

Part Two

# General Specifications

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SPECIFICATIONS

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**101.1a**

**DEFINITIONS \***

AASHTO = American Association of State Highway and Transportation Officials

CITY = City of Portage, MI

GLUMRB = Great Lakes Upper Mississippi River Board of State Public Health and Environmental Managers (Ten State Standards)

HMA = Hot Mix Asphalt

MDD = Maximum Dry Density as determined by the Modified Proctor Method

MDEQ = Michigan Department of Environmental Quality

MDOT = Michigan Department of Transportation

MMUTCD = Michigan Manual of Uniform Traffic Control Devices

RPR = Resident Project Representative

SD = Standard Detail

\* See City General Conditions for additional Definitions.

## **101.0 SUMMARY**

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**101.1 Summary** These General Specifications are intended to cover those items of work which are general and can be used to complete typical types of construction.

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## **102.0 SPECIFICATIONS BY REFERENCE**

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**102.1 Specifications by Reference** Whenever reference is made to specifications other than those contained herein, said specifications shall apply and be binding as if fully repeated herein; e.g., Sewer Pipe, M.D.O.T. Specifications 8.08. References to MDOT Specifications are to the MDOT's 2003 Standard Specifications for Construction.

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## **103.0 FUNDAMENTAL REQUIREMENTS**

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**103.1 As-Built Drawings** During construction, the CONTRACTOR, with assistance from the RPR shall make all measurements necessary for the preparations of a complete set of "As Built" drawings showing the exact location and elevation of all sewers, house leads or Y's, valves locations, fitting locations, leaching basins, and other appurtenances in a manner acceptable to the ENGINEER. It shall be the ENGINEER's responsibility to prepare final record "as built" drawings.

**103.2 Traffic Flow** All work shall be carried on in an orderly and satisfactory manner and interference with normal flow of traffic shall be kept to a minimum. Driveways and streets disturbed by construction shall be replaced as soon as possible and no street may be closed without permission of the ENGINEER.

**103.3 Line and Grade** Line and grade shall be established by the ENGINEER as specified in the General Conditions Article 4.4.

**103.4 Testing** All testing shall be witnessed by the RPR or ENGINEER. Any unwitnessed testing shall be re-tested in the presence of the RPR or ENGINEER.

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## **104.0 ROAD, RAILROAD, AND UTILITY CROSSINGS**

**104.1 Road Crossings** Road crossings shall be in accordance with the requirements of the governmental body having jurisdiction over the road to be crossed. Notice as required shall be given to said governmental body before work starts. In the case of the City of Portage the notice shall be in writing received a minimum of 72 hours prior to commencing the crossing. If the contract contains a separate item for "Road Crossing" the unit price will be payment in full for removing the existing surfacing, backfilling in a manner approved by the ENGINEER and replacing surfacing as shown on the Drawings. Otherwise the road crossings will be incidental to the installation of the utility.

### **104.2 Railroad Crossings**

**104.2.1** Where a facility crosses a railroad, the construction shall be in strict accordance with current railroad specifications and supplementary conditions as specified in the permit.

**104.2.2** The CONTRACTOR shall be responsible for the installation of the casement (if required) and the facility, across/under railroads as bid. The CITY shall bear the cost of railroad inspector, flagmen, underground markers, permits, etc., required by the Railroad Company.

**104.2.3** Such notice as required by the Railroad Permit shall be given to the railroad superintendent before any work is performed within railroad right-of-way.

**104.3 Utility Crossings** Where the sanitary sewer crosses under or over a utility, that utility shall be protected from damage. Back filling and restoration shall be in accordance with these specifications or as directed by the ENGINEER.

**104.3.1** Whenever the clearance between the crossed utility and the new facility is one foot (1' or less) both utilities shall be backfilled to twelve inches (12") above the higher utility as per specification 205.4.

**104.4 Water Crossings** Water crossing shall be constructed in accordance with the requirements of the governmental body having jurisdiction over the water way to be crossed. If the Contract contains a separate item for "Water Crossing" the price per linear foot shall be payment in full for furnishing materials, laying and properly anchoring the pipe. Otherwise, the cost of the water crossing will be incidental to the Contract Price for laying the facility.

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## 105 SIGN REMOVAL AND REPLACEMENT

**105.1 Sign Removal and Replacement** Street signs, mail boxes, private drives, culverts and other improvements shall be restored in a manner acceptable to the ENGINEER. Any street sign proposed to be removed during construction shall be removed from the project site and delivered to the Department of Public Services garage located at 7719 South Westnedge Avenue. Any street signs, mailboxes etc. not scheduled to be removed shall be temporarily supported during construction and properly replaced as soon as practical. In no case shall mailboxes be inaccessible for a period of more than 24 hours.

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## **106.0 MAINTENANCE OF TRAFFIC AND DRAINAGE**

**106.1 Vehicular and Foot Traffic** During the progress of the work, the CONTRACTOR shall accommodate vehicular and foot traffic except as otherwise specified herein and shall provide access to fire hydrants, water, gas valves, and driveways and walkways as directed by the CONTRACTOR'S Safety Representative.

**106.2 Street Closing** Streets or roads shall not be closed or partially barricaded without prior approval from the City Engineer.

**106.3 Cost of Detours, Barricades, Signs** Unless otherwise specified, the cost of detours, barricades, signs, etc., shall be incidental to the work being performed. All signage and barricading shall conform to the current issue of the MMUTCD, MDOT standards, and these specifications.

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## 107.0 PUBLIC AND PRIVATE UTILITY LOCATIONS

**107.1 Public Utility Locations** Public utilities of all types, insofar as possible, have been shown on the drawings. The location of these utilities are shown using the best information available, but no guarantee is given that the locations are accurate or that utilities other than those shown are not present. The CONTRACTOR prior to construction shall notify MISS DIG (Phone: 1-800-842-7171) for proper notification and staking of utilities.

If the CONTRACTOR neglects to restore or make good damage or injuries to utilities or structures, the CITY or its contract operator may, upon forty-eight (48) hours notice, proceed to restore or make good such damage or injury and to order the cost thereof deducted from any monies that are or may become due the CONTRACTOR for the work under this Contract.

**107.2 Public Utility Work** Public utility work, such as the maintenance, removal, relocation, replacement, chlorination, opening and closing valves, etc., of water and/or sewer lines necessary to complete the contractual work shall be the responsibility of the CONTRACTOR and cost thereof shall be included in his bid price for related items. Such work on water and sewer lines shall be done only with the proper CITY department or its contract operator in charge of the utility being fully informed of the work and having a representative on the site during the work period.

**107.3 Maintenance of Public Utility** Whenever, in the opinion of the ENGINEER, such utilities need not be removed or relocated, but can be maintained or secured without interfering with the proper execution of the work, such maintenance shall be performed or paid for by the CONTRACTOR. All work shall be carried out so as to secure the safety of the utility involved and the work under construction.

**107.4 Time Extension - Public Utility Work** The CONTRACTOR will not be entitled to an extension of time on account of delay in the movement of utilities, unless in the opinion of the ENGINEER and CITY, the CONTRACTOR is unreasonably delayed through the fault of others. Any change of Contract Times shall be addressed as per Article 12 of the City's General Conditions.

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## 108.0 SIGNS

### 108.1 Project Signs

**108.1.1** The CONTRACTOR, at the beginning of work on the site, shall furnish, erect and maintain on the site where directed by the ENGINEER, a minimum of one sign for each project site as detailed in SD-127.

**108.1.3** The lettering shall be done by a skilled sign painter and shall be properly proportioned, spaced and centered, and shall be of contrasting colors as indicated on Standard Detail #127 or approved by the ENGINEER.

**108.1.4** The sign(s) shall be removed at the completion of the work as directed by the ENGINEER.

**108.2 Advertising** No advertising signs of any kind shall be erected or displayed on the site without the authorization of the City Engineer.

**108.3 Job Instruction** Job instruction signs such as "Danger," "Keep Off," etc., shall be furnished, erected and maintained by the CONTRACTOR as may be required to safely conduct the work. Such signs shall be maintained in accordance with the MMUTCD and shall be neat in appearance, kept in good condition and promptly removed when their usefulness has expired.

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## 109.0 OTHER JURISDICTIONAL REQUIREMENTS

**109.1 Other Jurisdictional Requirements** If any of the municipal requirements identified herein should conflict with any other governmental, professional or manufacturing specifications or codes, the conflict shall be immediately brought, in writing, to the attention of the ENGINEER. The ENGINEER and CITY shall at that time determine which specification shall govern.

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## 110.0 REJECTED MATERIALS

**110.1 Rejected Materials** All materials rejected by the CITY or its representative shall be removed from the site of the work immediately.

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## 111 SAMPLES FOR TESTING

**111.1 Samples For Testing** The CONTRACTOR shall furnish without cost to the CITY certification from a reputable testing agency that all materials meet the requirements set forth in the Contract Documents. Samples shall be of the precise material proposed to be furnished as per General Condition 6.24.2. The number of samples and sample size shall be as directed by the Independent Testing Laboratory unless otherwise directed by the ENGINEER.

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## **112.0 MEASUREMENT AND PAYMENT**

**112.1 Method of Measurement** All facilities specified will be measured in place, in accordance with the appropriate units identified in the Bid Proposal.

**112.2 Basis of Payment** Facilities of the type specified will be paid for at the contract unit price, which shall constitute payment in full for excavation, backfilling, removal of excess excavation, furnishing all materials, labor, and equipment necessary to install the facility and appurtenances completely. All work necessary for a complete project shall be incorporated into the Unit Prices given for Bid Items in the Bid Proposal.

### **112.3 Materials Testing and Inspection**

**112.3.1** When a pay item is shown in the Bid Proposal for material testing and inspection costs, an independent testing laboratory will be selected and directed by the ENGINEER. The CONTRACTOR shall pay the laboratory upon the receipt of invoices, certified as correct by the ENGINEER.

**112.3.2** The CONTRACTOR will be reimbursed for actual inspection and testing costs as approved by the ENGINEER and set forth in General Conditions Article 13, and the Contract Documents. If the actual cost of laboratory services amounts to more or less than the sum set up in the Bid Proposal, the difference between actual amount paid and the amount bid will be added or deducted from the contract price.

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## 113.0 STATE OF MICHIGAN APPROVAL

**113.1 State Of Michigan Approval** The ENGINEER will submit plans and specifications to the appropriate agency of the State of Michigan for approval.

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## 114.0 SITE TV SURVEY

**114.1 Scope of Work** Prior to placement of materials or construction equipment in the construction area, the CONTRACTOR shall make a digital record and backup analog copy (VHS recording) of the construction area.

**114.2 Materials** The type of digital record required shall be digital video disc (DVD) capable of playback on any brand of DVD player.

**114.3 Resolution** The disc shall be of high grade quality. The disc must be of a type approved by the City.

### **114.4 Information Recorded**

**114.4.1 General** All video recording shall be by electronic means and shall display continuously and simultaneously by generated transparent digital information as shown below:

**114.4.2** Time information: Hours, minutes and seconds (e.g. 11:22:39 AM) appearing in upper left hand corner of screen.

**114.4.3** Date information: Month, Day and Year (e.g. 10/12/05) appearing immediately below the time information.

**114.4.4** Engineering stationing: Continuous, accurate, and corresponding to the project stationing, in standard engineering symbols (e.g. 108+32) appearing in the lower left hand corner of the screen.

**114.4.5** Description line: Name of area being viewed and the specific direction being viewed, appearing immediately above the engineering stationing.

### **114.5 Coverage**

**114.5.1 General** Include all surface features located within the zone of influence of construction supported by appropriate audio description.

**114.5.2 Omissions and Additions** The CITY reserves the right to add or omit areas to the digital recording.

**114.5.3 Audio/Video Description** Audio description shall be made simultaneously with the video coverage and shall include, but not necessarily be limited to, existing driveways, sidewalks, curbs, ditches, roadways, landscaping, trees, culverts, headwalls, retaining walls, and buildings. Audio description shall include any irregularities being noted (e.g. driveway cracked) with special video attention (close ups, etc.) being made of the irregularity.

**114.5.4 House Number Identification** Houses and other buildings shall be identified visually by house number (if visible) in such a way that manholes, hydrants, and the like can be located by reference thereto. In all instances, however, location shall be identified by audio and/or visual means at intervals not exceeding 100 feet in the direction of travel.

#### **114.6 Rate of Speed and Panning**

**114.6.1 Speed** The rate of speed in the general direction of travel shall not exceed an average of 48 feet per minute.

**114.6.2 Panning** Panning rates and zoom in/zoom out rates shall be controlled sufficiently in order that during playback the object can be viewed clearly.

**114.7 Weather Limitations** Recording shall be done during periods of good visibility. No recording shall be done during periods of precipitation or when more than 10 percent of the ground area is covered with snow unless specific written approval of the ENGINEER is obtained.

**114.8 Camera Height** When conventional wheeled vehicles are used, the distance from the camera lens to the ground shall be not more than 12 feet.

**114.9 Limits** Separate recordings shall be made on each side of the right-of-way, easement or street, unless otherwise specified.

**114.10 Accessibility** When areas to be recorded are not accessible by conventional wheeled vehicles, the CONTRACTOR shall provide special conveyances approved by the ENGINEER or record the information by hand carried apparatus.

**114.11 Delivery** Deliver one original of the completed recording to the CITY before any construction work commences. Unless specifically identified in the Bid Proposal, this work shall be incidental to the cost of construction.

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## **201.0 SITE PREPARATION**

**201.1 Site Preparation** This work shall consist of cutting, removing from the ground and disposing of trees, stumps, brush, shrubs, roots, logs and other vegetation occurring within the construction area which interfere with excavation or installation of the proposed facility. All vegetation which is not designated on the plans or by the ENGINEER to be removed shall be carefully protected from damage or injury during all construction operations. Unless otherwise called for in the Bid Proposal or the specifications, site preparation shall be incidental to the cost of construction.

**201.2 Clearing and Grubbing** Clearing and grubbing shall consist of the removal of ALL trees, shrubs, bushes, and undergrowth that occurs in such quantities that, in the opinion of the ENGINEER, it is impractical to identify as individual items. This work shall consist of the removal and proper disposal of all items, including the root structures, necessary to install the proposed facility. Unless specifically identified in the Bid Proposal, this work shall be incidental to the cost of construction.

### **201.3 Removal of Existing Materials**

**201.3.1 Excavation** This work shall consist of the removal and replacement of all materials necessary for the proper installation of the facilities called for on the plans. All excess materials shall be properly disposed of at the CONTRACTOR's expense.

**201.3.2 Rotomilling** This work shall consist of furnishing all equipment, manpower, and materials necessary for removal and storage of asphalt in such a manner that it can be used as a gravel material. The finished materials shall substantially meet the grading requirements of MDOT 22A gravel. Unless called for separately, all costs for this work shall be considered as incidental to the cost of construction. If this material is to be re-used as a gravel material, it shall be in accordance with Section 206.2.5.2.

**201.3.3 Diamond Grinding** Surface grinding of existing materials shall consist of a self propelled device meeting the current MDOT specifications for diamond grinding. All excess material shall be properly disposed of at the CONTRACTOR's expense.

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## 202.0 REMOVAL OF WATER

**202.1 Suitable Means** The CONTRACTOR shall provide suitable means to promptly remove and properly dispose of water entering the excavation at all times during the construction of the work.

**202.2 Excavation** The excavation shall be kept dry until backfill has been completed above the pipe. In water-bearing sand or quicksand, special precautions shall be taken, such as well-points, tight sheeting or drains. All costs of water removal shall be paid for by the CONTRACTOR and shall be incidental to the cost of the pipe or other facility being installed. Unless specifically identified in the Bid Proposal, this work shall be incidental to the cost of construction.

**202.3 Dewatering** As part of the various pay items, the CONTRACTOR shall design, furnish, install, test, operate, monitor and maintain a dewatering system of sufficient scope, size and capacity to control groundwater flow into excavations and to permit construction to proceed on dry, stable subgrades.

The CONTRACTOR shall protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, ponding and other hazards created by dewatering operations.

The dewatering system shall be installed to ensure minimum interference with roads, streets, walks and other adjacent facilities. Streets, walks or other adjacent facilities shall not be closed without permission from the CITY and authorities having jurisdiction.

The CONTRACTOR shall install the dewatering system utilizing wells, well points or similar methods complete with pump equipment, valves, appurtenances, water disposal and surface-water controls. Generators that are used to supply electrical power to the dewatering system pumps shall be properly muffled so as to not cause a nuisance to adjacent private residences.

Before excavating below the ground water level, place the dewatering system into operation to lower the water table as required. Operate the system continuously until drains, sewers and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

Provide an adequate system to lower and control ground water to permit excavations, construction of structures and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata to below bottom of foundations, drains, sewers and other excavations.

