ADDENDUM NO. 1

DATE: **December 21, 2018**

PROJECT: Sanitary and Storm Sewer Rehabilitation

OWNER: City of Owosso

BID DATE: **Tuesday, January 8, 2018 at 3:00 pm**

This addendum shall be considered part of the Contract Documents.

PROJECT MANUAL

Technical Specifications-

The technical specifications attached shall be incorporated into the contract documents.

End of Addendum No. 1

SECTION 01 11 00

SUMMARY OF WORK

PART 1 - GENERAL

1.1 SCOPE

A. The work of this Contract shall include furnishing of labor, materials, equipment, tools, construction equipment and machinery, transportation, insurance, taxes, superintendence, coordination and miscellaneous services required for construction and completion of Work.

B. Project location:

Owosso, Michigan

C. Description of Work:

1. Closed-circuit video inspection – initial, pre-installation
2. Point repair of joints and lateral connections
3. CIPP lining of sewer segments
4. Manhole rehabilitation
5. Testing
6. Closed-circuit video inspection – confirmation, final
7. Bypass pumping
8. Erosion prevention and sediment control
9. Traffic control
10. Close-out documents

D. Access to the Site

1. Limit the use of the Project site to areas with the Contract limits indicated. Do not disturb portions of Project site beyond the areas in which Work is indicated.
2. Contractor will have full access to those manholes and system appurtenances required to complete the Work. If road closures are required, the Owner must be given at least 24 hours' notice in order to facilitate.
3. Coordinate with residents for access to private property as required to obtain access to the sanitary sewer system and for temporary staging of tools or equipment.

E. Contract Drawings

1. Contractor to provide Record Drawings depicting the locations and extent of completed work so as to comprise a historical record for use by the Owner.
2. The Work is indicated on the set of Contract Drawings included with Appendix A of the contract documents. Contract Drawings shall be considered an integral part of the Contract Documents as defined herein.
3. In this Section and in other Sections of these Contract Specifications, the Contract Drawings are usually referred to as "Contract Drawings."

F. General Arrangement

The Contract Drawings indicate the extent and general arrangement of the Work. If the Contractor deems any departures from the Contract Drawings necessary, details of such

departures and reasons therefore shall be submitted as soon as known for approval via the Request for Information (RFI) or submittal process as appropriate. No such departures shall be made without prior written approval.

G. Owner Coordination

Maximum effort shall be extended by Contractor toward minimal inconvenience to Owner in performing work. Schedule and coordinate with Owner work that will interfere with normal occupancy and/or utilization of facilities.

1.2 RELATED SECTIONS

A. Division 01 – None referenced

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. Installation of cured-in-place pipe lining for existing 8-inch through 24-inch diameter sanitary and storm sewers
2. All pre-installation point repairs, CCTV, cleaning, excavatable sewer service replacements, and trenchless service line renewals as shown in the Contract Documents or as directed by the Construction Manager.
3. Sewer diversion pumping and service cleanout installation
4. Manhole rehabilitation with cementitious and epoxy-type linings
5. Sewer rehabilitation by chemical grouting
6. Pavement and property restoration as defined by the Specifications
7. All testing required by the Contract Documents to complete the Work
8. Erosion prevention and sediment control, and
9. Traffic control during installation

1.4 TIME OF WORK

A. The normal time of Work for this Contract shall be **Monday through Friday** except legal holidays observed by the City of Owosso and between the hours of **7:00 a.m.** and **6:00 p.m.,** local time, **and Saturdays between 7:00 am and 3:30 pm,** local time.

B. If it shall become necessary to perform Work at night or during hours other than those noted above, the Construction Manager shall be informed in writing no later than two (2) work days in advance of the beginning of such Work. No Work may commence until approval of the proposed work hours has been obtained from the Construction Manager. Temporary lighting and all other necessary facilities for performing and inspecting the Work shall be provided and maintained by the Contractor.

PART 2 – PRODUCTS

Not used

PART 3 - EXECUTION

Not used

END OF SECTION

SECTION 01 14 14

CONTROL OF WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Coordination of the Work

B. Interference with Existing Works

C. Protecting and Relocating Existing Structures and Utilities

D. Property Care and Protection

E. Occupying Private Land

F. Pipe Locations

G. Dimensions for Existing Structures

H. Open Excavations

I. Traffic Control

J. Parking Control

K. Weather Protection

L. Low-impact Pavement Marking

1.2 COORDINATION OF THE WORK

A. The Contractor shall be solely responsible for coordinating all Work. The Contractor shall supervise, direct, and cooperate fully with all subcontractors, manufacturers, fabricators, suppliers, distributors, installers, testing agencies, and all others whose services, materials, or equipment are required to ensure that the Work is completed within the Contract Time.

B. The Contractor shall cooperate fully with the city of Owosso and its representatives and all other contractors employed on the Work including utility service companies to effect proper coordination and progress to complete the Project on schedule and in proper sequence.

C. The Contractor shall allow the city of Owosso or its representatives and other project contractors or their representatives with access to the Contractor’s work areas to complete any work necessary for the facility’s normal operation and/or to complete other contractor’s work. A 24-hour notice shall be provided for non-emergency situations whenever possible.

1.3 INTERFERENCE WITH EXISTING WORKS

A. The Contractor shall, at all times, conduct their operations so as to interfere as little as possible with existing works.

B. All Work connecting with, cutting into, and reconstructing existing pipes or structures shall be planned so that it interferes with the existing facility's operation for the shortest possible time and when the demands on the facility best permit such interference even though it may be necessary to work outside normal working hours to meet these requirements. Before starting work that will interfere with the existing facility's operation, the Contractor shall do all possible preparatory work and shall ensure that all tools, materials, and equipment are made ready and are at hand.

C. The Contractor shall have no claim for additional compensation due to a delay or inconvenience in adapting their operations to the need for continuous sewage flow.

D. The Contractor shall have no claim for additional compensation due to a delay or inconvenience in adapting their operations to the need of the pumping station.

1.4 PROTECTING AND RELOCATING EXISTING STRUCTURES AND UTILITIES

A. The Contractor shall assume full responsibility for protecting the following including but not limited to: buildings, structures, and utilities—public or private including poles, signs, services to buildings, utilities in the street, gas pipes, petroleum pipes, water pipes, hydrants, sewers, force mains, drains, and electric and telephone cables whether or not they are shown on the Drawings. The Contractor shall carefully support and protect all such structures and utilities from injury of any kind. Any damage resulting from the Contractor's operations shall be repaired by the Contractor at their expense.

B. Assistance shall be given to the Contractor in determining the location of existing services to the degree normally provided by the utility owner. The Contractor, however, shall bear the full responsibility for obtaining all locations of underground structures and utilities including existing water services, drain lines, and sewers. Services to buildings shall be maintained, and all costs or charges resulting from damage thereto shall be paid by the Contractor.

