C588. Material shall be as manufactured by W.R. Meadows, Five Star, Embeco, or equal. Non-staining material shall be used for all exposed work.

- C. MORTAR: Shall be ASTM C270, Type M.
- 2.02 FINE AGGREGATE: Shall conform to MDOT Specification 2MS for masonry sand.
- 2.03 WATER: Shall be clean and free from injurious deleterious substances such as oil, alkali, and organic matter. If drinking water quality is not used, the Engineer shall approve the water source before use.
- 2.04 ADMIXTURES: Shall not be used without written permission of the Engineer.
- 2.05 PROPORTIONS: Grout shall be mixed in the following proportions:
 - A. GROUT: Shall consist of proportions of Portland Cement or mortar and sand with sufficient water to form a workable mix in accordance with the following requirements:

| Use | Parts Cement | Parts Sand |
|--------------------------------------|--------------|------------|
| Utility Structures - Precast Section | 1 | 2 |
| Sewer Joints - When Specified | 1 | 2 |

- B. NON-SHRINK GROUT: Shall be mixed in accordance with the manufacturer's recommendations.

PART 3 EXECUTION

- 3.01 GROUT: Shall be placed within 1 ½ hours of the time the mix is completed.
- 3.02 NON-SHRINK GROUT FOR HYDRAULIC STRUCTURES: Used for caulking around pipes through concrete walls, repair of joints in concrete pipe and other circumstances where the effectiveness and durability of the grout depends upon the reduction or elimination of drying shrinkage shall be placed in accordance with manufacturer's recommendations.
- 3.03 NON-SHRINK GROUT FOR EQUIPMENT OR STRUCTURAL BASES: Shall be used to completely fill the voids between bearing plates and the structural foundations to provide full bearing for the base. All grout shall be placed in accordance with the manufacturer's recommendations.

END OF SECTION