Dispose of water removed by dewatering in a manner that avoids endangering public health, property and portions of the work under construction or completed. Provide sumps, sedimentation tanks and other flow-control devices to remove the sediment from the water prior to discharge. Discharge of water removed by dewatering into a lake or stream other

than through an existing storm sewer outlet will require a MDEQ permit. The CONTRACTOR shall be responsible for obtaining the appropriate MDEQ permits unless otherwise noted in the project Specifications.

Treatment of dewatering effluent shall be provided where the groundwater being lowered is contaminated. All treatment shall be permitted and in accordance with MDEQ and EPA requirements. The CONTRACTOR shall submit shop drawings and the proposed treatment process for approval prior to dewatering contaminated areas.

Dewatering shall be maintained on a continuous basis. If dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system, restore damaged structures and foundations soils at no additional expense to the CITY.

The CONTRACTOR shall be responsible for all damage to and interruption of private water systems resulting from the dewatering operations. The CONTRACTOR shall provide temporary water service for affected private wells.

The dewatering system shall be removed from the project site upon completion of dewatering. All well holes shall be plugged and abandoned per the requirements of the MDEQ. Damage to adjacent facilities caused by dewatering operations shall be promptly repaired to an equal to or better condition than existed prior to installing the dewatering system.

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## **203.0 EXCAVATION SUPPORT SYSTEMS**

### **203.1 Sheeting and Bracing**

**203.1.1** The CONTRACTOR shall furnish and put in place at his own expense, bracing, shoring or sheeting, as may be necessary for the protection of the Work, public property or adjacent private property.

**203.1.2** Unless otherwise noted in the Contract Documents or directed by the ENGINEER, the sheeting, bracing or shoring shall be removed as the Work progresses in such a manner as to prevent the caving of the excavation or any damage to the sewer or structure. Any voids left by removal of said materials must be filled with sand and compacted. Unless specifically identified in the Bid Proposal, this work shall be incidental to the cost of construction.

**203.2 Support in Unstable Soil** Where the bottom of the trench at sub-grade is found to consist of material which is unstable to such a degree that, in the opinion of the ENGINEER, 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. If such conditions are encountered, they shall be paid for according to Article 11.00 of the General Conditions or as bid.

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## **204 EARTH WORK**

### **204.1 Excavation to Grade**

**204.1.1** The ENGINEER will establish control points, reference lines, and bench marks. Also, the ENGINEER will set construction stakes establishing lines, slopes and continuous profile-grade and will furnish the CONTRACTOR with all necessary information relating to lines, slopes and grades. These stakes and marks shall constitute the field control by and in accordance with which the CONTRACTOR shall establish other necessary controls to perform the work. The CONTRACTOR shall carefully compare all levels given on the drawings with existing levels and shall notify the ENGINEER of any discrepancies before proceeding with the work. When stakes are set by the ENGINEER, the CONTRACTOR shall request the staking 48 hours in advance.

The CONTRACTOR shall carefully preserve bench marks, reference points and stakes, and in the case of willful or careless destruction of the same, the CONTRACTOR shall be charged with the resulting replacement expense and shall be responsible for delays and errors caused by their unnecessary loss or disturbance.

**204.1.2** Any excavation below specified grade shall be corrected with approved material, thoroughly compacted as directed by the ENGINEER. Any extra cost incurred shall be borne by the CONTRACTOR.

**204.2 Pipe Construction in Fill Sections** Where it is necessary to lay pipe in a fill area, 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 materials and shall be placed in layers not to exceed one foot and shall be compacted to 95% MDD to the top of the pipe. The embankment shall be not less than three diameters wide at the invert of the pipe and shall be continued up to provide not less than one foot of cover over the pipe.

**204.3 Roadway Excavation** Roadway excavation shall consist of the removal and proper disposal of all materials necessary for construction of a prepared sub-grade to the elevations and cross-section indicated on the Drawings and/or called for in the specifications. It shall include clearing, grubbing, and the removal of trees or stumps encountered within the limits of the grading area. Roadway excavation may be further designated as borrow excavation, peat excavation, frost heave excavation or earth stripping, if so provided in the Bid Proposal supplementary conditions or required by the ENGINEER. Excavation shall at all times be performed in a manner and sequence that will provide drainage. Suitable materials shall be used to construct embankments on the project as required by the Contract and at the direction of the ENGINEER.

### **204.4 Preparing Roadway Foundation**

**204.4.1** Any material within lines two feet (2') outside the proposed surfacing that cannot be compacted to 95% MDD shall, at the request of the ENGINEER and upon approval from the CITY, be excavated to a depth determined by the ENGINEER. If such

conditions are encountered, they shall be paid for in accordance with Article 11 of the General Conditions.

**204.4.2** Embankments shall not be constructed on frozen earth, ice, snow, topsoil, mulch, or other unstable material. Where embankments are to be constructed on existing slopes steeper than one (1) vertical to six (6) horizontal, steps shall be formed in the slope before fill is placed.

#### **204.4.3 Excavation of Unstable Material**

**204.4.3.1** After unsuitable material has been excavated at the direction of the ENGINEER, sufficient time shall be allowed to cross-section the excavated area for the purpose of determining quantities, unless a lump sum amount or other method of payment satisfactory to the CITY and CONTRACTOR is agreed upon.

**204.4.3.2** Where it is possible, a six-inch (6") drainage pipe shall be placed from the low point of the excavated area to a natural drainage course, ditch, or storm sewer structure. The excavated area shall be backfilled with approved porous material. Where an outlet for drainage is not available and the surrounding earth is impervious, the backfill shall be made with materials free from silt or topsoil. All areas shall be compacted to not less than 95% MDD.

#### **204.5 Excavation and Preparation of Trenches**

**204.5.1 Excavation of Trench** The trench shall be excavated so that the pipe can be laid to the alignment and grade required and shall consist of the removal and stock piling or hauling of all materials of whatever nature encountered. Excavation shall proceed only as far in advance of pipe laying as permitted by the ENGINEER. Trench excavation shall include all clearing, grubbing and tree removal within and adjacent to the excavated area, supporting of all adjacent structures whether above or below ground.

#### **204.5.2 Width of Trench**

**204.5.2.1** The width of the trench shall be as per SD #122 .

**204.5.2.2** If the above width is exceeded, the CONTRACTOR shall install a concrete cradle as directed by the ENGINEER to support the added load on the pipe. The use of additional labor and material shall be at the expense of the CONTRACTOR.

**204.5.2.3** Trenches shall be of such extra width as necessary to permit the placement of timber supports, sheeting, and bracing, where required.

**204.5.3 Pipe Clearance in Rocks** Large rocks, boulders and stones over four inches (4") in diameter shall not be placed in bedding, haunching or backfill as defined in SD-122.

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## 205.0 BACKFILLING

### 205.1 General

**205.1.1** Unless otherwise directed, all excavations shall be initially backfilled as noted in SD-122 to a point of one (1) foot above the pipe immediately after installation.

**205.1.2** If it is apparent that the CONTRACTOR is not backfilling around the pipe in accordance with the specifications, the ENGINEER may request that the trench be left open above the pipe until compaction testing has been completed.

**205.2 Backfill Material** All backfill material shall be free from cinders, ashes, refuse, vegetable or organic matter, boulders, rocks or stones, or other materials which, in the opinion of the ENGINEER, is unsuitable.

**205.3 Around Pipe** In earth other than free draining sand or gravel, all pipe shall be laid with Class B bedding unless otherwise specified. The pipe shall be bedded in compacted granular material and placed on a flat bottom trench. Class B Bedding: The granular material shall be MDOT 17A stone. The granular bedding shall be placed as shown in SD-122.

Where Class B bedding as noted does not apply, all trenches shall be backfilled by hand, from the bottom of the trench to a horizontal plane passing through the center of the pipe, with approved sand placed in layers of four inches (4") and compacted. Backfill material shall be deposited uniformly in the trench for its full width on each side of the pipe and compacted in place to 95% MDD. Cost of furnishing, placing and compacting bedding shall be included in the price for installation.

**205.4 Grade** From a horizontal plane passing through the center of the pipe to a point one foot (1') above the top of the pipe, the trench shall be backfilled with material approved by the ENGINEER, placed in six inch (6") layers and compacted to 95% MDD. The trench may be backfilled from one foot above the pipe to the surface by means of a bulldozer and vibrator which shall compact the backfill by being operated longitudinally along the pipe line. Pushing material into the trench from the side without the above noted longitudinal compaction will not be permitted.

**205.5 Drives, Parking Areas and Streets** The trench backfill under drives, parking areas and in streets including an area 3' (three feet) from edge of pavement or back of curb, shall be MDOT Class II or ENGINEER approved native granular material, placed in layers not to exceed one foot (1') in thickness and compacted to 95% MDD. This fill shall be constructed to the proposed elevation. A road base of six inches (6") shall be filled with MDOT 22A aggregate compacted to 95% MDD and maintained until the replacement surfacing can be properly placed.

**205.6 In Freezing Weather** Backfilling shall not be done in freezing weather except by written permission of the ENGINEER. No frozen material shall be buried below final elevation of ground.

**205.7 Around Hydrants and Valve Boxes** Backfilling around hydrants shall be MDOT Class II or native material as approved by the ENGINEER placed in 4" to 6" lifts from a horizontal plane passing through the center of the lead main to one foot (1') below the top grade. The drain outlet shall be backfilled with 2 cubic feet of 6A washed stone to provide adequate drainage as shown in SD-144.

**205.8 Around Manholes** After the structure and/or mortar have set up sufficiently to avoid damage, backfilling shall be done in a manner that will not cause unequal pressure on the structure. No material except MDOT Class II or native material, approved by the ENGINEER, shall be placed within three feet (3') of the structure.

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## 206.0 PAVING AND SURFACING

**206.1 Sub-base Preparation** This shall consist of the CONTRACTOR furnishing all equipment, manpower, and materials necessary to prepare the subbase to the line and grade called for on the drawings or in the specifications. This shall be incidental to the cost of installation of the roadway surface.

### 206.2 Gravel Aggregate Base

**206.2.1 Description** This work shall consist of an aggregate base constructed on a prepared subgrade.

**206.2.2 Materials** The materials shall meet the requirements specified in the MDOT Specifications, for 22A unless otherwise specified in the Contract Documents.

**206.2.3 Deleted**

**206.2.4 Placing and Compacting Materials** Base material shall not be placed until the sub-grade has been approved by the ENGINEER. The Aggregate Base shall be placed by means of a mechanical spreader in such a depth that, when compacted, the thickness will equal the thickness shown on the Drawings. The depth of any layer shall not be more than six inches (6"), or less than three inches (3"), compacted. Each layer shall be floated with an approved maintainer or patrol grader until the mix is uniform and the surface smooth. This work shall be performed in conjunction with a vibrating type compactor, pneumatic tired roller, or other approved compaction method until 95% of MDD has been obtained. Water may be added as needed to obtain optimum moisture content.

### 206.2.5 Payment - Gravel

**206.2.5.1 Aggregate Base** Aggregate Base shall be paid for at the contract unit price per syd, which price shall constitute payment in full for furnishing and placing the materials specified and compacting to the grade and profile shown on the Drawings. This item shall be measured by receipt of a duplicate ticket for materials showing the weight of the material received by the RPR.

**206.2.5.2 Rotomilled Material** Rotomilled gravel shall be paid for at the contract unit price per syd, which shall constitute payment in full for rotomilling, storing, measuring, and calculating the quantity used, furnishing and placing the material as specified in Section 201.3.2 and compacting to the grade and profile shown on the Drawings. This item shall be measured by calculating the cubic yards of stockpiled material as described in Section 201.3.2. If the quantities are measured by weight, a figure of 3200 pounds per cubic yard will be used for converting to cubic yards.

## **206.3 Bituminous Materials and Preparation**

**206.3.1 Preparation of Subbase** This work shall be done in strict accordance with current MDOT Specifications.

**206.3.1.1 Payment - Bituminous Materials** The bituminous materials shall be paid for at the contract unit price which shall constitute payment in full for furnishing HMA as specified to the job site, placing and compacting the mixture, maintaining traffic and any other necessary operations for constructing the hot mix asphalt base.

### **206.3.1.2 Bituminous Bond Coat**

**206.3.1.2.1** The bond coat shall be SS-1h. The rate of application shall be 0.10 to 0.15 gallons per square yard unless otherwise noted on the Drawings or approved by the ENGINEER.

**206.3.1.2.2** The SS-1h asphalt emulsion shall be applied to a properly swept and cleaned base or leveling course prior to placing the next asphalt course.

**206.3.1.2.3** The bituminous material shall be uniformly applied by means of a pressure distributor, except in such areas that are inaccessible to the regular distributor, in which case, hand spraying application will be permitted.

**206.3.1.2.4** The foundation shall be free from moisture or frost and the surface temperature shall not be lower than 50°F when the treatment is applied, unless approved by the ENGINEER. SS-1h shall be applied immediately ahead of the laying operation an adequate distance to allow it to cure before placing the HMA.

### **206.3.2 HMA Base Course**

**206.3.2.1 Scope of Work** The work to be done under these specifications shall consist of construction of an HMA course applied to a prepared sub-grade.

**206.3.2.2 Preparation of Sub-Grade** The sub-grade will be compacted and graded and ready to accept the HMA base course.

**206.3.2.3 Materials** The HMA base shall consist of one or more courses constructed on a prepared sub-grade. It shall be applied at a rate and in a manner that conforms to the requirements of the current MDOT Specification. HMA classification and type shall be shown in the contract documents.

### **206.3.3 HMA Leveling Course**

**206.3.3.1 Description** This work shall consist of conditioning the existing road surface, grading to the plan grade and profile, treating with a bonding material, unless otherwise provided, and constructing thereon an HMA leveling course composed of materials and mixed in accordance with the current MDOT Specification. Where an existing pavement is to be widened, the existing shoulder shall be excavated sufficiently to allow for inclusion of a compacted aggregate base in accordance with the Contract Documents and the HMA leveling course.

**206.3.3.2 Placement** The HMA shall be placed by an approved self-propelled mechanical spreader, or other means as approved by the ENGINEER, to such a depth that when compacted, it will have the thickness specified or ordered by the ENGINEER.

The mixture shall be placed and compacted in accordance with the current MDOT Specifications and traffic shall not be allowed on the surface being placed until rolling has been completed. HMA level course classification and type shall be shown in the contract documents.

**206.3.3.3 Rolling** After the mixture is placed, each layer shall be compacted in accordance with the current MDOT Specifications. Any area that is defective shall be removed and replaced at the expense of the CONTRACTOR.

**206.3.3.4 Weather Limitations** Bond Coat shall not be applied when weather is threatening, or when the air temperature of the surface the coat is to be applied to in the shade is less than 50°F, or as authorized by the ENGINEER.

Bituminous mixture shall not be placed during rainy or threatening weather or when moisture on the surface to be treated would prevent satisfactory bond or when the air temperature in the shade is less than 40°F, unless authorized by the ENGINEER.

**206.3.3.5 Testing** The CONTRACTOR shall be required to furnish a certified analysis of the contents of the asphalt. The CONTRACTOR shall arrange to have samples collected and an extraction and mechanical analysis made by an independent laboratory for each 400 tons of material, but in no case less than one sample per project. The cost of testing shall be incidental to the unit cost of asphalt paving unless otherwise noted in the Bid Proposal.

#### **206.3.4 HMA Surface Course**

**206.3.4.1 Description** This work shall consist of conditioning the existing road surface, grading to the plan grade and profile, treating with a bonding material unless otherwise provided for, and constructing thereon an HMA Surface Course composed of materials and mixed in accordance with the current MDOT Specifications and as called for in the Contract Documents. HMA surface course classification and type shall be shown in the contract documents.

**206.3.4.2 Other Requirements** All other work in connection with the above operation shall be as specified under HMA Leveling Course specifications.

**206.3.5 Bituminous Valley Gutter** Bituminous valley gutter shall be installed in accordance with the current MDOT specifications and SD-131.

**206.3.5.1 Description** Where bituminous valley gutter is called for, it shall be placed integrally with the HMA surface Course with a self-propelled paving machine in accordance with the current MDOT Specifications for Construction.

Unless conditions warrant otherwise, the valley gutter construction operation shall be continuous from end to end of the street and in one direction so as to eliminate joints. Valley gutters shall be measured continuously through driveway openings. "Bituminous Valley Gutter" shall be paid for at the contract unit price per lineal foot and shall be payment in full for all materials and labor.

## 206.4 Concrete

### 206.4.1 Concrete Pavement

**206.4.1.1 Materials** The materials shall meet the requirements specified in the current MDOT Specifications for the following items:

Portland Cement Concrete	Steel Reinforcement
Cement	Water
Coarse Aggregate, 6A	Joint Material
Fine Aggregate, 2NS	Concrete Admixture and Curing Agents

Course aggregate shall consist of limestone or slag material.