C. Protection and temporary removal and replacement of existing utilities and structures as described in this Section shall be part of the Work under the Contract, and all costs in connection therewith shall be included in the Total Price Bid on the Bid Form.

D. The Contractor shall notify all utility companies in writing at least 72 hours (excluding Saturdays, Sundays and legal holidays) before excavating in any public way. The Contractor shall also notify Tennessee One-Call, telephone number 811, at least 72 hours prior to starting Work.

1.5 PROPERTY CARE AND PROTECTION

A. The Contractor shall be responsible for preserving all public and private property and shall use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in executing the Work on the Contractor's part, such property shall be restored by the Contractor, at its expense, to a condition similar or equal to that existing before the damage was done, or the Contractor shall make good the damage in another manner acceptable to the Construction Manager.

1.6 OCCUPYING PRIVATE LAND

A. The Contractor shall not (except after written consent from the proper parties) enter or occupy with workers, tools, materials, or equipment any land outside of city of Owosso's rights-of-way, easements, or property. A copy of the written consent shall be given by the Contractor to the Construction Manager prior to entering or occupying the property.

1.7 DIMENSIONS FOR EXISTING STRUCTURES

A. Where the dimensions and locations for the existing structures are important for installing or connecting any Work part, the Contractor shall verify such dimensions and locations in the field prior to fabricating any material or equipment that depends on such information's correctness. Any material or equipment fabricated to incorrect dimensions shall be replaced at the Contractor's expense.

1.8 OPEN EXCAVATIONS

A. All open excavations shall be adequately safeguarded by providing temporary barricades, fencing, caution signs, lights, and other means to prevent accidents to persons and damage to property. If the excavation becomes a hazard or if it excessively restricts traffic at any point, the Construction Manager may require special construction procedures such as limiting the open trench length or requiring the trench to not remain open overnight or to be covered with steel plates.

B. The Contractor shall take precautions to prevent injury to the public due to open trenches. All trenches, excavated material, equipment, or other obstacles that could be dangerous to the public shall be fully barricaded.

1.9 TRAFFIC CONTROL

A. The Contractor shall keep all streets and traffic ways within the Project limits and adjacent areas in such condition as to adequately accommodate traffic and pedestrian passage during the construction period unless otherwise approved by the city.

B. For controlling moderate traffic, the Contractor shall provide an adequate number of flag persons employed at no additional expense to the city.

C. Signs, Signals and Devices

1. Post-mounted and Wall-mounted Traffic Control and Informational Signs: As approved by the city.

2. Automatic Traffic Control Signals: As approved by the city.

3. Traffic Cones and Drums, Flares, and Lights: As approved by the city

4. Flag person Equipment: As required by the city

D. Flares and Lights: Use flares and lights during low visibility hours to delineate traffic lanes and to guide traffic.

E. Haul Routes

1. Consult with the authority having jurisdiction to establish public thoroughfares to be used

for haul routes and site access.

2. Provide traffic control at critical haul route areas to regulate traffic and to minimize interference with public traffic.

3. Comply with all roadway haul weight restrictions to prevent roadway damage.

F. Traffic Signs and Signals

1. Provide signs at approaches to the Site and onsite, at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.

2. Relocate as Work progresses to maintain effective traffic control.

3. The Contractor shall coordinate removing and replacing traffic loops and signals if required to perform the Work and at no additional cost to the city.

G. Removal

1. Remove equipment and devices when no longer required.

2. Repair damage caused by the installation.

1.10 PARKING CONTROL

A. Areas to be defined are Project-specific – include language for offsite parking if required

B. Parking is not allowed on the shoulders of any public road.

1.11 WEATHER PROTECTION

A. The Contractor shall be responsible for initiating, maintaining, and supervising all weather protection precautions and programs in connection with the Work as required by the conditions contained in the technical specifications. Weather protection shall mean temporarily protecting the Work adversely affected by heat, moisture, wind, and cold by covering, enclosing, and/or heating/cooling. The Contractor shall be responsible for all costs, including heating, required for weather protection.

B. Installing weather protection and heating devices shall comply with all safety regulations including provisions for adequate ventilation and fire protection devices and shall be in accordance with all local, state, and federal regulations.

C. If temporary heat is required to protect the Work, the Contractor shall provide and install a suitable heating apparatus, provide adequate and proper fuel, and maintain heat as required.

1.12 LOW-IMPACT PAVEMENT MARKING

A. The Contractor shall use practices and marking materials for low-impact marking of pavements, sidewalks, curbs, gutters, and permanent features such as walls, building, etc., not replaced by construction. Furthermore, the Contractor shall, by final completion, remove all such markings placed by the Contractor and placed by others in the project area for their use such as those placed by utilities and/or utility marking services.

PART 2 - PRODUCTS

Not used

PART 3 – EXECUTION

Not used

END OF SECTION

SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for unit prices.

B. Related Sections include the following:
1. Division 01 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
2. Division 01 Section "Quality Requirements" for general testing and inspecting requirements.

1.3 DEFINITIONS

A. Unit price is stated on the Bid Form, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: as described in list below.

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. List of Unit Prices: A list of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 LIST OF UNIT PRICE PAY ITEMS

Mobilization (Bid Item 1, 22)
The completed work as measured for MOBILIZATION will be paid for at the contract unit price for the following contract item (pay item):

Pay Item	Pay Unit
Mobilization	Lump Sum

The lump sum price shall be payment in full for all preparatory work and operations which may include, but is not limited to, the following items:

1. The movement of personnel, equipment, supplies, and incidentals to the project site.
2. The establishment of the Contractor's offices, buildings, and other facilities to work on the project.
3. Other work and operations that must be performed.
4. Expenses incurred, prior to beginning work on the various contract items on the project site.
5. Pre-construction costs, exclusive of bidding costs, which are necessary direct costs to the project rather than directly attributable to other pay items under the contract.
6. Permits, bonds, etc.

The pay item will state the maximum amount that can be bid. When the percentage of the original contract amount earned is less than 5 percent, the costs of project specific bonding, insurances, and permits will be reimbursed when a paid invoice is received by the Engineer. The costs of these will then be made in accordance with the Partial Payment Schedule shown below. The original contract amount is the total value of all contract items including the mobilization item. The percentage earned is exclusive of the mobilization item. The total sum of all payments for this item shall not exceed the original contract amount bid for mobilization, regardless of the fact that the Contractor may have, for any reason, shut down his work on the project, moved equipment away from the project and then back again, or for additional quantities or items of work added to the contract.

Partial Payment Schedule

Percentage of Original Contract Amount Earned	**Percentage of Bid Price for Mobilization Allowed**
5	50
10	75
25	100

When a pay item for mobilization is not included in the proposal, payment for any such work is considered to have been included in payments made for other items of work.