### 206.4.1.2 Construction

**206.4.1.2.1 Equipment** The equipment shall be as currently being used by the construction industry and in accordance with the current MDOT Standard Specifications for Construction.

### 206.4.1.2.2 Construction Procedures

**206.4.1.2.2.1 Preparation of Sub-Grade** The sub-grade shall be graded and thoroughly compacted to a point at least one foot outside of the proposed concrete facility. Forms shall then be placed to provide adequate time for the ENGINEER to check them in advance of placing concrete. The compacted sub-grade shall be moist and free from mud or frost at the time of concrete placement. Any areas disturbed by equipment shall be smoothed out and tamped.

**206.4.1.2.2.2 Placing Forms** Forms shall be placed on thoroughly compacted material and checked for line and grade by the ENGINEER in advance of placing concrete.

**206.4.1.2.2.3 Aggregates** Aggregates shall be handled in a manner that will provide uniformity of grading and moisture content at the time of batching. All aggregates shall be limestone or slag material.

**206.4.1.2.2.4 Concrete Design** The concrete mix shall be designed by an approved independent laboratory at the expense of the CONTRACTOR. Evidence of actual tests shall be furnished indicating that the proposed design will result in concrete meeting the requirements for MDOT P1-517: 6.5% entrained air with a tolerance of plus or minus 1.5%; compressive strength at 28 days of 3500 p.s.i.; modulus of rupture at 28 days of 650 p.s.i.; minimum content of cement 5.50 sacks per cu. yd.

**206.4.1.2.2.5 Proportioning** Aggregates shall be proportioned by weight. The equipment shall be an approved weighing device as specified by the current MDOT Specifications. The weighing device shall be accurate with a tolerance of 1% plus or minus. Water shall be discharged into the mixer by an approved device that will provide the amount required with a maximum variation of 1%.

**206.4.1.2.2.6 Consistency** Where machine methods are used for striking off and consolidating the concrete, the slump shall be between 1-1/2 and 2-1/2 inches. Where hand finishing is permitted, the slump may be increased to 3-1/2 inches. Concrete shall reach its place in the finished work without segregation. Moving the concrete with rakes or by use of a vibrator will not be permitted.

**206.4.1.2.2.7 Strength of Concrete** If the average results from the test beams or cylinders are below the required 28 day strength, it will be sufficient reason for rejecting for further use the materials being used. If said average results are more than 10% below the required strength, the CITY may elect to permit such curbing or sidewalk to remain in place and receive as compensation therefore a 50% reduction of the contract unit price, or to require the CONTRACTOR, at his own expense, to remove the deficient concrete and replace it with concrete of satisfactory quality.

**206.4.1.2.2.8 Mixing** The mixing time for concrete shall be for a period of not less than one (1) minute in a drum that shall revolve at the rate of not less than 14, nor more than 20, revolutions per minute. The volume of mixed material in each batch shall not exceed the Associated General Contractors of America rated capacity of the mixer.

The CITY reserves the right to require the CONTRACTOR to discontinue the use of ready-mixed concrete if, in the opinion of the ENGINEER, the use of such concrete does not produce satisfactory work and no claim will be considered due to such change.

**206.4.1.2.2.9 Transportation of Materials** Transportation of materials shall be as specified under the current MDOT Requirements.

**206.4.1.2.2.10 Placing Concrete** Concrete shall be placed in accordance with the current MDOT Specification, except commercial vehicles will not be permitted on non-reinforced pavement until tests indicate a modulus of rupture of not less than 500 p.s.i.

**206.4.1.2.3 Joints** All longitudinal and transverse joints shall conform to the details and position shown on the Drawings. Transverse joints shall be constructed at right angles to the center line of the pavement and shall not vary more than 1/4 inch from a true line. The surface of the pavement adjacent to

all joints shall be finished to a true surface and properly aged. The surface across the joints shall be tested with a ten foot (10') straight edge and any irregularities shall be corrected before the concrete has hardened.

**206.4.1.2.3.1 Longitudinal Joints** Longitudinal joints shall be sawed plane-of-weakness joints with bars, or bulkhead construction joints with hook bolts, as detailed in the current MDOT Standard Details and in accordance with the current MDOT specifications.

**206.4.1.2.3.2 Tranverse Joints** Transverse joints shall be contraction joints, expansion joints or construction joints and shall be strictly as indicated in the current MDOT Standard Details and in accordance with the current MDOT specifications.

**206.4.1.2.4 Consolidating and Finishing** The sequence of operations after the placing of the concrete shall be: striking off and consolidation, floating, scraping, and testing surface with straight edge, and edging and final finishing with burlap drag.

## **206.4.2 Concrete Sidewalk**

**206.4.2.1 Summary** This work shall consist of a single course of concrete constructed on a prepared and approved sub-grade to the width and thickness noted on the drawings.

**206.4.2.2 Materials** The materials shall meet the requirements as specified in the current MDOT specifications for the following items:

Concrete, Grade, S2, P1	Granular Material Class II
Water	
Joint-Fillers	

The concrete mix shall meet the requirements for MDOT P1-517: 6.5% air entrained with a tolerance of plus or minus 1.5%, compressive strength of 3,500 p.s.i. at 28 days and a slump within the range of 1-1/2 to 3 inches. Modulus of rupture at 28 days of 650 p.s.i., minimum cement content of 5.50 sacks per cubic yard. The aggregate shall consist of a limestone or slag material.

**206.4.2.3 Forming** The sub-grade shall be thoroughly compacted to insure its stability. Straight forms of wood or metal shall be placed to the plan grade and staked in a manner that will prevent deflection or settlement. They shall be set to an elevation that will provide 1/4 inch per foot slope toward the center of the street, or as otherwise detailed in the Contract Documents, or approved by the ENGINEER.

**206.4.2.4 Consolidating and Finishing** The sub-grade shall be thoroughly wetted and the concrete deposited thereon to the proper depth. It shall be spaded along the forms, compacted and struck off flush with the top of the forms. The surface shall be floated with a suitable float, edges and joints properly tooled and then finished with a wood float or brush as required by the CITY to provide a non-slip surface.

**206.4.2.5 Joints** One inch (1") transverse expansion joints shall be placed every 50 ft. for the full depth of the sidewalk and contraction joints formed with spacing equal to the width of the sidewalk or as directed by the ENGINEER. All joints shall be constructed at right angles to the centerline of the sidewalk.

**206.4.2.6 ADA Detectable Warning Devices** ADA ramps shall be installed at all public street intersections or as directed by the ENGINEER in accordance with current MDOT standards and SD-119.

### **206.4.3 Concrete Curb and Gutter**

**206.4.3.1 Summary** Where concrete curb or curb and gutter is specified, it shall be as detailed in the SD-113 or as indicated in the Contract Documents. The trenching, forming, placing, finishing and curing shall take place before the HMA base or leveling surface is placed and conform to the specifications for concrete sidewalk section 206.4.2.2 through 206.4.2.5 of these specifications. The forms shall be metal and extend to the full depth of the structure. The concrete shall be spaded to prevent honey-combing.

Expansion joints shall be placed through the curb at the spring points of the street returns and uniform intervals of not more than one hundred feet (100') between intersections. Expansion joint material shall also be placed five feet (5') on each side of all drainage structure castings. Plane of weakness joints shall be placed to divide the structure into uniform sections ten feet (10') in length. Irregular sections shall not be less than eight feet (8') in length. The concrete shall be cured in accordance with the current MDOT Specifications for Construction.

Concrete curbs shall be measured continuously through driveway openings which shall be left as required by the CITY. "Concrete Curb" or "Concrete Curb and Gutter" shall be paid for at the contract unit price per linear foot which shall constitute payment in full for all materials and labor. The aggregate shall consist of a limestone or slag material.

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## 207.0 UTILITY INSTALLATION

### 207.1 Water Mains

**207.1.1 Materials** Mains: four inch (4") to ten inch (10") diameter pipe shall be Class 52 Ductile Iron and twelve inch (12") diameter and larger pipe shall be Class 53 Ductile Iron, conforming to ANSI/AWWA A21.51 /C151. All piping inside structures shall have flanged joints. Pipe twelve inches (12") and less in diameter shall be rated for 250 p.s.i. internal working pressure (IWP), sizes exceeding twelve inches (12") in diameter shall be rated for 150 p.s.i. I.W.P.

**207.1.2 All Buried Fittings and Joints** Mechanical joints, flange joints, and push-on joints shall conform to ANSI 21.10/AWWA C110 specifications.

**207.1.2.1 Bolts and Nuts** Bolts and nuts used with mechanical joints shall be high strength cast iron NI-Resist or approved equal.

**207.1.2.2 Gaskets** Rubber gaskets shall be vulcanized styrene butadiene rubber (SBR) or approved equal conforming to ANSI A21.11/AWWA C111 as approved by the ENGINEER. The joints shall be assembled in strict accordance with the manufacturer's recommendations.

**207.1.2.3 Flanged Joints** Cast iron flanged fittings shall meet ANSI/AWWA A-21.10/C-110 and shall be assembled in accordance with the manufacturer's recommendations. Bolts and nuts shall be of steel, cadmium plated with a minimum yield strength of 45ksi and shall meet ANSI/AWWA A21.11/C-111. Gaskets shall be as described in Section 207.1.2.2.

**207.1.2.4 Gate Valves & Wells** Valves shall be furnished and installed at the locations shown on the Drawings. Valves shall be mechanical joint with mechanical joint gaskets. All valves shall be gate valves.

**207.1.2.4.1 Gate Valves** All gate valves shall be of the resilient wedge type for seating and operating characteristics meeting the requirements of AWWA C509 specifications. The valves are to be mechanical joint opening clock-wise, non-rising stem and fully bronze mounted.

**207.1.2.5 Valve Boxes** Valve boxes shall be East Jordan 8560 (for 3 piece boxes) or 8550 (for 2 piece boxes) or approved equal). Non-ferrous models are not allowed.

**207.1.2.6 Hydrant, Valve, & Valve Box Assembly** Hydrants shall be of dry barrel design, Underwriters Laboratory listed, and conforming to AWWA C 502 standards. The hydrant mechanism shall be of a non -rising stem, opening clockwise, with a 5-1/4 inch valve that closes with the system pressure. The hydrant shall be a "traffic" model with breakaway design. Hydrants shall be East Jordan Iron Works Model 5-BR250 or Clow Valve Co. "Medallion" Model

F-2545. All hydrants shall be installed in accordance with Standard Detail #144.

- 207.1.2.6.1 The inside diameter of the hydrant barrel shall be at least seven inches (7").
- 207.1.2.6.2 Hydrants shall be manufactured with a main valve set ring of bronze and bronze upper valve plate.
- 207.1.2.6.3 Each hydrant shall be supplied with a six inch (6") gate valve, mechanical by mechanical joint complete with a two (2) piece cast iron valve box having a 5-1/4" inch screw shaft opening.
- 207.1.2.6.4 The inlet at the hydrant shoe shall be mechanical joint ANSI A21.11 standard 6".
- 207.1.2.6.5 The hydrant bonnet shall have two 2-1/2" National Standard Hose Connection (7-1/2 threads per inch with O.D. of thread 3-1/16") and one 4" Pumper Connection (6 threads per inch with a 4-13/16" O.D.).
- 207.1.2.6.6 The hydrant shall have a bury length of 5-1/2 feet from the invert of the inlet to the ground line, unless otherwise specified.
- 207.1.2.6.7 Each nozzle cap shall have a suitable rubber-like gasket. Nozzles shall have rubber-like "O" ring gaskets.
- 207.1.2.6.8 Each hydrant shall have all chains removed prior to activation for public use.
- 207.1.2.6.9 Each hydrant assembly shall have factory-applied yellow paint above the ground line.
- 207.1.2.6.10 The hydrant operating nut and nozzle caps shall have 15/16 inch square operating lugs.
- 207.1.2.6.11 The stem packing in the hydrant bonnet shall be of the double "O" ring type.
- 207.1.2.6.12 All hydrant operating stems shall have a steel coupling attached with stainless steel coupling pins to the upper and lower stems.
- 207.1.2.6.13 All hydrant extensions shall be made at the ground line or above, without the necessity of digging.
- 207.1.2.6.14 The outlet nozzles shall be mechanically attached into the bonnet.

**207.1.2.6.15** The hydrant bonnet shall be able to be positioned 360° by loosening the bonnet flange bolts.

**207.1.2.6.16** All hydrant drains or drips shall be open unless these are lying in the water table, in which case, they shall be plugged.

**207.1.2.6.17** All hydrants and hydrant valves shall be restrained as detailed in Standard Detail #144 or as recommended by the manufacturer or other means acceptable to the ENGINEER.

**207.1.2.6.18** All hydrants shall be installed in a manner such that the center of the pumper connection is a minimum of twenty-one inches (21") and a maximum of thirty-six inches (36") above the adjacent finished grade. The hydrant shall have an area of thirty-six inches (36") clear of obstructions surrounding the outlet nozzles and operating nut.

**207.1.2.6.19** All hydrants shall have signs installed in accordance with SD-145 unless otherwise specified in the Bid Proposal. The cost of the signs and installation shall be considered included with the cost of the fire hydrant assembly.

**207.1.2.7 Joint Restraints** The following methods of restraining the joints are acceptable: 1) U.S. Pipe Field Lock Gasket, 2) Retainer Glands, 3) Threaded Rods, 4) Meg-a-Lug Glands. Any other method of restraint must be approved by the ENGINEER. The ENGINEER shall indicate on the construction drawings which Tees and Bends are to be restrained. **Thrust blocks shall not be allowed.**

**207.1.2.7.1 Restraint** All pipe deflections over twenty (20) degrees, all tees, and valves at the dead ends of lines shall be restrained, tied or harnessed in a manner acceptable to the ENGINEER. The restraint shall be applied to joints each direction from the deflection or fitting an adequate distance to resist the axial thrust of the test pressure. Minimum acceptable distance shall be seventy (70') feet each way from said deflections.

**207.1.2.8 External Conductors** All pipe placement shall provide for electrical conductivity across each joint. The electrical conductivity connections shall be of the external conductor type. The conducting medium shall be adequately sized and designed to carry 400 amperes for an extended period of time. The conductor shall be fastened to each side of each joint in a permanent manner. External conductors shall be U. S. Pipe and Foundry Co., "Electro-Bond" strips; Erico Products, Inc., "Cadwell" connectors; Clow Corporation, "Cable-Bond Connectors"; conductivity gaskets approved by the ENGINEER or equal. All connection areas shall be coated as per manufacturer's requirements. **Bronze wedges shall not be allowed.**

### **207.1.3 Installation**

**207.1.3.1 Installation of Service** No valve or other control on the existing system shall be operated for any purpose by the CONTRACTOR without prior permission of the CITY. It shall be the responsibility of the CONTRACTOR to notify all persons to be affected by any shut off 48 hours prior to the operation of any valves.

**207.1.3.2 Bedding** In earth other than free draining sand or gravel, all pipe shall be bedded with MDOT Class II or 17a unless otherwise specified.

**207.1.3.3 Handling Material** Proper and suitable tools and appliances for the safe and careful handling, conveying and laying of the pipe shall be used. Care shall be taken to prevent the coating of ductile iron pipe from being damaged, particularly on the inside of the pipe. Pipe, valves, hydrants and fittings strung along the route shall be placed in such a manner that they will not be submerged or collect water. All pipes and castings shall be carefully examined and tested for defects. If any materials are found to be defective, they shall be removed from the site and replaced with acceptable materials.

**207.1.3.4 Cleaning Pipe & Fittings** All lumps, blisters and excess coal-tar coating shall be removed from the bell and spigot end of each pipe and fitting and the outside of the spigot and the inside of the bell shall be wire-brushed and wiped clean, dry and free from oil or grease prior to laying.

**207.1.3.5 Laying Pipe** Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed. The ENGINEER may require that a heavy tightly woven bag be placed over each end and left there until the connection is to be made. 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 any time when pipe laying is not in progress, the open end(s) of pipe shall be closed by a watertight plug or other means approved by the ENGINEER. This provision shall apply during the noon hour as well as overnight. If water is in the trench, the plug shall remain in place until the trench is pumped completely dry. Watermain shall be placed a maximum of 6'-0" and a minimum of 5'0" depth as measured from finished grade to the top of the pipe unless existing water table conditions warrant the ENGINEER to direct otherwise.

Whenever a main is installed under any existing utility line such as gas, sewer, water, etc., provisions shall be made to prevent the weight of such utility line from straining and possibly breaking the main. Such provisions shall consist of concrete bedding of the main, complete concrete encasement, or some other method approved by the ENGINEER. If it is a sanitary sewer line, the CONTRACTOR will be required to encase the water main with a minimum of nine inches (9") of five (5) sack concrete a distance of ten feet (10') each way from the sewer line. Separation of watermain and sewer shall be in accordance with the current version of the GLUMRB - "10 State Standards".