Traffic Maintenance and Control (Bid Item 2,23)
The completed work as measured for TRAFFIC MAINTENANCE AND CONTROL will be paid for at the contract unit price for the following contract item (pay item):

Pay Item	Pay Unit
Traffic Maintenance and Control	Lump Sum

The contract lump sum price shall be payment in full for all submittals, meetings, labor, materials, and equipment necessary to furnish, install, and maintain all signs, cones, barricades, flagging, etc. as required by the Michigan Manual of Uniform Traffic Control Devices, the Specifications and Washtenaw County Road Commission requirements. Removal of any temporary signs or other traffic control equipment upon completion of the project shall be considered as incidental to the traffic maintenance and control work.

Soil Erosion and Sedimentation Control (Bid Item 3,24)
The completed work as measured for SOIL EROSION AND SEDIMENTATION CONTROL will be paid for at the contract unit price for the following contract item (pay item):

Pay Item	Pay Unit
Soil Erosion and Sedimentation Control	Lump Sum

Soil Erosion and Sedimentation Control shall be measured by the unit lump sum.
The contract unit price shall be payment in full for all submittals, meetings, labor, materials, and equipment necessary to furnish, install, and maintain soil erosion and sedimentation control in

accordance with the plan notes and details or as directed by the permitting agency. The contract unit price shall be payment in full for all labor, material, and equipment necessary to place silt fence, check dams, temporary seed and mulch blanket, filters for dewatering discharge and other items required to minimize sediment leaving the site to downstream areas. Maintenance of stone check dams and other soil erosion and sedimentation control devices, including adding clean stone and removing old stone and sediment shall be included for the duration of the project. The removal and disposal of stone and accumulated sediment after construction completion shall also be included.

Remove Pavement (Bid Item 4)
The completed work as measured for REMOVE PAVEMENT will be paid for at the contract unit price for the following contract item (pay item):

Pay Item	Pay Unit
Pavt, Rem	Square yard

Pavement removal shall be measured in place by area in square yards. The removal area shall be based upon the average length and width measurements as determined in the field by the Engineer. Remove pavement shall include removal to its full depth and proper disposal offsite regardless of depth of pavement or material or combination of material.

Maintenance Aggregate (Bid Item 5)
The completed work as measured for MAINTENANCE AGGREGATE will be paid for at the contract unit price for the following contract item (pay item):

Pay Item	Pay Unit
Maintenance Aggregate, 21AA	Ton

Maintenance aggregate, 21AA shall be measured in tons based upon certified weight delivery tickets. The aggregate shall be used at various locations for temporary maintenance of local traffic and shall be considered for payment only where authorized by the Engineer.

The contract unit price shall be payment in full for all labor, materials, and equipment necessary to place, grade, and compact 21AA limestone where authorized by the Engineer. Removal of the maintenance aggregate shall be considered as incidental to the placement work.

Cured in Place Pipe Rehabilitation (CIPP) (Bid Item 6-8, 25-28)
The completed work as measured for CURED IN PLACE PIPE (CIPP) REHABILITATION will be paid for at the contract unit price for the following contract items (pay items):

Pay Item	Pay Unit
Sanitary Sewer CIPP Lining, _ inch	Foot
Storm Sewer CIPP Lining, _ inch	Foot

Cured in place pipe rehabilitation shall be measured in place horizontally by linear feet. The length shall be measured along the centerline of pipe from center of structure to center of structure.

The contract price shall be payment in full for all labor, materials, and equipment necessary to install the CIPP in accordance with the plan details and specifications and as described in Appendix A. The payment shall include, but not be limited to, items such as pre-examining the existing sewer including pre-video inspection; cleaning and disposing of debris, sludge, roots, and protruding taps; bypass pumping;

installation and curing of the resin-impregnated pipe; re-establishing service connections; testing, post video inspection, and final cleanup and site restoration.

Note: The CONTRACTOR should note that this pay item may increase or decrease depending upon field conditions.

SEWER SPOT REPAIR (BID ITEM 9)

The completed work as measured for SEWER SPOT REPAIR will be paid for at the contract unit price for the following contract item (pay item):

Pay Item	Pay Unit
Sewer Rehab, Spot Repair, 8 inch	Foot

The contract price shall be payment in full for all labor, materials, and equipment necessary to install a CIPP spot repair in accordance with the project details and specifications. The payment shall include, but not be limited to, items such as examining the existing sewer including pre-video inspection; cleaning and disposing of debris, sludge, and roots; bypass pumping; installation of the lining; and final cleanup.

It is anticipated that each spot repair will be approximately 20' in length to provide sufficient overlap onto adjacent pipe. If defects exceed the anticipated lengths, multiple spot repairs may be paid at the discretion of the ENGINEER. In the event that the repair length exceeds the anticipated length, the CONTRACTOR shall notify the ENGINEER prior to installing the CIPP spot repair.

The CONTRACTOR should note that this pay item may increase, decrease, or be zero depending upon field conditions. Spot repairs shall only be placed at the direction of the ENGINEER or OWNER.

Lateral Connections (Bid Item 10,30)

The completed work as measured for LATERAL CONNECTIONS will be paid for at the contract unit price for the following contract items (pay items):

Pay Item	Pay Unit
Sanitary Lateral Connection, Post CIPP Grouting	Each
Storm Lateral Connection, Post CIPP Grouting	Each

The contract price shall be payment in full for all labor, materials, and equipment necessary to perform the chemical grouting of sanitary lateral connections after completion of the CIPP sewer lining and re-establishing service connections. The payment shall include, but not be limited to, items such as pre-examining the existing sewer including pre-video inspection bypass pumping; installation of the chemical grout around the resulting cut area; post video inspection; and final cleanup. The Contractor shall use as much grout as required to completely stop any leaks around the connection. The re-established connections shall be examined via video inspection no sooner than 14 days after the connection has been grouted.

Note: The CONTRACTOR should note that this pay item may increase, decrease, or be zero depending upon field conditions. Chemical grouting of any joints shall only be performed at the direction of the ENGINEER, CONSTRUCTION OBSERVER, or OWNER.

Sewer Rehab, Grout Joint, _inch (Bid Item 11,12)
The completed work as measured for Sewer Rehab, Grout Joint, _inch will be paid for at the contract unit price for the following contract items (pay items):

Pay Item	Pay Unit
Sewer Rehab, Grout Joint, _ inch	Each

The contract price shall be payment in full for all labor, materials, and equipment necessary to perform the installation of chemical grouting to repair pipe joints and cracks as discussed in the Appendix A. The payment shall include, but not be limited to, items such as pre-examining the existing sewer including pre-video inspection; cleaning and disposing of debris, sludge, and roots; bypass pumping; installation of the grout; re-establishing service connections; testing of pipe joints, post video inspection, and final cleanup.

Sewer Repair, Open Cut Trench (Bid Items 13-15,29)
The completed work as measured for SANITARY SEWER REPAIR, OPEN CUT TRENCH will be paid for at the contract unit price for the following contract item (pay item):

Pay Item	Pay Unit
Sanitary Sewer Repair, Open Cut Trench, _ inch	Foot
Storm Sewer Repair, Open Cut Trench, _ inch	Foot

The contract unit price shall be payment in full for all labor, materials, and equipment necessary to perform a pipe repair on the existing sanitary sewer prior to cured in place pipe rehabilitation. The payment for pipe repair shall include the following (except such items for which separate prices are received on the bid form): pre-examining the existing sewer including pre-video inspection; clearing; excavating; removal of existing sewer; trenching; disposal of items from clearing; disposal of unsuitable or excess excavated materials; temporary sheeting, bracing and shoring of excavations; bypass pumping; dewatering; support, relocation, replacement, connection or reconnection of existing pipe lines, building leads and utilities; furnishing and placing of pipe, jointing materials, fittings, bulkheads, plugs, adaptors and markers; cleaning and testing; furnishing and placing of required bedding, backfill and fill materials; testing, post video inspection, complete cleanup and surface restoration. Reconnection of service leads, if present in the sewer repair section, are considered incidental to this work and will not be paid for separately. Spot repairs to different pipe materials (PVC, clay, etc.) are considered incidental to this work.

Note:
Unless otherwise noted, this item shall also be used at the direction of the ENGINEER in order to repair a section of pipe when the repair work cannot be accomplished by the proposed method. The CONTRACTOR should note that this pay item may increase or decrease depending upon field conditions.

Sanitary Manhole, Reconstruct (Bid Item 16)
The completed work as measured for SANITARY MANHOLE, RECONSTRUCT will be paid for at the contract unit price for the following contract item (pay item):

Pay Item	Pay Unit
Sanitary Manhole, Reconstruct	Each

The contract unit price shall be payment in full for all labor, materials, and equipment necessary for the removal of the manhole chimney and cone including the casting, adjusting rings, riser sections and base. Proper offsite disposal of the manhole shall be inclusive as well as any temporary sheeting, shoring, and bracing that may be necessary for the removal work. If the Owner wishes to retain the salvaged castings, then the Contractor shall deliver them to the Owner's designated site. Otherwise, the Contractor shall dispose of the castings offsite.

The contract unit price shall be payment in full for all labor, materials and equipment necessary to construct the manholes. Each manhole shall be complete with base, steps, frames and covers, stubs, pipe openings and channels. Payment for Sanitary Manholes shall include the following: excavating; disposal of unsuitable or excess excavated materials; removal and disposal of existing sanitary manhole sections; temporary sheeting, bracing and shoring of excavations; support, relocation, replacement, connection or reconnection of existing or new pipe lines, building leads and utilities; furnishing and placing of structure, jointing materials, fittings, bulkheads, and plugs; cleaning; furnishing and placing of required bedding, backfill and fill materials; final adjustment or reconstruction of casting to finished grade; complete cleanup and surface restoration. The contract unit price shall include all materials necessary for the construction of a new sanitary manhole in accordance with the City of Livonia standard sanitary sewer detail.

The contract price for this pay item shall also include any dewatering necessary for completion of this work through open cut trenching. No separate payment shall be made for dewatering. This work shall include precautions that are necessary to control the discharge of dewatering pumps in order to prevent damage to adjacent property or soil erosion and sedimentation of ditches, culverts, storm structures, storm sewers, streams, lakes, or wetlands. If a County Drain is selected, then a permit must be obtained by the Contractor as incidental to this item of work. The Contractor shall provide any sound proofing measures should they be deemed necessary by the Owner or Engineering when dewatering operations are occurring near residential homes. Soundproofing shall be incidental to this item of work.

The contract unit price shall also include payment in full for dewatering of excavation as described in the Earth Moving section. The contract unit price does not include dewatering by means of deep wells or well points. In the event that dewatering by means of deep wells or well points is required, as determined by the Engineer, then this work shall be paid for separately.

This pay item will not be subject to additional payment for the items of work included above, even if other bid items appear on the bid form, unless otherwise approved by the Engineer.

Manhole, Line Chimney (Bid Item 17)
Payment for MANHOLE, LINE CHIMNEY will be made on the basis of unit price for the following contract item (pay item):

Pay Item	Pay Unit
Manhole, Line Chimney	Foot

Work shall be measured in place by vertical feet. Payment shall include all labor, tools, equipment and materials required to complete the work in accordance with the project details and specifications.

This item shall be paid when the structure involved shows evidence of deterioration or leaking of the manhole chimney section and when it is more cost effective to line the interior of the chimney than to use external lining, as determined by the Engineer. Liner shall be non-cementitious**,** but made from a material designed to allow for a good bond to the metal frame and promote a good frame seal.

Typical candidates for interior chimney lining are manholes within paved surfaces that exhibit signs of chimney deterioration or leakage or manholes that have either a leaking chimney section or broken frame seal. Payment shall include the cleaning of the existing structure as required prior to placement of the repair material and cleaning of the structure after placement of repair material along with hydro-blasting, dry media blasting, or appropriate media preparation prior to placement of the repair material as incidental. Cleaning shall include removal of corrosion to clean metal on the frame to allow the sufficient bonding to seal the joint between the frame and chimney. Payment shall also include any necessary temporary sealing of minor active leaks using an acceptable water-stop material to provide a dry surface prior to placement of the repair material as incidental. Contractor shall prevent water, debris, and un-cured interior lining material from moving downstream in the sewer system, while ensuring uninterrupted

flow of sanitary sewage, by blocking the downstream flow and by-pass pumping or other means acceptable to the Engineer and the Owner. Any debris in the bottom of the manhole shall be removed to the satisfaction of the Engineer prior to restoring the flow through the manhole.

Manhole, Interior Lining, Polyurea (Bid Item 18)
The completed work as measured for the placement of MANHOLE, INTERIOR LINING, POLYUREA will be paid for at the contract unit price for the following contract item (pay item):

Pay Item	Pay Unit
Manhole, Interior Lining, Polyurea	Foot

The work shall be measured in place by vertical feet. The contract unit price shall be payment in full for all labor, tools, equipment and materials required to complete the work in accordance with the project details and specifications.