**207.1.3.6 Direction of Laying** Pipe shall be laid with bell ends facing in the direction of laying, unless directed otherwise by the ENGINEER. Where pipe is laid on a grade of 10% or greater, the laying shall start at the bottom and shall proceed upward with the bell ends of the pipe up grade.

**207.1.3.7 Cutting of Pipe** The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe. Flame cutting of pipe by means of an Oxyacetylene torch shall not be allowed. Where the pipe joint is such that it employs a single gasket to effect the joint seal, the outside of the cut end will be tapered back 1/8 inch at an angle of approximately 30 degrees so as to remove any sharp, rough edges which might damage the gasket.

**207.1.3.8 Tapping Sleeves** Tapping sleeves shall only be ductile iron or epoxy coated steel. The tapping sleeve shall be Rockwell 622, U.S. Pipe T-28 or equal. Where a "size on size" tap is required, a mechanical joint ductile iron tapping sleeve shall be used. The tapping sleeve shall be U.S. Pipe T-9, Mueller H-615 or approved equal.

**207.1.3.9 Cutting in Tees** Cutting in tees shall only be allowed by written permission of the City Engineer.

**207.1.3.10 Poly Wrap** When the water main is to be located in potentially corrosive soil, it may, at the ENGINEER's discretion, be poly wrapped. The poly wrap shall conform to AWWA C104. The unit price bid for the poly wrap shall include all labor, material, and equipment necessary to install the poly wrap.

## **207.1.4 Water Service Materials**

**207.1.4.1 Corporation Stop** 3/4 inch and 1 x 1-1/4 inch shall be Mueller H-15000 or approved equal. 2 inch shall be Ford FB 600-7 (Ball Valve) or approved equal.

**207.1.4.2 Curb Stop** 3/4 inch and 1-1/4 inch shall be Mueller B-25204 or Ford B22-333 or B22-555 or approved equal. 2 inch services shall be Ford B-44-777 or approved equal.

**207.1.4.3 Curb Box** 3/4 inch and 1-1/4 inch services shall be Mueller H10308, Ford EA2-60-40-54R Buffalo style Armor Access Boxes or approved equal. Non metal curb boxes shall have a metal lid suitable for metal detection. 2 inch services shall be standard main gate valve box as per 207.1.2.5.

**207.1.4.4 Service Saddle** 2 inch service saddle shall be double strapped, ductile iron saddle with iron pipe threads and galvanized or cadmium plated straps, Ford F202, Rockwell 311, or approved equal.

**207.1.4.5 2 inch Adapter** 2 inch Adapter to connect copper pipe to ball valve shall be Ford C-84-77 or approved equal.

**207.1.4.6 Copper Pipe** Copper pipe for water services shall be in accordance with ASTM B-88, Type "K" annealed, seamless copper.

**207.1.4.7 Copper Pipe Fittings** Fittings for copper pipe shall have flared type connection with the exception that 2 inch copper pipe fittings may have compression type connections with locking devices.

## 207.2 Sewers

### 207.2.1 Materials

**207.2.1.1 Pipe** All sewers installed shall be of the type (storm or sanitary) and size indicated on the drawings.

**207.2.1.1.1** The following approved materials shall conform to the applicable A.S.T.M., AASHTO, and other applicable specifications. All other types must meet with the approval of the City Engineer.

#### Sanitary Sewers

Extra Strength Clay Pipe C-700 ASTM

Concrete Sewer Pipe C-76, AASHTO M-170

Plastic (PVC) Pipe D-3033 or D-3034, SDR 26 ≤  
15" Diameter

18-24" ASTM F-679, T-1 wall thickness

Asbestos-Cement Pipe C-428

Ultra Rib Pipe ASTM F794

Armco A-2000 Pipe ASTM F949, F794

#### Storm Sewers

Reinforced Concrete Pipe C-76,  
AASHTO M-170

Smooth lined corrugated high  
density polyethylene M-294 type S  
with water tight joints

**207.2.1.1.2 Corrugated** metal pipe shall conform with current MDOT specifications and table. Pipe shall be Zinc or Bituminous coated in accordance with AASHTO specifications.

**207.2.1.2 Joints** Joints shall be one of the following unless otherwise called for on the Drawings or Special Specifications.

**207.2.1.2.1 Rubber** Rubber joints shall be "tylox", "Press-Seal", "Robber Pressure Joint", "Ring-Tite", or approved equal, and installed according to the manufacturer's recommendations.

**207.2.1.2.2 Corrugated Metal** (on corrugated metal pipe only). Corrugated metal two (2) piece coupling bands or Contech's "Hugger" with rubber "O" Ring shall be used and installed according to the manufacturer's recommendations.

**207.2.1.2.3 Bituminous Mastic** Bituminous mastic joints shall be made when the joint surfaces are clean and dry, using "DeWitt #10", "Sewertite" by Philip Carey Company, or approved equal.

**207.2.1.2.4 Slip Seal** Bituminous precast rings of tapered design around the spigot and inside of the bell shall be cast on the pipe at the foundry. They must be kept clean and coated with a softening agent prior to using.

**207.2.1.2.5 Sanitary Sewer Joints** Joints shall be one of the following unless otherwise called for on the Drawings or Special Specifications:

Clay: ASTM C-425

Concrete: ASTM C-443

Asbestos-Cement: ASTM C-1869

Plastic (ABS): ASTM D-2680

Plastic (PVC): ASTM D-3212 or D-2855, ASTM F-477

**207.2.1.2.6 HDPE** HDPE pipe is permitted only for 24" diameter pipe and under. Minimum cover shall be 3 feet measured from top of pipe to finished grade.

### **207.2.1.3 Laying of Pipe**

**207.2.1.3.1** Pipe shall be laid from the lower end of sewer upwards. The use of brick, lumps of clay, wood, etc. to level the pipe will not be permitted. Pipe joints shall be properly seated in accordance with the manufacturer's guidelines.

**207.2.1.3.2** Each pipe shall be inspected for possible defects before being placed in the trench. Joint surfaces shall be free of earth or frozen matter.

**207.2.1.3.3** All pipe shall be laid with bell ends up-grade to line and grade as called for on the plans and each pipe as laid shall be checked by the CONTRACTOR. After laying of pipe, care in backfilling and other operations shall be taken so as not to disturb its line or grade.

**207.2.1.3.4** Pipe joints on sewer 36" diameter and larger shall be pointed up on inside with F-100 grout by Sauereisen, Five Star Grout or equal after backfilling has been completed.

**207.2.1.3.5** The CONTRACTOR shall excavate to the required grade for the type of bedding specified. Bell holes for bell and spigot pipe shall be dug at each joint. As work progresses, the interior of the sewer shall be cleaned of all dirt, jointing material and foreign material of every description. On small sewers, where cleaning after laying may be difficult, a swab or drag shall be kept in the pipe lines and pulled forward past each joint immediately after its completion.

**207.2.1.4 Concrete Cradle** Where required, a concrete cradle shall be constructed of 1500 psi concrete, having a minimum thickness of 4" under the pipe and extending up the sides of the pipe equal to one-fourth its outside diameter. Concrete cradle shall have no slump and shall be mechanically mixed. Payment for concrete cradle shall be as provided in the Bid Proposal.

### **207.2.1.5 Pipe Bedding**

**207.2.1.5.1 Storm Sewer** In earth other than free draining sand or gravel, all pipe shall be laid with Class B bedding unless otherwise specified. Class B bedding: The pipe shall be bedded in compacted granular material placed on a flat bottom trench. The granular material shall be MDOT 17A. The granular bedding shall have a minimum thickness of 6 inches below the pipe and shall extend to the spring line of the pipe as per SD-122. Cost of furnishing and placing bedding shall be included in the price for sewer installation.

### **207.2.1.5.2 Sanitary Sewers**

**207.2.1.5.2.1** Bedding Classes A, B, or C, as described in ASTM C-12-74 (ANSI A106.2) or WPCF MOP No. 9 (ASCE MOP No. 37) shall be used for all rigid pipe provided the proper strength pipe is used with the specified bedding to support the anticipated load.

**207.2.1.5.2.2** Bedding Classes I, II, or III as described in ASTM D2321 (ANSI K65-171) shall be used for all flexible pipe provided the proper strength pipe is used with the specified bedding to support the anticipated load.

**207.2.1.6 Clearance to Water Main** Minimum clearance to a public supply water main shall be as follows: eighteen inches (18") vertically and ten feet (10') horizontally in accordance with GLUMRB "10 States Standards".

**207.2.1.7 Sewer Saddles** Sewer saddles for new connections on existing pipe shall be Romac Style "CB" Sewer Saddles or approved equal.

**207.2.1.8 Bore and Jack Construction** All bore and jack materials shall be in accordance with MDOT Specification 401.03.I. Casing spacers shall be Uni-Flange Series 1300 Casing Spacers or approved equal.

**207.2.1.9 Horizontal Directional Drilling** The work generally consists of three phases, beginning with drilling a pilot hole from the surface or pit at a starting point to an exit pit at the surface beyond the obstacle or area that is to be avoided. The second phase consists of reaming the pilot hole to make it large enough for the pipeline to be installed. Finally, the pipeline is pulled into place. During the pipe pulling operation, drilling fluid (a bentonite, water, and polymer solution) is injected to stabilize the hole, remove cuttings, and lubricate the pipe.

**207.2.1.9.1** Directional drilling CONTRACTORS or subcontractors and their field supervisory personnel shall have actively engaged in the installation of pipe using directional drilling for a minimum of five years.

**207.2.1.9.2** Submittals shall be in accordance with the requirements of the City of Portage Specifications. The CONTRACTOR shall submit to

the ENGINEER for review and comment, prior to commencing any work, a detailed statement of the drilling equipment, with a pulling gauge monitor, and tracking transmitter/devices selected and procedures to be used in performance of the work. A drilling fluid disposal plan shall also be submitted.

**207.2.1.9.3** During the construction, a data sheet or drilling log for each pilot hole shall be prepared to document the location and depth of the drill head in relation to the found elevation and centerline of the drilling path at a minimum of ten (10) foot intervals. Locating and guidance can be completed by the walkover system or by wireless steering tool system.

**207.2.1.9.4** Construction in other agencies rights of way or properties shall conform to the requirements of the regulating agency and the City of Portage Specifications.

**207.2.1.9.5** Polyethylene pipe shall conform to the material designations of Plastic Pipe Institute (PPI) and ASTM, PE3408, ASTM F714 and AWWA C906. The pipe shall be made from a high density, molecular weight resin that is classified as TR-4 by the PPI in accordance with ASTM D1248. The resin shall contain antioxidants and be stabilized for protection against ultra-violet degradation. Pipe shall have a cell classification of PE 345464C and meet or exceed all requirements of ASTM D3350. Pipe shall have a designated use color stripe applied during production. Pipe shall meet ANSI/NSF Standard 60-1988 or 61-1988 as applicable and be permanently identified as meeting all required standards.

**207.2.1.9.6** Pipe size shall be DIPS nominal diameters. The minimum wall thickness for the directional drilling installation process shall be DR 11 with a minimum working pressure of 160psi.

**207.2.1.9.7** PVC pipe for horizontal directional drill installation method shall have fused joints and meet AWWA C-900 or C-905 as specified or noted, DR-18 test requirements. The pipe shall be extruded with plain ends suitable for fusing. The pipe shall be Fusible C-900 or C-905 as specified or noted and will be blue for potable water applications, purple for recycled or reclaimed water, green for sanitary sewer or force main applications and white for irrigation or storm sewer application.

**207.2.1.9.8** Two Number 6 braided wires for tracing with a tensile strength equal to or greater than the pipe being pulled shall be utilized. Wires shall be secured to the pipe with tape at intervals not to exceed 10 feet. Wires shall be XHHW type with heat shrink encasement at all splices. Tracer wires shall terminate inside air relief structures or at

valve box assemblies. Tracer wires shall extend 4' above the opening on structures.

**207.2.1.9.9** The CONTRACTOR shall familiarize himself with the geologic characterization of the soil stratum at the proposed drilling path.

**207.2.1.9.10** The CONTRACTOR shall be responsible for informing the ENGINEER of any changes that are required in the directional drilling procedure due to geologic conditions.

**207.2.1.9.11** If any obstruction is encountered that stops the forward progress of the drilling operation or the pull back process, the CONTRACTOR and ENGINEER shall review the situation and jointly determine the feasibility of continuing drilling operations, making adjustments or switching to an alternative construction method.

**207.2.1.9.12** Launching and recovery pits shall be as small as practicable. Dewatering of pits and excavations shall be done in accordance with the General Provisions and the City of Portage Specifications. When water is encountered, the CONTRACTOR shall provide a dewatering system of sufficient capacity to keep any excavation free of water until the backfill operation is in progress. Dewatering shall be performed in a manner such that removal of soil particles is held to a minimum. Water from the dewatering system shall be desilted before discharge. Methods of dewatering and desilting, including all costs, shall be the CONTRACTOR's responsibility.

**207.2.1.9.13** Drilling path shall be walked in the presence of the ENGINEER, RPR, CONTRACTOR, CONTRACTOR'S Superintendent, and subcontractor, if applicable, with the guidance system that shall be used for each segment of drill path. The CONTRACTOR shall locate and record any surface and subsurface magnetic variations or abnormalities and all points of interference, as well as verifying all utilities location and corresponding utility maps. Should any discrepancy arise between utility maps, field locations, and guidance system findings the CONTRACTOR shall clarify all discrepancies prior to beginning drilling operations. The drill path survey shall be performed no earlier than two (2) days prior to commencing drilling operations. Provide ENGINEER 48-hour notice of drill path survey.

**207.2.1.9.14** The drilling equipment shall be capable of placing the pipe within the planned line and grade. The drilling equipment shall be capable of pulling product pipe from either the downstream or upstream location. The equipment must be adequately sized for the application. The guide system shall have the capability of measuring inclination, roll and azimuth. The guidance system shall have an independent means to ensure the accuracy of the installation. The CONTRACTOR shall demonstrate a viable method to eliminate accumulated error due to the

inclinometer (pitch or accelerometer). The guidance system shall be capable of generating a plot of the borehole survey for the purpose of a record drawing.

**207.2.1.9.15** The guidance system shall meet the following specifications:

Inclination:	Accuracy	+ 0.05
	Range	+ 90
	Repeatability	+ 0.02
Roll:	Accuracy	+ 0.05
	Range	+ 90
Azimuth:	Accuracy	+ 0.05
	Range	+ 90

Equipment set-up requirements at the launch and recover locations shall be determined by the CONTRACTOR in accordance with the Contract Drawings and submitted to the ENGINEER per the requirements of the City Standard Specifications.

**207.2.1.9.16** Pilot Hole Drilling: The entry angle of the pilot hole and the boring process shall maintain a curvature that does not exceed the allowable bending radii of the product pipe. The CONTRACTOR shall follow the pipeline alignment as shown on the Drawings, within the specification requirements. The location and depth of the drill head in relation to the profile and centerline of the alignment shall be determined at a maximum of ten foot intervals.

**207.2.1.9.17** In the event of difficulties at any time during drilling operations requiring the complete withdrawal from the tunnel, the CONTRACTOR shall either be allowed to withdraw and abandon the tunnel and begin a second attempt at a different location; or excavate at the point of the difficulty and install the product pipe by an alternate method of installation. Either alternative shall be approved by the ENGINEER before the CONTRACTOR withdraws.

**207.2.1.9.18** Access pits shall be at the beginning and end of the segments shown on the Drawings. Intermittent pits shall be approved by the ENGINEER prior to proceeding with drilling operations. No intermittent access pits shall be allowed in wetland areas.

**207.2.1.9.19** Installing Product Pipe: After the pilot hole is completed, the CONTRACTOR shall install a swivel to the reamer and commence pullback operations. Reaming diameter shall not exceed 1.5 times the outside diameter of the product pipe being installed. The product pipe being pulled into the tunnel shall be protected and supported so that it

moves freely and is not damaged by stones and debris on the ground during installation. Tracer wire shall be attached to product pipe before pullback operations begin. Pullback forces shall not exceed the allowable forces for the product pipe.

**207.2.1.9.20** The CONTRACTOR shall allow sufficient lengths of product pipe to extend past the termination point to allow connections to adjacent pipe sections, manholes, or tees. Pulled HDPE pipe shall be allowed 24 hours for stabilization prior to making tie-ins. Any required length of extra product pipe shall be at the CONTRACTOR's discretion. Restrained connections to conventional water main or appurtenances shall be made using a mechanical-joint adapter with stainless steel stiffener or approved equal.

**207.2.1.9.21** All pipe sections, specials, and jointing materials shall be carefully examined for defects and no piece shall be laid that is known to be defective. Any defective piece discovered installed shall be removed and replaced with a sound one in a manner satisfactory to the Resident Project Representative at the CONTRACTOR's expense. Defective material shall be marked with lumber crayon and removed from the job site before the end of the following day. Pressure and leakage testing shall be in conformance with the City of Portage Standard Specifications.

## 207.3 Sewer Structures

### 207.3.1 General

**207.3.1.1** Structures shall be hard-burned common-brick, concrete radial block, reinforced concrete or precast concrete unless a specific type is called for in the Supplementary Specifications or on the Drawings. Brick shall be thoroughly wetted and laid in a full bed of mortar. The laying of the brick shall never be more than three (3) courses ahead of the exterior plaster. Brick and precast concrete block shall only be allowed if approved by the ENGINEER.

**207.3.1.2** Floors shall be at least eight inches (8") thick and shall extend six inches (6") outside the wall of the structure. Precast floor slabs may be used if a uniform bearing can be obtained.

**207.3.1.3** The wall thickness of manholes constructed of various materials and set at various depths shall be as follows:

<u>Depth</u>	<u>Brick</u>	<u>Poured Concrete</u>	<u>Precast</u>	<u>Concrete Block</u>
0-8'	8"	6"	5"	6"
8'-15'	8"	8"	5"	8"
15'+	12"	12"	5"	12"

Minimum inside diameter shall be 48". Sanitary sewer manholes shall be either poured concrete or precast.

**207.3.1.4** All precast sanitary manholes shall conform to ASTM C-478 with O-ring rubber gasket type joints, ASTM C-443 and Butyl Rubber Joint Sealant Conforming to SS-S-210A. All pipe openings in precast sanitary manholes shall be fitted with a resilient rubber boot, utilizing stainless steel bands as per SD-105.

**207.3.1.5** All brick and concrete work shall be properly cured and protected from freezing for a minimum of 72 hours. When the temperature is expected to be below 40° F during placing or within 24 hours thereafter, cold weather concreting in accordance with ACI 306R shall apply, mortar and concrete shall be heated to a minimum temperature of 70°.

**207.3.1.6** Brick and block manholes shall be plastered on the outside with at least 1/2" of mortar in a manner that will seal the structure completely.

**207.3.1.7** A minimum of three (3) courses and a maximum of six (6) courses of brick shall be placed above the top of the cone section of all poured, precast or block manholes and inlets when the structures are installed in non-curb and gutter areas. When in curb and gutter areas, only the maximum adjustment shall apply. When specified by the ENGINEER, recycled rubber adjustment rings shall be used for the final adjustment between pavement and the cone section. Rubber adjustment rings

shall be "Flex O Ring" as manufactured by American Highway Products or approved equal.

### **207.3.2 Materials**

**207.3.2.1 Concrete** Concrete for bases and poured structures shall have a compressive strength of 3,000 p.s.i. and a minimum of five (5) sacks of cement per cubic yard. Slump shall not exceed three inches (3"). Aggregates shall meet current MDOT requirements.

**207.3.2.2 Brick** Brick shall be Grade MS conforming to the requirements of the Standard Specifications for Sewer Brick. American Society for Testing Materials, Designation C-32.

**207.3.2.3 Mortar Block** Mortar block shall meet ASTM requirements for load bearing Concrete Masonry Units C-90, Grade N-II (MDOT).

**207.3.2.4 Water** Water for concrete or mortar shall be clean and fresh, free from oil, acids or organic matter.

**207.3.2.5 Mortar** for laying brick or block and plastering outside of structure shall be C-270, Type S composed of one (1) part portland cement and two (2) parts fine aggregate MDOT 2NS - Specifications. The mortar cement shall be of the "non shrinking" characteristic.

**207.3.2.6 Frame and Cover** The manhole frame and cover shall be of gray iron conforming to ASTM A-48, Class 35 in a solid cover of design conforming to the Standard Details. All frames and covers shall be dipped in coal tar varnish. Castings shall be free from pouring faults, sponginess, cracks, blowholes, blisters, shrinkage strains, and other defects. Plugging of defective castings is not permitted. Castings shall be true to pattern in form and dimension. Weight of castings shall not vary by more than 5 percent from published weight. CONTRACTOR shall submit invoices showing actual weight of casting as certified by manufacturer. Castings shall have machined bearing surfaces. All castings shall be coated with non-toxic, nonflammable, water-based, asphalt paint. Lettering shall be cast on covers. Unless indicated otherwise, the manufacturer's name shall be cast in cover. Covers for sanitary sewer manholes shall be solid lids and labeled "Sanitary Sewer". Castings for Storm Sewer Structures shall include the phrases "DUMP NO WASTE" and "DRAINS TO WATERWAYS" with the "eco-fish" symbol. All storm sewer manhole covers shall be vented.

**207.3.2.7 Manhole Steps** Manhole steps shall be one inch (1") high-grade aluminum or cast iron with foot recess and suitably scored so as to provide a non-slip surface, or as approved by the ENGINEER. The step shall be placed fifteen inches (15") apart (center to center) with the top step no more than twenty-four inches (24") from the top of casting and the bottom step no farther than twenty-four (24") inches from the bench of the manhole.

### **207.3.3 Installation**

**207.3.3.1 Backfilling** After the structure and mortar have set up sufficiently to avoid damage, backfilling shall be done in a manner that will not cause unequal pressure on the structure. No material except MDOT Class II or native material if approved by the ENGINEER shall be placed within three feet (3') of the structure.

**207.3.3.2 Drop Manholes** Drop manholes shall be constructed in accordance with SD-105 unless otherwise stated in the Contract Documents.

**207.3.3.3 Covers** "Covers", as specified, will be included in the contract unit price for manholes, which shall constitute furnishing new castings and other materials and placing and adjusting the castings.

**207.3.3.4 Reconstruction** "Reconstructing Manholes", "Reconstructing Catch Basins", and "Reconstructing Inlets" will be paid for at the contract unit price each, which shall constitute payment in full for furnishing the labor and materials and fittings, and for all necessary excavation, backfilling, and proper disposal of surplus material necessary to complete the reconstruction.

**207.4 Oil/Sediment In-Line Separators** Storm water treatment devices shall be in accordance with the current City Storm Water Design Criteria Manual.

**207.5 Chain-Link Fence** Install chain-link fence, as manufactured by American Steel and Wire Company, Continental Steel Corporation, Kokomo, Indiana, Page Steel and Wire Division, Monessen, Pennsylvania, or approved equal.

Fabric shall be 9-gage wire (before galvanization) woven in a 2-in mesh with knuckled top and bottom salvage. Fabric shall be hot-dip galvanized after weaving.

Corner posts and gate posts shall be 3 inches outside-diameter round hot-dip galvanized pipe spaced at 10 feet – 0 inches on center, with a minimal weight of 1.33 pounds per lineal foot.

Footings for corner and gate posts shall be 12 inches in diameter and shall be 40 inches deep with posts set 32 inches deep.

Footings for line posts shall be 12 inches in diameter and shall be 36 inches deep with posts set 32 inches deep.

Top and bottom rail shall be 1-5/8 inches outside-diameter round hot-dip galvanized pipe.

Fence shall be 6 feet high above grade, using 6-foot chain-link fabric.

The gate frames shall be made of 2-inch tubing and jointed at the corners in such a manner so as to form a rigid panel. The frame shall be filled with the same gage and mesh-size fabric as used on the fence. The fabric shall be fastened in the frame on all four sides, by means of adjustable hook bolts and tension rods. When barbed wire is used, three strands of barbed wire shall be fastened to the extended end bars of the gate frames.

The gate shall be 12 feet wide and capable of being opened and closed easily by one person.

The latches shall have a plunger-bar arrangement to engage the center stop. Latches shall be arranged for locking. The center stops shall consist of a device arranged to be set in concrete, and to engage to plunger-bar of the latch.

All public basin fencing shall be 6 feet high, vinyl-coated, chain-link fabric, brown in color.

#### **207.6 Retaining Wall, Block**

The work under this item shall be performed in accordance with Section 706 of the 2003 MDOT Standard Specifications for Construction and manufacturer specifications, with exceptions noted below.

This work shall consist of all labor, material, and equipment necessary to furnish and install the block retaining wall as shown on the plans and herein described.

The masonry wall shall be built of classic units in antique red color, manufactured by Rockwood Retaining Walls, Inc., phone number (800) 536-2376.

The CONTRACTOR shall prepare the new embankment grade, place geotextile liner identical to that required for heavy rip rap, and place the block retaining wall units.

The block retaining wall will be measured by length and multiplied by the average height, measured from the bottom of the first course to the top of the top course, to obtain the face area of block retaining wall actually installed. The CONTRACTOR shall be paid this unit price bid per square foot of block retaining wall actually built.

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## 208.0 QUALITY CONTROL

### 208.1 Water Mains

#### 208.1.1 Pressure Tests

**208.1.1.1 General** Preliminary testing of mains shall be done by the CONTRACTOR to ascertain if there are any major leaks. Final pressure tests shall be made in the presence of the ENGINEER who shall receive 24 hour notice prior to testing. If it is necessary for the ENGINEER to supervise more than one test, the CONTRACTOR will be liable for the additional cost involved. Operation of system valves shall only be done by the CITY or the CITY's contract operator. **The CONTRACTOR shall not operate valves on an active system.**

**208.1.1.2 Test Restrictions** Test pressure shall not be less than 1.25 times the working pressure at the highest point along the test section. Test pressure shall not exceed pipe or thrust-restraint design pressures. The hydrostatic test shall be of at least a 2 hour duration. The pressure shall not vary by more than 5 psi (35 Mpa or 0.35 bar) for the duration of the tests.

Valves shall not be operated in either direction at differential pressure exceeding the rated valve working pressure. Use of a test pressure greater than the rated valve pressure can result in trapped test pressure between the gates of a double-disc gate valve. For tests at these pressures, the test setup should include provision, independent of the valve, to reduce the line pressure to the rated valve pressure on completion of the test. The valve can then be opened enough to equalize the trapped pressure with the line pressure, or fully opened if desired.

**208.1.1.3 Pressurization** After the new pipe has been placed, it shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the lowest point along the test section. Each valved section of pipe shall be slowly filled with water, and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the CITY. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure. The system shall be allowed to stabilize at the test pressure before beginning the leakage test.

**208.1.1.4 Air Removal** Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the CONTRACTOR shall install additional corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the unneeded corporation cocks shall be removed and plugged at the CONTRACTOR's expense.

**208.1.1.5 Examination** Any exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, hydrants, or joints that are discovered following the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until it is satisfactory to the ENGINEER.

**208.1.1.6 Leakage Defined** Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi (35 Mpa or 0.35 bar) of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

**208.1.1.7 Allowable Leakage** No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = SD\sqrt{P} \div 133,200$$

Where: L = Allowable leakage, in gallons per hour  
 S = Length of Pipe Tested, in feet  
 D = Nominal Diameter of the Pipe, in inches  
 P = Average test pressure during the leakage test, in pounds per square inch

This formula is based on an allowable leakage of 11.6g gdp/mi/in. of nominal diameter at a pressure of 150 psi and shown in the following table:

Table allowable leakage per 1000 ft of Pipeline\* -- gph

Nominal Pipe Diameter - in.

Avg. Test Pressure psi (bar)	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54
450 (31)	0.48	0.64	0.95	1.27	1.59	1.91	2.23	2.55	2.87	3.18	3.82	4.78	5.73	6.69	7.64	8.60
400 (28)	0.45	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.60	4.50	5.41	6.31	7.21	8.11
350 (24)	0.42	0.56	0.84	1.12	1.40	1.69	1.97	2.25	2.53	2.81	3.37	4.21	5.06	5.90	6.74	7.58
300 (21)	0.39	0.52	0.78	1.04	1.30	1.56	1.82	2.08	2.34	2.60	3.12	3.90	4.68	5.46	6.24	7.02
275 (19)	0.37	0.50	0.75	1.00	1.24	1.49	1.74	1.99	2.24	2.49	2.99	3.73	4.48	5.23	5.98	6.72
250 (17)	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14	2.37	2.85	3.56	4.27	4.99	5.70	6.41
225 (16)	0.34	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25	2.70	3.38	4.05	4.73	5.41	6.03
200 (14)	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12	2.55	3.19	3.82	4.46	5.09	5.73
175 (12)	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	1.98	2.38	2.98	3.58	4.17	4.77	5.36
150 (10)	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84	2.21	2.76	3.31	3.86	4.41	4.97
125 (9)	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68	2.01	2.52	3.02	3.53	4.03	4.53
100 (7)	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.80	2.25	2.70	3.15	3.60	4.05

\*If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

**208.1.1.8 Water** Water for making tests will be furnished by the CITY if it is available under pressure; otherwise by the CONTRACTOR at his expense.

**208.1.1.9 Valves** When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gph/in. of nominal valve size shall be allowed.

**208.1.1.10 Hydrants** Acceptance shall be determined on the basis of allowable leakage. If any test of laid pipe discloses leakage greater than that specified in Section 208.1.1.7, the CONTRACTOR shall, at his own expense, locate and make approved repairs as necessary until the leakage is within the specified allowance.

**208.1.1.11 Visible Leaks** All visible leaks shall be repaired, regardless of the amount of leakage. All piping shall be "Bottle Tight" at system pressure prior to acceptance.

## **208.1.2 Disinfection**

**208.1.2.1 General** The CONTRACTOR shall sterilize all new water mains in accordance with AWWA C-651 and in a manner acceptable to the MDEQ. The following method or others acceptable to the MDEQ and the ENGINEER shall be used. Chlorine pills and/or powder are not acceptable when placed in the pipe during construction.

**208.1.2.2 Flushing** Flush out the new pipe lines until the water runs clear. This shall be done after the pressure test and before disinfection. Each valved section of the newly laid pipe shall be flushed separately with potable water from the public supply. The CONTRACTOR shall notify the water utility responsible for maintenance of the existing system prior to any scheduled flushing. Flushing shall provide a minimum of 2.5 feet per second of water velocity.

**208.1.2.3 Disinfection** Disinfect the pipe lines in accordance with AWWA C-651 with chlorine applied either as a gas from cylinders through a portable solution feed chlorinator or by the introduction of a hypochlorite solution. Calcium hypochlorite in commercial grades contains about 65% to 70% of free chlorine. Hypochlorite powder shall first be made into a paste and then thinned to 1% chlorine solution.

**208.1.2.4 Application** The point of application of the chlorinating agent shall be at the beginning of the pipe line extensions, any valved section of it, or through a corporation cock inserted in the newly laid pipe. Water from the existing distribution system shall be controlled to flow very slowly into the newly laid pipe during the application of chlorine. Partially open the end-most hydrant or valve on the section of pipe line under treatment to permit the flow of water through the pipe line and to prevent the building up of water pressure in excess of twenty (20) p.s.i. Continue treatment until the flow of water from the far end of the main contains sufficient

residual chlorine, 40 to 50 parts per million, as determined by the drop dilution test as per Michigan Department of Health Instructions.

The treated water shall remain in the pipe line for a minimum of twenty-four hours, following which period the main shall be thoroughly flushed until all of the heavily chlorinated water is removed. Test water samples with orthotolidine reagent to see that the replacement water is chemically and bacteriologically acceptable.

**208.1.2.5 Samples** Bacteriological water samples shall be collected by the ENGINEER or his duly authorized representative from the end of the main being tested. Analysis of the sample shall be made by a State approved laboratory. If the results are unsafe, the disinfection process shall be repeated. The responsibility for the test rests with the CONTRACTOR who shall also be liable for any costs to the ENGINEER when more than two treatments or tests are necessary. Two samples will be required with the second sample taken 24 hours after the first sample in accordance with AWWA C-651.

**208.1.2.6 Sampling Distances** Bacteriological water samples shall be collected in accordance with current AWWA, MDEQ and Michigan Department of Public Health guidelines. Sampling points shall be located between the beginning of the new main and the chlorination point and also at the end of the newly installed water main or every 1,000 lineal feet whichever is the smaller distance. In no case shall the distance between sampling points exceed 1,200 lineal feet.

Upon completion of the sampling, any corporation fitting(s) used shall be removed and permanent brass plug(s) installed as approved by the ENGINEER.

### **208.1.3 Electrical Conductivity**

**208.1.3.1 General** All cast iron, ductile iron pipe and fittings furnished and installed under this contract shall be provided with electrical conductivity connections as described in Sections 208.1.3.2 and 207.1.2.8 of these specifications.

**208.1.3.2 Testing** If requested by the ENGINEER, after installation of the mains and before backfilling of the joints, the CONTRACTOR shall verify to the ENGINEER's satisfaction, that the system (pipeline and mechanical joint fittings) provide for electrical continuity across each joint and fitting.