This item shall be paid for the placement of a polyurea lining when the structure involved shows evidence of structural damage, active and/or passive leaks on the interior walls of the manhole, or improper sealing of the manhole joints, to be determined by the Engineer. Payment shall include the cleaning of the existing structure as required prior to placement of the repair material and cleaning of the structure after placement of repair material along with hydro-blasting, dry media blasting, or appropriate media preparation prior to placement of the repair material as incidental. Payment shall also include any necessary temporary sealing of minor active leaks using an acceptable water-stop material to provide a dry surface prior to placement of the repair material as incidental. Separate payment will be eligible under “Manhole, Seal Leak” for permanent sealing of any major active leaks (in excess of 2 gallons per minute) in the manhole prior to lining the manhole, as approved by the Engineer/Owner. Contractor shall prevent water, debris, and un-cured interior lining material from moving downstream in the sewer system, while ensuring uninterrupted flow of sanitary sewage, by blocking the downstream flow and by-pass pumping or other means acceptable to the Engineer and the Owner. Any debris in the bottom of the manhole shall be removed to the satisfaction of the Engineer prior to restoring the flow through the manhole.

Several manholes in the project area have precast concrete manhole sections installed on top of brick bases which are exhibiting evidence of groundwater leaks. Additionally there are brick manholes in good overall condition with evidence of leaking visible in the bottom portion of the manhole. In these situations, the Engineer has specified that the bottom portion of the manhole be lined. The contractor shall line the bottom of the manhole as directed by the Construction Observer or Engineer.

Manhole, Replace Chimney (Bid Item 19,32)
Payment for MANHOLE, REPLACE CHIMNEY will be made on the basis of unit price for the following contract item (pay item):

Pay Item	Pay Unit
Manhole, Replace Chimney	Foot

The work shall be measured in place by vertical feet and shall be measured to the closest tenth of a foot (0.1'). Payment shall include all labor, tools, equipment and materials required to complete the work in accordance with the project details and specifications.

This item shall be paid when the structure involved is within a paved surface and requires removal of the existing adjusting rings, or brick and mortar chimney, and replacement with new manhole adjusting rings, or with concrete brick and/or block. For manholes that are buried under pavement and require adjusting ring replacement, additional adjusting rings shall be added to bring the rim up to grade. Payment shall include resetting the existing frame, and final rim elevation adjustment as incidental. Separate payment may also apply under bid items Remove and Replace Cover or Replace Frame and Cover (Pavement) for

paid for separately. Removal of soil underneath pavement shall be considered incidental to this item of work.

Heavy Cleaning (Bid Item 20,31)
Payment for HEAVY CLEANING will be made on the basis of unit price for the following contract item (pay item):

Pay Item	Pay Unit
Heavy Cleaning	Hour

The work shall be measured by the hour and will include all labor, equipment and materials necessary to provide heavy cleaning based on Section 33 35 20..

Surface Restoration (Bid Item 21,33)
The completed work as measured for SURFACE RESTORATION will be paid for at the contract unit price for the following contract items (pay items):

Pay Item	Pay Unit
Surface Restoration, Seeding	Lump Sum

Surface Restoration shall be measured in place by square yards and shall be based upon the average length and width measurements of the restored area as determined by the Engineer. Areas disturbed during construction shall be replaced in kind. The Contractor should be aware that this item may increase, or decrease, or be zero depending upon field conditions

The contract unit price shall be payment in full for all labor, materials, and equipment necessary to furnish and place 3” of topsoil, seed or sod, mulch as called for on the plans and specifications. Staking or pegging of sod shall be considered as included in the surface restoration work. Application of mulch anchoring shall be considered as included in the placement of the surface restoration.

Watering until vigorous turf growth is established shall be included in this work and will not be paid separately. Water for the item will be paid for by the contractor. Watering shall be completed at a rate of 3.5 gallons per square yard or as directed by the Engineer.

END OF SECTION 01 22 00

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

B. Related Sections include the following:
1. Division 01 Section "Allowances" for procedural requirements for handling and processing allowances.
2. Division 01 Section "Unit Prices" for administrative requirements for using unit prices.
3. Division 01 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 FIELD WORK ORDER

A. Engineer will issue a Field Order authorizing minor changes in the work, not involving adjustment to the Contract Sum or the Contract Time.

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
1. Proposal Requests issued by Engineer are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
2. Within **20 days** after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
c. Include costs of labor and supervision directly attributable to the change.
d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to Engineer.
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Division 01 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

C. Proposal Request Form: Use forms provided by Owner. Sample copies are included at end of this Section].

1.5 ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, base each Change Order proposal on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
1. Include installation costs in purchase amount only where indicated as part of the allowance.
2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the Purchase Order amount or Contractor's handling, labor, installation, overhead, and profit. Submit claims within [**7**] days of receipt of the Change Order or Work Change Directive authorizing work to proceed. Owner will reject claims submitted later than [**7**] days after such authorization.
1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

1.6 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, Engineer will issue a Change Order for signatures of Owner and Contractor.

1.7 WORK CHANGE DIRECTIVE

A. Work Change Directive: Engineer may issue a Work Change Directive on EJCDC Document 1910-8. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.
1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
   3. Requirements for Contractor to provide quality-assurance and -control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections include the following:
   1. Division 01 Section "Allowances" for testing and inspecting allowances.
   2. Division 01 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
   3. Division 01 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.
   4. Divisions 02 through 49 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Engineer.

C. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

E. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
   1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

I. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of **five** previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 REGULATORY

A. Public Agency Requirements: It is the intention of these specifications to construct all work in accordance with the applicable requirements of the Owner, the contract specifications, and the contract drawings. Where there is a conflict between any of the aforementioned specifications and the permit requirements of the agency controlling the respective utility or rights-of-way, the more restrictive shall govern.

1.5 CONFLICTING REQUIREMENTS

A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Engineer for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.6 SUBMITTALS

A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Reports: Prepare and submit certified written reports that include the following:
   1. Date of issue.
   2. Project title and number.
   3. Name, address, and telephone number of testing agency.
   4. Dates and locations of samples and tests or inspections.

5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

C. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.7 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirement for specialists shall not supersede building codes and regulations governing the Work.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
   1. Contractor responsibilities include the following:
      a. Provide test specimens representative of proposed products and construction.
      b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
      c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
      d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
      e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
      f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.
   2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Engineer**,** with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.8 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
   1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
   2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
   3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor**,** and the Contract Sum will be adjusted by Change Order.

B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
   1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
      a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
   2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
   3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
   4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
   5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
   1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
   2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
   3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
   4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
   5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
   6. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
   1. Access to the Work.
   2. Incidental labor and facilities necessary to facilitate tests and inspections.
   3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
   4. Facilities for storage and field curing of test samples.
   5. Delivery of samples to testing agencies.
   6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
   7. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
   1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
   1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
   2. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:
   1. Division 01 Section "Summary" for limitations on utility interruptions and other work restrictions.
   2. Division 01 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
   3. Division 01 Section "Execution" for progress cleaning requirements.
   4. Division 32 “Bases and Paving” for maintenance aggregate material.

1.3 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to the Owner’s representatives and construction forces, Engineer, occupants of the project, testing agencies, and authorities having jurisdiction.

B. Water Service: Contractor will pay water-service use charges for water used by all entities for construction operations.

1.4 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

1.5 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Erosion Control Geotextile and Stone in accordance with 2012 MDOT Standard Specifications for Construction, Section 916.

B. Temporary Traffic Control devices including plastic drums, barricades, signs, sign covers, lighted arrows, and temporary pavement markings in accordance with 2012 MDOT Standard Specifications for Construction, Section 812.

C. Aggregate 21AA in accordance with 2012 MDOT Standard Specifications for Construction table 902-1.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance as specified in Division 01 Section "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TRAFFIC CONTROL

A. General
1. During the course of construction, provisions must be made to maintain access for emergency vehicles at all times. Where possible and when directed by the Engineer, all streets must be left open to traffic at the end of each working day. Traffic maintenance and control as defined in this section shall be considered as included in the unit bid prices or lump sum bid prices that are given in the Bid Form.
2. All work for maintaining traffic and control shall be in accordance with Section 812 of the 2012 MDOT Standard Specifications for Construction and the current edition of the Michigan Manual of Uniform Traffic Control Devices (MMUTCD). The Contract shall also comply with work zone sign requirements as described in Public Act 315 of 2003.
3. The Contractor shall conduct his operations and use of equipment in such a manner that traffic will be maintained throughout the entire length of the project. When conditions are such as to warrant variations from this requirement, the procedure to be followed shall be approved by the Engineer prior to such procedure being put into effect.
4. The Contractor shall furnish, erect and maintain all barricades, signs and lights as required according to the current edition of the MMUTCD. The Contractor shall be responsible for notifying concerned parties such as Police, Fire, and school officials if a road closure and/or detour will be in effect. The Contractor shall notify the same parties when the road has been reopened.
5. Once work on a particular utility is begun, the Contractor must continue his work to completion. The Owner will not permit random movements of work operations among the project area that tend to confuse traffic patterns.

B. Provisions for Local Traffic
   1. During the progress of the work, the Contractor shall accommodate both local vehicular and pedestrian traffic along the roads.
   2. Access to all residences and businesses shall be maintained except as noted on the plans or as directed by the Engineer. The use of maintenance aggregate to maintain access shall be as approved by the Engineer.
   3. Maintain access for fire-fighting equipment and access to fire hydrants.
   4. The Contractor's truck and equipment operations on public streets shall be governed by all local traffic ordinances and regulations of the Fire and Police Departments, the Owner, and the Michigan Department of Transportation.

C. Existing Warning and Regulatory Signs
   1. Wherever possible, all existing signs on this project are to be preserved and maintained as incidental to the project.
   2. Where it is not possible to preserve existing traffic control signs and street name signs, they shall be removed, temporarily reset and maintained by the Contractor. Upon completion of the project, the Contractor will reset traffic control signs and street name signs in the proper position.
   3. In cases where new signs are called for, they shall be placed in accordance with the requirements outlined elsewhere in the plans or technical specifications.
   4. Any new or existing signs damaged by the Contractor shall be replaced in kind by him at no additional cost to the Owner.

D. Lane Closures and Detours
   1. Any lane closures or detours shall be approved by the Owner and the appropriate governing agency, and shall meet their specifications and standards as well as those of the MMUTCD. Where there are conflicts, the more restrictive requirement shall apply. If any type of closure is to occur during twilight or darkness, proper lighting will be required.

E. Construction Signs and Barricades
   1. Warning signs and barricades configurations shall meet the requirements of the MMUTCD, the Owner, and the Michigan Department of Transportation.
   2. The Contractor shall not begin any operation on the project until all required signs and barricades have been set.
   3. All signs to be used during twilight or darkness shall be reflectorized, in good condition, with two continuous flashing lights.
   4. The construction site shall at all times be maintained and left in a clean, neat, and safe condition, including any construction signing.
   5. After working hours, signs that are not appropriate shall be covered and/or removed so that motorists will not be confused. The Contractor shall also remove and replace or cover (where practical) existing traffic signs that may conflict with the proposed construction.

F. Flag Control
   1. Traffic regulators (flaggers) shall be provided by the Contractor as necessary to protect the vehicular and pedestrian traffic and the work within the work zone areas.
   2. Flaggers shall be trained in accordance with 2012 MDOT Standard Specifications for Construction, Section 812.

3.3 TEMPORARY EROSION AND SEDIMENT CONTROL

A. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction. Comply with MDOT Standard Detail R-96-D.

1. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

END OF SECTION 01 50 00

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.

2. Removing existing vegetation.

3. Clearing and grubbing.

4. Stripping and stockpiling topsoil.

5. Removing above- and below-grade site improvements.

6. Disconnecting, capping or sealing, and removing site utilities.

7. Temporary erosion- and sedimentation-control measures.

B. Related Sections:

1. Division 01 Section "Temporary Facilities and Controls" for temporary utility services, construction and support facilities, security and protection facilities, and temporary erosion- and sedimentation-control measures.

2. Division 01 Section "Execution" for field engineering and surveying.

1.03 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

D. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated .

E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.04 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.05 SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or videotape.

2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.06 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures to maintain sensitive natural features.

1.07 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

C. Utility Locator Service: In Michigan, notify MISS DIG for area where Project is located before site clearing. Provide a minimum of three full working days advance notification.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

E. The following practices are prohibited within protection zones, the 100-year floodplain, and surrounding wetlands:

1. Storage of construction materials, debris, or excavated material.

2. Parking vehicles or equipment.

3. Foot traffic.

4. Erection of sheds or structures.

5. Impoundment of water.

6. Excavation or other digging unless otherwise indicated.

7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

F. Do not direct vehicle or equipment exhaust towards protection zones, the 100-year floodplain, and surrounding wetlands.

G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones, the 100-year floodplain, and surrounding wetlands.

H. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 31 Section "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.01 PREPARATION

A. Provide flagging to delineate limits of areas to be cleared or grubbed. Review at site with Engineer before commencing removal of trees, vegetation, and other materials to be removed.

B. Replace flagging that is lost, removed, or destroyed, until clearing and grubbing work is complete and Engineer allows removal of flagging.

C. Protect and maintain benchmarks and survey control points from disturbance during construction.

D. Locate and clearly identify trees, shrubs, and other vegetation to remain. Wrap a 1-inch blue vinyl tie tape flag around each tree trunk at 54 inches above the ground.

E. Protect existing site improvements to remain from damage during construction. Existing site improvements include, but are not limited to, streets, driveways, structures, underground facilities to remain, adjacent property, and structures.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

F. Identify a salvage area for placing removed materials.

3.02 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones, the 100-year floodplain, and surrounding wetlands.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.03 TREE AND PLANT PROTECTION

A. General: Protect trees and plants remaining on-site according to requirements in Division 01 Section "Temporary Tree and Plant Protection."