This test can be accomplished by attaching one lead of a simple volt/ammeter tester to one side of the joint or fitting and the other lead to the opposite side of the joint or fitting and observing that a current is being conducted. If the CONTRACTOR wishes to employ other means of testing, the CONTRACTOR must first outline the procedure for the approval of the ENGINEER.

### **208.2 Sanitary and Storm Sewers**

**208.2.1 General** All tests shall be performed under the observation of the ENGINEER or RPR. Prior to connecting any active sewer services or extending services beyond the property line, the new sewers and services shall be tested for alignment and leakage. The sewer shall be thoroughly cleaned before the ENGINEER is requested to witness or perform any tests.

**208.2.2 Alignment** Sewers must be straight between manholes and will be tested for straightness by lamping between manholes or by other means acceptable to the ENGINEER.

#### **208.2.3 Deflection**

**208.2.3.1** Deflection tests shall be performed on all flexible pipe. The test shall be conducted after the final backfill has been placed and prior to installing any asphalt or concrete surface, unless otherwise approved by the ENGINEER. The ENGINEER may require that a second deflection test be performed 30 days or more after the initial test.

**208.2.3.2** Maximum deflection under full load shall not exceed 5% of the ASTM designated average inside diameter as determined by the laboratory for the specified piping. Should a pipe exceed the allowable deflection, the CONTRACTOR shall, at his expense, replace those pipes and retest the section.

## 208.2.4 Leakage (sanitary only)

### 208.2.4.1 Water Testing

**208.2.4.1.1 General** Unless otherwise called for in the Special Specifications, the maximum allowable infiltration or exfiltration shall be 200 gallons per day per inch of diameter per mile of pipe. The joints shall be tight and any visible leakage in the joints and leakage in excess of that specified shall be repaired.

Branch fittings and ends of house service stubs shall be securely plugged to withstand test pressure. The section of line being tested shall also be securely plugged as required. All plugs shall be adequately braced.

No section tested may show a leakage over the allowable limit and the average leakage for the project shall not exceed the allowable limit. All manholes will be inspected for visible leakage and the CONTRACTOR shall make all necessary repairs.

**208.2.4.1.2 Infiltration** Where the ground water level is above the top of the pipe, the sewer shall be tested for infiltration. The CONTRACTOR shall furnish, install and maintain a "V" notch weir, tightly secured to the low end of each section of sewer, so that the infiltration may be checked. The weir shall be direct reading of an approved design calibrated to read gallons per day. When the infiltration is demonstrated to be within the allowable limits, the CONTRACTOR shall remove the weirs and all framing, leaving the sewers and manholes clean and free of any debris.

**208.2.4.1.3 Exfiltration** Exfiltration tests will be required only when the natural or induced ground water table is less than 2 feet over highest point in pipeline under test, including house services. Exfiltration tests shall be made by filling the line to minimum depth of 2 feet above the high point of the line under test, with allowance for ground water level, and measuring the water required to maintain this level.

**208.2.4.2 Low Pressure Air** Where approved by the ENGINEER, the CONTRACTOR may perform low pressure air acceptance tests in lieu of infiltration and exfiltration tests. The CONTRACTOR shall furnish all equipment and personnel to conduct an acceptance test using low pressure air in accordance with ASTM F-1417.

Air shall be slowly supplied to the plugged pipe line until the internal air pressure reaches 4.0 pounds per square inch greater than the average back pressure of any ground water that may submerge the pipe. At least two minutes shall be allowed for temperature stabilization before proceeding further.

The rate of air loss shall then be determined by measuring the time interval required for the internal pressure to decrease from 3.5 to 2.5 pounds per square inch.

The pipe line shall be considered acceptable if the time interval for the 1.0 psi pressure drop is not less than the holding time listed in 208.2.4.2.2.

**208.2.4.2.1 Water Table Conditions** In areas where ground water is known to exist, the CONTRACTOR shall determine the extent of ground water over the invert of the pipe and apply additional pressure to the test pressure as follows:

<u>Extent of Ground Over Invert of Pipe</u>	<u>Pounds of pressure to be Added to Test Pressure</u>
1 foot	0.5
2 feet	0.8
3 feet	1.3
4 feet	1.7
5 feet	2.1
6 feet	2.6
8 feet	3.4
10 feet	4.3
12 feet	5.2
14 feet	6.1
16 feet	6.9

**208.2.4.2.2 Table for Loss** Time required for loss of pressure from 3.5 PSIG to 2.5 PSIG for size and length of pipe indicated for Q = 0.003 (cu. ft./min/sq. ft. of internal surface area).

Pipe Diameter (in.)	Minimum Time (min:sec.)	Length for Minimum Time (ft.)	Time for Longer Length (sec.)	Specification Time for Length (L) Shown (min:sec)										
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	500 ft	550 ft	600 ft
4	1:53	597	.190L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:54
6	2:50	398	.427L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12	3:34	3:55	4:16
8	3:45	298	.760L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42	6:20	6:58	7:36
10	4:43	239	1.187L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54	9:54	10:53	11:52
12	5:40	199	1.709L	5:40	5:40	5:42	7:08	8:33	9:48	11:24	12:50	14:15	15:40	17:06
15	7:05	154	2.671L	7:05	7:05	8:54	11:08	12:21	15:35	17:48	20:02	22:16	24:29	26:43
18	8:30	133	3.846L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51	32:03	35:16	38:28
21	9:55	144	5.235L	9:55	13:05	17:27	21:11	30:11	30:32	34:54	39:16	43:37	47:59	52:21
24	11:20	99	6.837L	11:24	17:57	22:48	28:30	34:11	39:11	45:35	51:17	56:59	62:41	68:23
27	12:45	88	8.653L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54	72:07	79:20	86:33
30	14:10	80	10.683L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07	89:02	97:56	106:51
33	15:35	72	12.926L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57	107:44	118:31	129:17
36	17:00	66	15.384L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23	128:13	141:02	153:51
39	18:25	61	18.054L	30:57	45:09	60:11	75:14	90:16	105:19	120:22	135:24	150:32	165:31	180:34
42	19:50	57	20.939L	34:54	52:21	69:48	87:15	104:42	122:09	139:36	157:03	174:31	191:58	209:25

NOTE: When 2 sizes of pipe are involved, the time shall be computed by the ratio of lengths involved.

Example: 400 feet of 10 inch pipe and 200 feet of 6 inch pipe.

$$\begin{aligned} \text{Time} &= \frac{\text{Length}_1 \times \text{Time}_1 + \text{Length}_2 \times \text{Time}_2}{\text{Length}_1 + \text{Length}_2} = \\ &= \frac{400 \times 7:54 + 200 \times 2:50}{400 + 200} = \frac{400 \times 474 + 200 \times 170}{400 + 200} \\ &= 373 \text{ seconds} = 6.13 \text{ (min:sec)} \end{aligned}$$

**208.2.5 Televising** This item shall consist of televising the sewer to check for misalignment, infiltration, defective pipe or joints, debris and the location of wyes. The digital video disc must have a screen record of date, project name and number and stationing to assist in locating physical features such as joints, wyes and other items listed above. The disc, along with written log and backup VHS copy, shall be furnished to and become the property of the CITY prior to acceptance.

## 208.3 Roadways

### 208.3.1 Subgrade

**208.3.1.1 Compaction** All roadway subgrades shall have the proper compaction tests performed on it to verify that all materials have been compacted to within 95% MDD.

Compaction tests shall be performed on each 500 feet of roadway or as otherwise directed by the ENGINEER.

**208.3.1.2 Grade Control** All roadway subgrades shall be checked by means of stretching a string line across the entire roadway and verifying that the proper cross slope in relation to the center line of the roadway has been provided.

This testing will be done for a maximum of every 200 lineal feet of roadway with measurements taken at the center line, 1/4 points and edge of pavement.

**208.3.2 Gravel** Finish gravel grades shall be checked in accordance with the specifications in section 208.3.1. In addition, a certified sieve analysis of the gravel shall be provided for the material from its source site. If the material is obtained from more than one site, then such analysis must be provided for each site.

### 208.3.3 HMA (Bituminous Pavement)

**208.3.3.1 Mix Design** Prior to laying of any bituminous materials for a roadway, the CONTRACTOR must submit for approval a "mix design" from his supplier.

**208.3.3.2 Extraction Testing** Sufficient materials will be supplied from the job site by the CONTRACTOR to an approved independent laboratory for the purpose of performing an extraction test. One sample shall be taken for every 400 tons of material, or fraction thereof, delivered to the site.

An extraction test (AASHTO T164-70) and a mechanical analysis (AASHTO T30-70) shall be performed on the mix samples. It shall be the responsibility of the CONTRACTOR to have the samples tested by the approved laboratory which shall furnish to the ENGINEER two (2) copies of the results.

**208.3.3.3 Material Yield** During the paving operations, "yield" calculations shall be performed on each 300 lineal feet of paving to show the average thickness of pavement being installed. This "yield" shall agree with designed pavement thickness shown on the construction drawings when unit weight is calculated at 110 lb/syd./in.

## **208.3.4 Concrete**

**208.3.4.1 Paving** Before the CONTRACTOR starts work he will be required to submit and have approved a design mix with evidence that said mix will meet all the requirements of the Specifications. This information shall be furnished by an approved laboratory which shall also check slump, entrained air content and make two (2) test beams for each pour of 250 cubic yards of concrete or less and a set for each additional 250 cubic yards or fraction thereof. It shall be the responsibility of the CONTRACTOR to have the beams delivered to the laboratory, properly cured, and tests performed by an approved laboratory which shall furnish the ENGINEER with two (2) copies of the results. If the test beams are lost or mishandled, the CONTRACTOR shall have cores taken from the pavement affected and furnish two copies of reports of their strength to the ENGINEER.

Unless otherwise provided for in the Special Specifications and/or Bid Proposal, the cost of laboratory and tests shall be incidental to the unit price for Concrete Pavement.

**208.3.4.2 Curb and Gutter** The CONTRACTOR shall provide a minimum of three test cylinders per every 500 lineal feet of curb and gutter installed to be tested by a certified laboratory. These cylinders will be tested to show the level of the flexure or compression strength of the cylinders at 7 days and 28 days.

**208.3.4.3 Side Walk** The CONTRACTOR shall provide a minimum of 3 test cylinders per each daily pour of concrete to be tested by a certified laboratory. These cylinders will be tested to show the level of compressive strength of the cylinders at 7 days and 28 days.

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## 209.0 RESTORATION

### 209.1 Sodding

**209.1.1 General** This work shall consist of furnishing and placing approved sod on the earth bed or approved soil and shall include preparation of earth bed and proper disposal of surplus material. No sod shall be placed when the temperature is below 32°F (0°C). No frozen sod shall be placed nor shall any sod be placed upon frozen soil.

**209.1.2 Materials** The sod shall be a minimum of four inches (4") in thickness and shall consist of a dense, well rooted growth of desirable perennial grasses free from noxious weeds.

**209.1.2.1 Submittals** Submittals shall be in accordance with the requirements of the City Specifications and shall include:

**209.1.2.1.1 Shop Drawings for Review:**

- a. The CONTRACTOR shall indicate all variances from the requirements of the Contract Documents.
- b. Manufacturer's material certification.

**209.1.2.1.2. Information for the Record:**

- a. Submit to Resident Project Representative:
  - 1) Invoices indicating the weight, brand, and composite analysis of fertilizer used on the project.
  - 2) Bag tickets indicating weight and composition of all seed used on the project.

**209.1.3 Payment** Trees in easements shall be included in this Section, except as otherwise stated in the easement agreement. "Sodding" shall be paid for at the contract unit price per square yard and shall be payment in full for all materials and labor.

**209.2 Seeding & Mulching** Seed shall be sown only between the dates of May 1st and October 15th, unless otherwise permitted by the ENGINEER. The operation of finish grading and sowing shall not be performed when the ground is frozen or muddy.

**209.2.1 General** Where grass areas maintained as a lawn are disturbed, the fill shall be compacted, seeded and mulched as follows:

**209.2.2 Work** This work shall consist of placing four inches (4") of top soil compacted, preparing the soil, application of fertilizer, sowing seeds of the mixture specified and placing mulch over the area seeded. The top soil shall be obtained from a source approved by the ENGINEER prior to material placement.

**209.2.3 Topsoil** Topsoil obtained from off-site shall consist of loose, friable, loamy topsoil without admixture of subsoil or refuse. It shall be reasonably free from peat, muck, roots, hard clay, coarse gravel, stones, weeds, tall grass, brush, sticks, or other litter. Each load of topsoil shall be subject to the approval of the ENGINEER. The fraction of topsoil passing a No. 10 sieve shall contain not more than 40% clay. Topsoil shall contain not less than 5% or more than 20% organic matter as determined by loss on ignition of oven-dried samples to constant weight at 212 deg F.

**209.2.3.1 Class "A" Mixture** Class "A" seed mixture shall be used for lawn areas that have been disturbed or for adjacent backslopes and shall be as follows:

	<u>Percentages</u>
Manhattan Rye	40%
Creeping Red Fescue	20%
Red Top	20%
Common Bluegrass	20%

**209.2.3.2 Class "B" Mixture** All other areas that have been disturbed shall be as follows:

	<u>Percentages</u>
Perennial Rye	30%
Kentucky Blue	20%
Creeping Red Fescue	30%
Alsike Clover	20%

**209.2.3.3 Preparation of Area** After the areas to be seeded have been brought to the required grade, the soil shall be loosened and mixed to a depth of four inches (4") until it is in a friable condition. (Chemical fertilizer of the 12-12-12 grade and worked into the soil 48 hours prior to seeding.)

**209.2.4 Fertilizer** The area to be seeded shall be disked and harrowed and all depressions filled in accordance with MDOT Item 621.03. Fertilizer shall be applied at a rate which will provide 240 lbs/acre of chemical fertilizer nutrients in equal proportions of Nitrogen, Phosphoric Acid, and Potash. Either dry or liquid fertilizer may be used and shall be distributed in an even pattern over the specified area, then thoroughly disked, harrowed, or raked into the soil to a depth of not less than 1 in.

All clods, rubbish, and stones greater than 1 in. in any dimension shall be removed and the area graded to a smooth surface. Hand raking will be required in areas

inaccessible to machines and will be required in areas of urban character and in front of residences where machines do not provide results equivalent to hand raking.

**209.2.4.1 Rate** Seed as specified above shall be sown at a rate of 6 pounds per 1,000 square foot for lawns. After seeding, the area shall be rolled.

**209.2.5 Mulching** Mulching consisting of clean straw or hay shall be spread over the surface of the seeded area at a uniform thickness at the rate of 100 pounds per 1,000 square feet. Within 48 hours after an area has been seeded, it shall be mulched in conformance with one of the following specified methods as designated in the Special Provisions or the Contract Item for Seeding:

**Hay or Straw Mulch:**

- a. Mulching with hay or straw shall be in conformance with mulching requirements of MDOT Sections 816.03E and 816.03G. except that in front of residences the mulching material shall be kept in place by an approved nontracking adhesive or other approved method in lieu of the specified asphalt emulsion.
- b. Matting used for mulching shall be placed in conformance with MDOT Section 816.03F. Matting shall be used on all slopes greater than 10:1.

**209.2.6 Hydro-Mulch** Hydro-mulching shall meet or exceed specifications for conventional seeding. Weight tickets for seed (with proper mixture identified), fertilizer and mulch shall be required for payment according to the unit price bid per square yard.

**209.3 Watering and Maintenance** Seeded and sodded areas shall be watered and maintained as specified below until they are established.

1. The seed bed shall be thoroughly watered as soon as the seed is covered.
2. Water shall be applied by a hydro-seeder or water tank under pressure with a nozzle producing a spray that will not dislodge the mulching material.
3. Water applications shall be made at least once a week, provided significant rainfall has not occurred within the weekly period.
4. The rate of application shall be 120 gal/1,000 sf.
5. The CONTRACTOR shall keep all sodded areas, including the subgrade, thoroughly moist for two weeks after sodding. After the two-week period, the CONTRACTOR shall water the sod as specified for seeded areas.
6. Matting areas shall be maintained until all work on the Contract has been completed and accepted.

7. The seeded areas shall be mowed once at an approximate height of 6-in. as directed by the ENGINEER to control excess growth, including weeds.
8. Maintenance shall consist of the repair of areas damaged by erosion, wind, fire, or other causes. The soil in these damaged seeded areas shall be restored to the condition of grade existing prior to application of matting, and restored areas shall be relimed, refertilized, and reseeded. Where necessary, the matting shall be completely replaced. Damaged sod shall be replaced with new sod.

## **209.4 Driveway Replacement**

**209.4.1 Gravel Drives** All disturbed gravel driveway surfaces shall be replaced with six inches of MDOT 22A gravel compacted to 95% MDD. This shall be paid for and measured under MDOT 22A Gravel.

**209.4.2 Crushed Stone Drives** All disturbed driveways which had crushed stone or pea gravel surfaces shall be replaced with like material to a depth required by the ENGINEER. This shall be paid for according to the number of cubic yards delivered.

**209.4.3 Bituminous Drives** All disturbed bituminous driveway surfaces shall be replaced with 6 inches of compacted MDOT 22A gravel and surfaced with 3 inches of compacted MDOT bituminous top course material. This shall be paid for under bituminous driveway replacement and includes gravel and bituminous. The bituminous material may be laid in one layer.

**209.4.4 Concrete Drives** All disturbed concrete driveway surfaces shall be replaced with 6 inches of Portland cement concrete placed over 2 inches of compacted sand or suitable base material. Concrete mixture shall be P1 or S2 with limestone or slag aggregate.

**209.5 Concrete Curb and Gutter** Concrete curb and gutter removed to facilitate construction shall be replaced in kind to the line, grade and limits as established by the ENGINEER. Replacement shall be in accordance with the Standard Specifications, Section 207.4.3.

Removal and replacement of concrete curb and gutter shall be measured according to the number of lineal feet replaced. This payment shall be payment in full for all necessary labor, equipment and materials necessary for this removal and replacement.

**209.6 Sprinkler Heads** The CONTRACTOR shall remove all sprinkler heads, water lines, and appurtenances necessary, and take such precautions necessary to prevent damage to the same. As soon as possible after the construction of the improvement, the CONTRACTOR shall replace the sprinkler heads, water lines, and appurtenances in good condition. Removal and replacement of the sprinkler heads, water lines, and appurtenances shall be paid for as specified in the Bid Proposal.

## **209.7 Tree & Stump Removal**

**209.7.1 General** This work shall consist of removing trees where called for on the plans or directed by the ENGINEER, and shall include cutting such trees, removing their stumps and roots from the ground and properly disposing of the material.

**209.7.2 Chipping** The trees, stumps, roots and debris shall be removed and properly disposed of by the CONTRACTOR. 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.

**209.7.3 Payment** The complete work as measured for REMOVE TREE will be paid for at the contract unit prices as set forth in the Bid Proposal.

The size of the trees will be determined by the average diameter of the tree trunk, measured to the nearest full inch, at a point 4-1/2 feet above the base of the tree at the ground line. Trees having major limbs lower than 4-1/4 feet from the ground shall be measured at the smallest diameter below such limbs.

Removing trees less than 8 inches in diameter shall be considered incidental to Clearing and Grubbing.

**209.7.4 Multiple Trees** Where more than one tree has grown from a common stump, each tree will be measured as a separate tree or stump.

## **209.8 Tree Replacement**

**209.8.1 General** Unless otherwise specified, each tree removed shall be replaced with nursery grown tree. The replacement tree shall be at least 2-1/2 inches in diameter. The replacement tree shall either be of the variety indicated on the drawings, of the same variety as the tree removed, or of the variety listed below. It is the CITY's intent to have the replacement tree be of the same variety as the tree removed unless the property OWNER requests otherwise or the tree removed is of an undesirable variety. If the tree's variety is not indicated on the drawings, the replacement tree shall be of a variety listed below. Final selection of the replacement tree's variety shall be made by the ENGINEER.

**209.8.2 Payment** The replacement shall be paid for at the contract unit price as specified under section Nursery Grown Plants. Tree replacement shall be planted at the location staked out by the ENGINEER.

### **209.8.3 Tree Type**

Ginko (Ginkgo Biloba) - male trees only

Norway Maple (Acer Platanoides)

Crimson King Maple (Acer Platanoides "Crimson King")

Sugar Maple (Acer Asaccharum)

Seedless Ash (Fraximum Pennsylvanicum)

Little Leaf Linden (Tilia Cordata)

Silver Linden (Tilia Tomentosa)  
Crimeam Linden (Tilia Euchlora)  
Honey Locust (Gledistsia Traicanthos)  
Red Oak (Quercus Levelia)  
English Oak (Wuercus Robur)  
Bradford Pear (Pyrus Calleryana)

## **209.9 Shrubs and Plantings**

**209.9.1 General** Shrubs and other plantings which may be damaged during any phase of the construction shall, with the permission of the OWNER, be replanted as directed or removed to an area provided by the CONTRACTOR and "heeled" in until such time as they can be replanted in their original location. The work shall be done in the acceptable manner and the CONTRACTOR shall be required to replace any shrubs or trees that fail to survive.

## **209.9.2 Nursery Grown Plants**

### **209.9.2.1 Materials**

**209.9.2.1.1** All plants shall be nursery grown in accordance with modern horticultural practice under climatic conditions similar to those in the locality of the job. They shall have been root pruned or transplanted several times.

Plants shall be freshly dug. No cold storage or healed in plants will be acceptable. Plants shall be typical of their species or varieties. Plants shall have normal, well-developed branches and vigorous fibrous root system. They shall be healthy, vigorous plants free from defects, decay, disfiguring roots, sun-scald injuries, abrasion of the bark, plant diseases, insect pests eggs, bores and all forms of infestations of objectionable disfigurements.

Trees shall have straight trunks with the leader intact, undamaged and uncut. Any old cuts and abrasions shall be completely callused over.

**209.9.2.1.2 Sizing** All trees and shrubs shall be measured when their branches are in normal position. Height and spread refer to main body of the plant.

The determining measurement for trees shall be the caliper 12" above the ground for trees greater than 4" in caliper and 6" above ground for trees less than 4" in caliper.

All plant sizes shall be in accordance with those called for on the plans or in the specifications. Larger plants shall not increase contract price, unless prior approval has been granted.

Small plants shall be used only by prior approval and must adjust contract prices accordingly.

**209.9.2.1.3 Pruning** No pruning will be done prior to delivery.

**209.9.3 Installation**

**209.9.3.1** Final planting shall be staked out by the ENGINEER.

**209.9.3.2** Planting shall be performed by personnel familiar with planting procedure and under the supervision of a qualified foreman.

**209.9.3.3** All trees and shrubs shall be planted plumb.

**209.9.4 Inspection of Materials** Plants will be subject to inspection on quality, size and color. Plants lacking compactness or proper proportion, plants which are weak or thin, or plants injured by too close planting in nursery rows will not be accepted. Plant material which has been cut back from larger grades to meet certain specified requirements will be rejected. Right is reserved to reject plants considered as unsatisfactory. Rejected plants shall be removed from site.

**209.9.5 Guarantee and Replacement**

**209.9.5.1 General** Any planting failing to grow within two year guarantee period shall be replaced and replanted with materials of like size, quality, and variety by the end of the first transplanting season following termination of the guarantee period.

**209.9.5.2 Guarantees** All guarantees shall be limited to one replacement of each plant, unless the cause of plant mortality is a direct result of CONTRACTOR negligence. The guarantee will not apply where plants die because of animal damage, vandalism, injury by fire, drowning, storm, hail, drought, insects disease, exceptional or untimely freeze, or act of nature. Guarantee period will not begin until completion of project.

**209.9.5.3 Payment** Plantings will only be paid for on a unit price basis when agreed upon by the ENGINEER. This price shall include the initial material, installation and replacement of dead plantings. All other plantings shall be incidental.

## **209.10 Roadway**

**209.10.1 Ditch Cleanout** The CONTRACTOR shall clean and reshape existing ditches to the grades and cross sections as shown on the drawings. Excess excavation shall be properly disposed of in a manner satisfactory to the ENGINEER. "Ditch Cleanout" shall be paid for at the unit price per lineal foot of ditch cleaned.

**209.10.2 Relaying Existing Culverts** This work shall consist of removing existing culverts, cleaning and relaying to the new grade established under ditch cleanout. Deformed ends of CMP shall be straightened out so they do not impede the flow of water. Backfill shall be as per 207.2.1.5.1. "Relay Existing Culverts" shall be paid for at the contract unit price per foot and shall be payment in full for all Work listed above.

**209.10.3 Adjustment of Utility Covers** On any project that is resurfaced, the CONTRACTOR shall be required to adjust the covers on all utility structures or monument boxes to the elevation of the new cross section. The cost of such adjustments shall be as set forth in the Bid Proposal.

**209.10.4 Flush and Clean Existing Culverts** This Work shall consist of cleaning all dirt and debris from existing culverts where called for on the Drawings. The contract unit price per lineal foot shall be payment in full for equipment and labor necessary to complete the Work.

**209.10.5 Deformed Culverts** Deformed ends of culverts not covered under other items shall be straightened out to the satisfaction of the ENGINEER.

## **209.11 Erosion Controls**

**209.11.1 Erosion Control Blanket** Areas indicated on the drawings and areas directed by the ENGINEER shall be stabilized with "Curlex II doublenet" Excelsior Blanket by American Excelsior Company, S150 Hi Velocity Erosion Control Blanket by North American Green, or approved equal following application of the specified restoration materials. This material shall be installed in accordance with the manufacturer's guidelines.

**209.11.2 Plain Rip Rap** This work shall consist of construction of a protective covering of approved stone on an earth bed covered with a filter fabric and shall include excavation and proper disposal of excavated material. The rip-rap shall be a minimum of four inches (4") thick and shall commence to a foot above the ditch bottom on the inside slope and continue to the top of the back slope. Rip Rap shall be native stone, broken concrete is not allowed. Each stone shall be laid by hand and firmly embedded into the slope. "Plain Rip-Rap" shall be paid for at the unit price per square yard, and shall be payment in full for all material and labor.

**209.11.3 Grouted Rip Rap** The stone shall be laid as specified for plain rip-rap and the spaces shall be filled with mortar as specified in Section 7.02 MDOT Specifications. "Grouted Rip-Rap" shall be paid for at the unit price per square yard and shall be payment in full for all material and labor.

## **2.09.12 Steel Beam Guard Rail**

**209.12.1 Materials** All materials, methods of construction and basis of payment shall be in accordance with the applicable portion of current MDOT Specification and Standard Details.

**209.12.2 Use** Steel beam guard rail (12 gauge galvanized) shall be used in sections of the required lengths where called for on the drawings.

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## 210.0 LIFT STATIONS

**210.1 General** The CONTRACTOR shall supply to the CITY one complete below ground submersible pump station with all necessary equipment and material needed for its operation. Main items of work include the valve and pump chambers, submersible pumps, valves, piping, force main, electrical wiring and controls, and control panel.

**210.2 Discrepancies** Before starting the fabrication and installation of the lift station, the CONTRACTOR shall examine the proposed plans and these specifications. If any discrepancies occur, he shall report them to the ENGINEER in writing and obtain written instructions for changes in the work.

### 210.3 Submittals

**210.3.1 Shop Drawings** The CONTRACTOR shall submit to the ENGINEER all shop or setting drawings and schedules required for the work. The CONTRACTOR shall make any corrections in the drawings required by the ENGINEER and resubmit the same without delay.

**210.3.1.1 Required Shop Drawings** The CONTRACTOR shall furnish shop drawings for the below listed equipment:

- |                          |   |
|--------------------------|---|
| a) Pump, Motor and Seals | i) Access Doors, including dimensions and locations |
| b) Guide Bars or Rails   | j) Grating and Supports                             |
| c) Discharge Connection  | k) Control Panel(s)                                 |
| d) Check Valves          | l) Transformers                                     |
| e) Plug Valves           | m) Motor Starters                                   |
| f) Gate Valves           | n) Wiring Devices                                   |
| g) Trash Basket and Rake | o) Sewer Power Lightning Arresters                  |
| h) Sump Pump             | p) Electrical Receptacles                           |

**210.3.1.2 Pump Curves** The CONTRACTOR shall furnish to the ENGINEER with the shop drawings, performance curves and tables showing flow in gallons, total head in feet, efficiency in percent, and brake horsepower. Also, within sixty (60) days after lift station start-up the CONTRACTOR shall furnish certified performance curves for each pump showing flow in gallons, total head in feet, efficiency in percent, and brake horsepower.

**210.3.1.3 Controls and Enclosures** Shop drawings shall be required for all pump controls, for all equipment, and electrical enclosures. Schematic drawings and wiring diagrams showing all components shall be submitted for the pump controls, equipment enclosures, lift station control circuitry and alarms.

## **210.3.2 Manuals**

**210.3.2.1 Installation Instructions** The CONTRACTOR shall furnish to the ENGINEER at the time of the delivery of the equipment one copy of installation instructions for such equipment.

**210.3.2.2 Operating and Maintenance Manuals** The CONTRACTOR shall deliver to the ENGINEER four (4) copies, each containing "as-Built" data on lift station equipment, instructions on operation and maintenance, list of spare parts and sources from which they may be obtained and a list of spare parts recommended to be maintained on the site. These manuals shall be delivered within sixty (60) days after lift station start-up. Each copy shall be submitted in separate three-ring binders, properly indexed, and identified with Table of Contents, including pump curve data.

## **210.4 Structures**

**210.4.1 Installation** The installation of the chambers and appurtenances shall be as per the manufacturer's recommendations, approved shop drawings, the drawings and these contract documents. All precast concrete bases shall be set on a bed of pea gravel, with a minimum thickness of four inches or as approved by the ENGINEER.

**210.4.2 Pump Chamber** The pump chamber shall be the diameter and wall thickness as specified on the drawings. The chamber shall be precast reinforced concrete ASTM C-478 (manhole sections) with O-ring joints. The base and top shall be precast and as detailed on the drawings. The top slab shall have a 5 to 7 percent air entrainment in the concrete. The joints between the precast sections shall be of the O-ring seal type ASTM C-443, with the joints between the base and sections sealed with RAM-NEK, Cadilloc or an approved equal material. All connections into the structure shall be Kor-N Seal or approved equal.

The CONTRACTOR shall paint the exterior of the pumping chamber with two coats of self-priming coal tar water proofing at 7.0 mils per coat. The exterior shall be wire brushed prior to painting. All other metallic surfaces (not aluminum), supports and fasteners, shall be painted and wire brushed prior to being painted. All submerged surfaces shall be painted with two coats coal tar epoxy (8 mils per coat); and all not-submerged surfaces shall have one coat epoxy primer (1-1/2 mils) and two coats polyamide cured epoxy gloss enamel (8 mils per coat). All aluminum surfaces in contact with concrete or steel shall be coated with a bitumastic material.

**210.4.3 Valve Chamber** The valve chamber shall be of the diameter as specified on the drawings. The material method of installation, and painting shall be as specified in Section 210.4.2. The CONTRACTOR shall provide a sump in the valve chamber as detailed on the drawings. The sump shall have a galvanized bar-grating cover capable of supporting a 300 psf loading. Suggested manufacturers of the sump are Reliance, Borden Blaw-Knox or an approved equal. A sump pump will be required.

## **210.5 Equipment and Materials**

**210.5.1 Ladder and Grating** The CONTRACTOR shall provide within the pump chamber an aluminum, removable ladder. The rails of the ladder shall be approximately 3 inches wide by 3/4 inches deep, and the rungs shall be at least 1-1/4 inches in diameter of non-slip design and on 12 inch centers. All grating provided shall be aluminum and designed for a 150 psf loading.

The ladder shall be bolted to aluminum brackets with aluminum bolts and nuts of sufficient number and size to safely accommodate the designed loading of the ladder. The brackets shall be anchored to the pump chamber wall in a manner acceptable to the ENGINEER.

**210.5.2 Submersible Pumps** Two Class I, Division 1, Group D intrinsically safety explosion proof sewage pumps shall be furnished. The cast iron stator casting shall be oil filled with stainless steel fasteners. Seals on the pumps shall have double mechanical seal running in oil. The pump impellers shall be single or double vane of non-clog design capable of passing a 3 inch spherical solid. The material for the pump impeller shall be either cast iron or bronze.

All submersible pumps shall have motor seal chambers fitting with electrode moisture probes. Signal lights shall be provided to indicate water in the seal chambers. Thermal sensors in the motor windings shall deactivate starter when temperature exceeds safe level. Motor insulation will be the minimum of NEMA code F.

Guide bars for the pump removal shall be 2 inch diameter Schedule 40-304 non-sparking stainless steel with intermediate supports. Also provide a stainless steel chain for raising and lowering the pumps. It should be capable of lifting/lowering a minimum of 1,000 pounds. In addition, the pump discharge shall be sealed to the cast iron discharge connection bolted to the floor. The motors shall be capable of driving the pump over the full range of the characteristic curve within service factor of 1.15. The housing shall be an air or oil filled water tight casing and the Insulation shall be Class F. The motor shaft shall be stainless steel and the motor shall be capable of operating either fully or partially submerged. The CONTRACTOR shall provide a seal leakage water sensor probe. The motor starting requirements are not to exceed NEMA Code G. The specified operating conditions for the pumps and motors shall be as listed in the supplementary specifications.