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Engineer. Trees and shrubs intended to remain, that are damaged beyond repair or that are removed, shall be replaced by Contractor at no additional cost to Owner.

3.04 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Coordinate with utility owners as required for shutting off service..

B. Locate, identify, and disconnect utilities indicated to be abandoned in place.

1. Coordinate with utility owners as required for shutting off service.

C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than five days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Engineer’s written permission.

D. Excavate for and remove underground utilities indicated to be removed after Engineer’s permission has been obtained. Notify property owners and residents of proposed interruption schedule two days in advance of interruption.

3.05 CLEARING AND GRUBBING

A. Prior to the start of construction, the Contractor shall verify the limits of trees and other items that are to be saved. The Contractor shall then clear the site or trench excavation area of all remaining trees, brush, and other miscellaneous items that are not to be saved.

B. Remove obstructions, trees (including stump and main roots), shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.

2. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.

3. Use only hand methods for grubbing within protection zones.

4. Chip removed tree branches.

5. Dispose of all trees, shrubs, stumps, root, and all associated foliage and debris offsite.

6. Trees less than six (6) inch diameter shall be removed where required by the work as incidental to the Contract.

7. The Contractor shall abide by any easement agreements regarding the tree removal work and wood ownership.

8. Clear undergrowth and deadwood without disturbing subsoil.

9. Do not use cleared or grubbed materials as fill, backfill, or in embankments.

C. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

D. Stump Removal: Where called for on the plans, the Contractor shall remove existing stumps, including main roots (two (2) inch diameter and larger), dispose of all associated debris offsite, and backfill the void with suitable material.

3.06 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth indicated on drawing in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches.

2. Do not stockpile topsoil within protection zones, the 100-year floodplain, and surrounding wetlands.

3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.

4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.07 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

C. Remove fencing where removal is designated on the drawings.

3.08 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Do not burn clearing debris at the site, unless approved by Owner and authorities having jurisdiction. If burning is permitted, comply with requirements of authorities having jurisdiction and Owner’s requirements.

END OF SECTION 31 10 00

SECTION 31 20 00 - EARTH MOVING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Work shall include furnishing of labor, materials, tools, equipment, accessories, and services necessary for completing the excavation and backfilling for the items as shown on the contract drawings and/or as herein required. This also includes trenching, trench or subgrade undercutting, roadway earthwork, complete and continual drainage of excavation, sheeting, bracing, and shoring of sides of the excavation, backfilling around structures and over pipelines, and the disposal of excess excavated material.

B. Section Includes:

1. Preparing subgrades for slabs-on-grade, walks, pavements, turf, grasses and plants.

2. Excavating and backfilling for structures.

3. Drainage course for concrete slabs-on-grade.

4. Subbase course for concrete walks and pavements.

5. Subbase course and base course for asphalt paving.

6. Subsurface drainage backfill for walls and trenches.

7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

8. Dewatering.

C. Related Sections:

1. Division 01 Section “Temporary Facilities and Controls”.

2. Divisions 32 and 33 Sections for “Bases and Paving” and Sewer Repair.

3. Division 31 Section "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.

4. Division 32 Section "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.

5. Division 33 Section “Sanitary Sewer”

1.03 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.

2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.

3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.04 SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.

2. Controlled low-strength material, including design mixture.

3. Geofoam.

4. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

1. Geotextile: 12-inch by 12-inch.

2. Warning tape: 12 inches long; of each color.

C. Qualification Data: For qualified testing agency.

D. Material Test Reports: For each borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.

2. Laboratory compaction curve according to ASTM D 698 and ASTM D 1557.

E. Pre-excavation Photographs or Video Recording: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.05 QUALITY ASSURANCE

A. Pre-excavation Conference: Conduct conference at Project site.

B. References to Michigan Department of Transportation (MDOT) Specifications shall pertain to the current edition of the Standard Specifications for Construction.

1.06 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify MISS DIG for area where Project is located before beginning earth moving operations. Provide a minimum of three full working days advance notification.

C. Do not commence earth-moving operations until temporary erosion- and sedimentation-control measures are in place.

D. Do not commence earth-moving operations until plant-protection measures are in place.

E. The following practices are prohibited within protection zones, 100-year floodplain and wetlands:

1. Storage of construction materials, debris, or excavated material.

2. Parking vehicles or equipment.

3. Foot traffic.

4. Erection of sheds or structures.

5. Impoundment of water.

6. Excavation or other digging unless otherwise indicated.

7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

F. Do not direct vehicle or equipment exhaust towards protection zones, 100-year floodplain and wetlands.

G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones, 100-year floodplain and wetlands.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS - GENERAL

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

2.02 BEDDING

A. Sand shall be a sharp, clean sand free of lumps of clay or debris with 100 percent passing a 3/8 inch sieve and less than 10 percent loss by wash.

B. Granular material shall meet the requirements of Section 90 2. 07 of the MDOT Standard Specifications for Construction for Granular Material Class II and Class III.

C. Pea gravel shall be unwashed and shall be from ¼ inch to 5/8 inch in size.

D. Bedding material shall be provided from offsite unless the trench passes through a well-defined strata of sand or gravel. Bedding material shall be subject to the approval of the Engineer.

E. Stone material shall meet the requirements of Section 90 2. 03 of the MDOT Standard Specifications for Construction for 6A crushed Coarse Aggregate or approved equal.

2.03 BACKFILL

A. Job Excavated Backfill: Job excavated backfill shall be defined as material excavated from the site that is free from frozen earth, boulders, rocks, stones larger than 3 inch in size, debris, blue and gray clay, and organic material.

B. Granular Backfill: Granular backfill shall be defined as sharp sand, gravel, or crushed stone that is free from lumps of clay and soft or flaky material and shall conform to the latest MDOT Standard Specification for Granular Material Class II of III. Granular backfill shall be used for fill work located under or within the influence of roadway surfaces. The Owner's standard details shall dictate which type of granular material (Class II or III) is required for the project.

Material excavated from the trench may be used as granular backfill when, in the opinion of the Engineer, it meets the granular backfill grading requirements.

C. Stone Refill

1. Stone refill shall consist of natural gravel, slag, or crushed gravel that is equivalent in gradation to MDOT 6A unless otherwise called for in the plan details.

D. Embankment

1. Embankment material shall consist of sound earth as described in Section 20 5. 03H of the MDOT Standard Specifications for Construction.

2.04 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:

1. Red: Electric.

2. Yellow: Gas, oil, steam, and dangerous materials.

3. Orange: Telephone and other communications.

4. Blue: Water systems.

5. Green: Sewer systems.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, protection zones, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.02 PAVEMENT CUTS

A. Where a trench must be cut through pavement, driveway, or sidewalk, particular care shall be taken to avoid unnecessary damage to adjoining areas of the pavement, driveway or sidewalk. All cuts through existing surfaces shall be made full-depth with a concrete saw. Cuts in concrete pavement shall be made parallel with longitudinal and transverse construction or contraction joints.