**210.5.3 Piping** All force main and lift station piping shall be cement lined ductile iron pipe of the size as specified on the drawings. The pipe shall be as specified in Section 207.1.1 of these Standard Specifications. The joints within the station shall be flanged ANSI A21.10 with composition gaskets and shall be secured by stainless steel nuts and bolts as required within AWWA Standards. The joints on the force main and outside of the pump chamber shall be mechanical or push on joint capable of withstanding 150 psi pressure. All joints shall conform to Section 207.1.2 and Section 207.1.2.7.1 of these Standard Specifications. All force main shall be tested in accordance with these Standard Specifications. The piping for the sump pump discharge shall be sized as shown on the drawings and be Schedule 80 PVC with treaded joints.

**210.5.4 Valving** All Eccentric plug valves shall be rated at 150 psi, lever operated with 2 inch operating nut and position indicator and be permanently lubricated. Also, all plugs shall be eccentric seated with a drip-tight shut-off and the port area being a minimum of 80% of the pipe size. The body of the valve shall be either cast iron or stainless steel with class 125 flanged end connections. All bushings will be stainless steel and the seating surface shall be 90% nickel, 300 series stainless steel or bronze; mechanically retained; or brazed to body and be machined or ground. The rotating element seating surface shall be a neoprene capacity stuffing box and spring loaded or with an adjustable bolted gland packing the follower.

All gate valves shall conform to the standard specifications 207.1.2.4.1 as detailed herein.

All check valves shall be fully opening, iron body, bronze mounted swing checks with outside lever. The lever shall be weighted or spring loaded. A check valve shall be located on each discharge line and as shown on the plans.

**210.5.5 Access Doors** All access doors shall be heavy duty, aluminum hatches with extruded aluminum channel frame and 1/4 inch thick diamond plate cover. Each cover shall be designed to withstand a 300 psf live load and be watertight. The operations shall be tubular spring, securing bottom of lifting mechanism housing to bottom shoe. Provide holes in shoe for water drainage. The hinges for the access doors shall be forged brass with stainless steel pins.

Each door shall have a holding arm to engage when door is fully open. The door shall open to 90 degrees and lock automatically in that position. Also provide a vinyl grip handle to release door for closing.

The CONTRACTOR shall reinforce the hatches over the trash basket as necessary with aluminum stiffeners to support the trash basket with 200 pounds load in the full open position. Also provide a flush, spring loaded locking device, capable of unlocking from the interior. The CONTRACTOR shall place a bituminous coat on the underside of the frame where it will come in contact with the concrete slab.

**210.5.6 Sump Pumps** The CONTRACTOR shall furnish one sump pump in the sump in the valve chamber. It shall be a submersible pump with 120 volt hermetically sealed heavy duty motor, to be permanently lubricated and with sealed bearings. The pump shall be portable with a connection for sump pump piping in the valve chamber. It shall be rated at 20 gpm at 10 foot discharge head equipped with an automatic level control system.

**210.5.7 Trash Basket** The CONTRACTOR shall furnish a trash basket as detailed on the drawings. It shall have 2 inch by 1 inch rollers made from either hard rubber, nylon, hard plastic or of similar material.

The CONTRACTOR shall furnish as accessories one aluminum rake, 12 inches wide with a six foot handle, with slots to fit the bar spacing of the trash basket, and one shovel, flat and at least 16 inches wide.

**210.5.8 Spare Parts** The CONTRACTOR shall furnish with the station the following spare parts:

- a) One Impeller
- b) One Key, Lockwasher and Nut
- c) One Set of Mechanical Seals for the Pumps
- d) One Set of Relays

**210.5.9 Controls for Submersible Station** Each pump shall be equipped with overload protection, circuit breaker, 6 digit elapsed time meters (minutes and 0.1 minutes) starting relays, run lights, H-O-A switches - Pump alternation shall be automatic with operator override to allow manual operation. Motor electric service cable shall be of sufficient length to reach control panel without splices. Also provide 2-1/2 inch ammeters on each leg of the wastewater pump circuits. The ampere meter shall be sized for the pump provided, with a meter accuracy of  $\pm 2\%$  full scale.

The wiring in the chamber shall permit 20 feet submergence without affecting operation. Controls shall be mounted in a NEMA 12 enclosure with drip shield, lockable control panel with disconnect as detailed. Provide seal-off fittings where conduit exists from the pump chamber. Each door shall have a holding arm to engage when the door is fully open. The door shall open to 90 degrees and lock automatically in that position. The control panel should be similar to Standard Detail #160.

All construction shall be Class 1 construction type B wiring. The Equipment is as shown in the details following these specifications.

**210.5.10 Motor Starters** All motor starters shall be either combination, circuit breaker type or magnetic with the following accessories:

- a) 120 Volt Control
- b) Name Plate
- c) Bi-metallic Overloads
- d) Run Pilot Light
- e) Selector Switches - 3 position

The overload shall be capable of being reset from the front of the starter enclosure. Each starter shall be padlockable in the "off" position and all wiring shall be type B.

**210.5.11 Grounding** All grounding materials shall be #2/0 bare copper wire and 5/8 inch by 10 feet copperweld ground rods. All connections between the grounding elements shall be thermoweld where concealed or mechanical where exposed to view. Any grounding conductor penetrating a concrete surface shall be 5/8 inch solid copperweld. The grounding resistance shall be 25 ohms or less.

**210.5.12 Conduit Systems** All exposed conduit shall be PVC piping or PVC coated galvanized rigid steel. In all explosive areas all seals shall be Class 1, Division 1, Grade

D. All wiring shall be in conduit with an external junction box, except in the pump chamber where cables go to floats and pump motors.

**210.5.13 Motor Efficiencies** All motors less than 5 hp shall have a minimum motor efficiency of 75%. All 5 hp and above shall be 80%.

**210.6 Gate Valves** All gate valves shall conform to those as specified in Section 207.1.2.4.1 of these specifications.

**210.7 Joint Restraints** All joint restraints shall conform to that specified in Section 207.1.2.7 of these specifications.

## **210.8 Electrical Work**

**210.8.1 Description of Work Included** The work included in this section shall be furnishing and installation of electric power. The main items of work include electric service to the stations, branch circuits, conduit, wiring devices, connection to motors, float switches and the like.

**210.8.2 Installation** All installation shall be as suggested by the manufacturer, as indicated on the shop drawings or as specified in the contract documents or on the drawings.

**210.8.3 Permits** The CONTRACTOR will be required to secure an electrical permit from the City of Portage Community Development Department. All work must be inspected and approved by the CITY's Electrical Inspector prior to Consumers Energy setting the meter.

**210.8.4 Electrical Service** The power requirements shall be 3 phase, 480 volts, 60 amperes unless otherwise specified in the Supplementary Conditions. The CONTRACTOR shall make all necessary arrangements with Consumers Energy for the installation of the power service from the meter to the nearest available line source. The CONTRACTOR shall, as part of the contract, pay all costs incurred in the installation of the electrical service. The CONTRACTOR shall take out all necessary permits with Consumers Energy on behalf of the CITY.

**210.8.5 Power Service Lightning Arrestor** The Lightning Arrestor shall be 600 volt, 3-phase with conduit connection for attaching to the meter enclosure. Suggested manufacturers are General Electric and Westinghouse.

**210.8.6 Instrumentation and Controls** To control the operation of the pumps with variation in sewage level in the pump chamber, a solid state submersible differential pressure transducer and circuit board as manufactured by Magnova, Inc. shall be provided.

The submersible pressure transducer shall be enclosed in a watertight PVC housing with 1/2" pipe thread at the top and shall be suitable for wastewater applications. It is to be mounted at the end of a 1/2" non-corrosive pipe below the low water level set point. The

cable shall be continuous without splicing from the transducer to the control unit. Transducer housing and cable shall be supplied by the manufacturer. Set points shall be LWA (Low Water Alarm), Off, Lead, Lag, HWA (High Water Alarm).

PVC transducer bellows shall be of phosphor bronze. The cable affixed to the transducer will consist of one shielded pair, one unshielded pair, shield drain wire and a vent tube that are all enclosed in a high density waterproof polyethylene jacket. Normal power input of 120 VAC/60Hz. Line voltage variations of plus or minus 15 volts shall affect output less than 1% of the range.

Provide 4-20 ma D.C. output signal proportional to level.

The lift station shall have a Modicon 110CPU61200 PLC with a built-in flash-PROM which will automatically control the two lift station pumps based on the pump chamber level. The pump chamber level signal will be generated by the above described submersible 4-20 ma level transmitter. In case of failure by the level transmitter or PLC, the lift station shall also be designed to turn the pumps on and off by the two intrinsic mercury float switches in the pump chamber.

The PLC shall radio the station signals back to the DPS building (central location). Communication shall be through a Freewave 902-928 MHZ spread spectrum radio part number DGR09RXS with Free wave jumper part number ASC9182SN and a Maxrad 15db Yagi directional antenna part number BMOY8905. The radio will require a polyphaser RF surge suppressor part number IS-B50LN-C2.

The lift station shall include the following:

- 1 - NEMA 12 enclosure size approximately 24" high x 20" wide x 8" deep with the following equipment mounted and wired inside the station's main control panel.
- 1 - A Murr 24V DC 120 W Power supply Part number 85084 with (2) Douglas 12V 4.5 AH batteries part number DG12-4.5 and Transtronic battery backup UPS part number BVUPS24PF.
- 1 - Modicon 110CPU61200 Micro PLC with discrete and analog inputs/outputs:  
Use City of Portage standard field connection layout.:
  - 16 - D/I
  - 12 - D/O
  - 4 - Analog inputs (4-20 ma)
  - 2 - Analog outputs (4-20ma)
  - 1 - RS232 Modbus port
  - 1 - Modbus programming port for hand-held terminal (Magellus HMI with 24v supply)
  - 1 - Expandable I/O port
- 1 - Citel 110 VAC surge suppressor part number DU40S-120
- 2 - EAO Entry alarm door switch part number 01 151 025 and required accessories

**210.8.7 Reprogramming Master PLC** The reprogramming of the master PLC and the revising of the existing Wonderware 2000 graphics display panel, SCADA Alarm Program and XL Reporter Software at the central location (DPS Building) shall be done by a licensed Wonderware programmer provided by the CONTRACTOR.

**210.8.8 Sequence of Operation** As the water level in the pump chamber rises to the elevation shown for "Lead Pump On" on the drawings, the pump shall be activated. The lead pump shall pump the water down to the elevation shown for "Lead Pump Off", and the lead pump shall shut off.

If the water level in the pump chamber rises to the elevation shown for "Lag Pump On", the lag pump shall be activated. As the water level in the pump chamber decreases to the elevation shown for the "Lag Pump Off", the lag pump shall shut off and the lead pump shall continue to operate as specified above.

The CONTRACTOR shall provide for manual alternation of the pumps.

When the water level in the pump chamber rises to the level of the high water level float switch, an alarm shall be activated and start both pumps. This function will be independent of the operation of the PLC. Both pumps shall shut off if the water level decreases to the elevation shown for "Both Pumps Off - Alarm".

**210.8.9 Alarm Conditions** System shall be programmed for the following alarm conditions:

- |                         |                           |
|-------------------------|---------------------------|
| 1. Data Failure         | 7. Pump Seal Failure      |
| 2. Power Failure        | 8. Pump #1 Run (Green)    |
| 3. High Water           | 9. Pump #1 Failure (Red)  |
| 4. Low Water            | 10. Pump #2 Run (Green)   |
| 5. Entry Alarm          | 11. Pump #2 Failure (Red) |
| 6. Entry Alarm Disabled |                           |

All alarms shall remain on until manually reset after correction of alarm system.

#### **210.8.10 Control Panel**

**210.8.10.1 General** The control panel shall be as specified in Section 210.5.9. All connections to this panel shall be made at terminal strips. All wiring shall be copper, do not use aluminum wire. All wiring shall be numbered for identification.

A complete "As Built" wiring diagram and terminal strip diagram complete with numbered identification shall be furnished to the City of Portage (4 copies).

All wiring shall be in strict accordance with local, state, and National Electric Codes.

Power and control terminals shall be located at the bottom of the panel. Locate conduit stubs accordingly.

The control panel shall be equipped with a Crouse-Hinds AR2042-522, or approved equal, emergency generator receptacle.

Conduits shall be installed to prevent moisture or water from entering and accumulating within the enclosure. All conduits shall be sealed.

Conductors shall be located so that they will be free from physical damage and to avoid overheating. The conductors shall be supported properly.

All incoming and outgoing control and power connections shall be numbered for identification and installed as per manufacturer's wiring diagram.

**210.8.10.2 Control Panel Accessories** The below listed accessories shall be furnished with the control panel:

- a) Name Plates
- b) Pilot and Alarm Lights
- c) Selector Switches
- d) Control Circuits

All name plates shall be a minimum 1 inch by 3 inch white plastic with engraved black lettering. Provide name plates for all switches and circuit breakers, motor starters and push buttons.

All pilot and alarm lights shall be 120 volt, 60 Hertz with plastic lens and color matched rings. The CONTRACTOR shall furnish special tools for lamp replacement, if required. All lights shall be of the "push to test" type.

All selector switches shall be rated at not less than 120 volts, 10 amperes, 60 Hertz with maintained or momentary contacts as required and oil tight. All switches shall be "Off-On", "Off-Auto", "On-Off-Auto", or "Open-Close" as shown on the drawings.

All control circuits shall be rated at not less than 120 volts, 10 amperes. The relays shall be of the plug-in type with octal socket.

**210.8.10.3 Piping and Supports** All non-submerged piping and supports shall be coated with 1 coat of epoxy primer (1-1/2 mils) and 2 coats polyamide cured epoxy enamel (2 mils per coat). All submerged piping and supports shall be painted with 2 coats of coal tar epoxy (8 mils per coat). All surfaces prior to painting shall be wire brushed to remove all rust and loose scale.

## **210.8.11 Testing**

**210.8.11.1 Factory Testing of Pumps** Each pump shall be tested at the factory prior to shipment. At the time of shipment, furnish certified performance curves for each pump based on these test results.

**210.8.11.2 Motor Rotation** After completion of the electrical service connections to the pump, the direction of rotation of pump will be checked by the CONTRACTOR.

**210.8.11.3 Current Unbalance** Upon ascertaining that the pump is rotating in the proper direction, the CONTRACTOR will check for current unbalance between phases. Current unbalance shall not exceed 4% between phases.

**210.8.11.4 Pressure Testing Force Main** The CONTRACTOR shall provide the ENGINEER 48 hour notice prior to testing. If it is necessary for the ENGINEER to supervise more than one test, the CONTRACTOR will be liable for the additional cost involved.

Before applying the specified test pressure, all air shall be expelled from the pipe. At high points, the CITY shall make the necessary taps at the expense of the CONTRACTOR to release the air and insert plugs after the tests have been completed.

The CONTRACTOR shall furnish proper appliances and facilities for testing and draining the main without injury to the work, and surrounding territory. The CONTRACTOR shall test by filling the main with clean water under a minimum hydrostatic pressure on one hundred fifty (150) pounds per square inch based on the elevation of the lowest point in the line to be tested and corrected to the elevation of the test gauge. Pressure shall be maintained for two (2) hours.

No pipe installation will be accepted if the leakage per 1,000 feet of pipeline is greater than that shown below.

<u>Diameter</u>	<u>Gal/Hour</u>
4-inch	0.37
6-inch	0.55
8-inch	0.74
10-inch	0.92
12-inch	1.10
16-inch	1.47
20-inch	1.84

Water for making tests will be furnished by the CITY if it is available under pressure; otherwise, by the CONTRACTOR at the expense of the CONTRACTOR.

**210.8.11.5 Station Performance Test** Before connecting station to the sanitary sewer system, it shall be inspected and performance tested with the ENGINEER. The CONTRACTOR shall notify the ENGINEER at least 48 hours prior to the time of test. The ENGINEER, CONTRACTOR, appropriate CITY personnel and a factory representative for instrumentation shall be present at the time of the performance test. All components shall be tested and inspected for compliance and operational correctness. Any components not functioning correctly shall be repaired/corrected by the CONTRACTOR and the test shall be repeated until accepted by the ENGINEER.

## **210.8.12 Rotary Converter**

**210.8.12.1 General** A variable frequency system shall be installed to provide 3 phase power to the pump motors.

1. Variable Frequency Drive 1 Phase to 3 Phase:
  - a. Circuit Breakers:
    - (1) NEMA 3R enclosures suitable for outdoor use.
    - (2) Sized to match rotary converter or as shown.
  - b. Variable Frequency Drive Phase Conversion System
    - (1) 1 phase to 3 phase
    - (2) 480 V 1 Phase to 480 VAC 3 Phase
    - (3) Install inside control cabinet

**210.8.13 Lift Station Cost Breakdown** The successful bidder will be required to submit a cost breakdown for the major lift station components such that the ENGINEER can prepare partial pay estimates based upon the amount of work completed. This cost breakdown will be subject to review and approval by the ENGINEER.