B. Saw cuts in concrete pavement shall not be nearer than five feet (5’-0”) to a transverse joint, to the centerline of pavement, or to the edge of pavement or curb, i.e., no existing or replacement pavement shall be less than five feet (5’-0”) in width. If the damaged pavement or surfacing is nearer than five feet (5’-0”) to a joint or centerline of pavement , or to edge of pavement, surfacing or curb, removal and replacement shall be extended to said joint, centerline, edge of pavement, surfacing, or curb. These same requirements shall apply to the saw cutting and replacement of concrete driveways.

C. If a square or block of sidewalk is cut, broken, or cracked, the entire square or block shall be removed and replaced.

3.03 EXCAVATION AND TRENCH DEWATERING

A. The Contactor shall maintain any excavation or trench free of water during construction of any structures and/or pipelines. Water accumulated due to rainfall or runoff and minor groundwater inflow that can be controlled through the use of portable trash, submersible or positive displacement pumps shall be considered normally expected and anticipated conditions associated with underground construction. This effort will be considered as included in the cost of construction. For contracts with a unit price for dewatering, the work described herein will not be reimbursable at the unit price bid for dewatering in the bid form.

B. The required use of deep wells and/or well points to lower and maintain a reduction in the groundwater elevation below the trench bottom shall be subject to approval of the Engineer and shall constitute a reimbursable expense for trench or excavation dewatering. If a pay item for dewatering is included in the bid form, then the Contractor would receive payment for this work based upon the unit bid price. If there are no provisions in the contract for payment for dewatering (i.e. bid item or included in other pay items), then the Contractor shall submit a detailed estimate of the additional cost. Upon acceptance of the Contractor's estimate, the Engineer shall issue a change order. The Contractor must demonstrate that a continuous effort is required to control hydrostatic pressure in the construction area in order to claim compensation for dewatering.

C. The Contractor shall take adequate precautions to control the discharge of dewatering pumps so as to prevent soil erosion or sedimentation of drainage ditches, structures, storm sewers, culverts, natural drainage courses, ponds, lakes or wetlands.

D. The Contractor shall insure that discharge from any dewatering operations has a suitable outlet and that it will not cause any damage to adjacent dwellings or property. Water and discharge hoses shall be placed and/or controlled so as to prevent a hazard to pedestrians or motor vehicles passing in the vicinity of the construction site.

E. Electric pumps shall have suitable power supply and appurtenances meeting NEC requirements and properly fused and grounded to prevent electrical shock hazards to on-site personnel.

F. Internal combustion engine driven pumps, if operated 24 hours per day, shall have adequate exhaust silencers in good repair to muffle engine noise to an acceptable level for the area where located.

3.04 CLASSIFICATION OF EXCAVATION

A. Earth, as a name for excavated material, shall include all glacial deposits whether cemented or not, except solid boulders one-half cubic yard or more in volume. It shall also include all alluvial deposits and material of every kind that can be excavated with equal facility by the equipment and means typically used for earth excavation.

B. Peat, as a name for excavated material, shall include all unstable organic soils such as peat, muck, marl, and underlying very soft clay.

C. Rock, as a name for excavated material, shall include pre-glacial solid ledge rock that can be removed most practically by blasting, barring or wedging, or by some other standard method of quarrying solid rock. It shall also include solid boulders of one-half cubic yard or more in volume as well as existing concrete, masonry with mortar joints, or other existing structural work that can be excavated practically only by methods of quarrying solid rock. It shall not include fragile,

friable, or disintegrated materials of any kind that can be excavated by equipment and means used for earth excavation.

3.05 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

2. Remove rock to lines and grades indicated to permit installation of permanent construction.

B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Engineer. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in Contract Time may be authorized for rock excavation.

1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, land other materials not classified as rock or unauthorized excavation.
2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction.

3.06 METHODS OF EXCAVATION IN EARTH

A. All excavation shall be by open cut from the surface, except in special cases where boring/jacking under pavement or structures may be required, or where boring/jacking under the root system will be required for tree root protection. All excavation shall be made in such a manner and to such depth, length, and width as will give ample room for building the structures, bracing, sheeting, and supporting the sides of the excavation, pumping and drainage of ground water and sewage which may be encountered, and removal of all materials excavated. Special care shall be taken so that the soil below the bottom of structures to be built shall be left undisturbed so that a firm bed will be provided for construction. Any voids shall be backfilled with suitable granular material and shall be properly compacted.

3.07 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

3.08 EXCAVATION FOR WALKS, PAVEMENTS AND ROADWAYS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

B. Roadway earthwork shall be performed in accordance with the construction methods that are described in Section 205 Roadway Earthwork of the MDOT Standard Specifications for Construction unless otherwise called for in the plan notes, details, or supplemental specifications.

3.09 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. General

1. Excavation shall be of sufficient width and depth to provide adequate room for construction and installation of the work to the lines, grades and dimensions called for on the plans. Unless otherwise called for on the Owner's standard details, the width of a trench from the invert to a height twelve (12) inches above the top of the pipe barrel shall be indicated as follows:

   a. Pipe size 4" through 12": Maximum trench width = 30"

   b. Pipe size larger than 12": Maximum trench width = outside diameter plus 24"

   If the maximum trench width as specified above is exceeded, unless otherwise shown on the drawings, the Contractor shall install, at his own expense, such concrete cradling or other bedding as is approved by the Engineer, to support the added load of the backfill.

2. Where trench excavation is in granular material, the last six (6) inches of trench depth shall be carefully excavated and trimmed by hand to the exact elevation and contour of pipe. Where trench excavation is in rock or clay soil, the trench bottom shall be undercut a minimum of four (4) inches below the final elevation of pipe. The bedding material as hereinafter specified shall be placed and compacted to the underside of the pipe.

3. Excavation for structures shall be made to the outside lines and surfaces of such structures wherever it is practicable to build directly against the sides and bottoms of excavations. In such cases, care shall be taken not to disturb the original foundation or backing. Final trimming shall be done by hand just before construction of the structure. If excess excavation is made, or the material becomes disturbed so as to require removal beyond the prescribed limits, the resulting space shall be refilled with bedding, as specified hereinafter, and solidly machine tamped into place to 95 percent of maximum unit weight before the construction work proceeds.

4. Excavation for structures shall be extended sufficiently beyond the limits of the structure to provide ample room for form construction and other construction methods to be followed, wherever necessary.

C. Bedding

1. Where the subgrade below the bottom of the pipe is disturbed during the construction, the space shall be refilled with sand or pea gravel bedding material solidly tamped to form a firm foundation for the pipe. Sand or pea gravel bedding material shall be extended to one (1) foot above the pipe, except that the bedding shall be exclusively pea gravel to the springline for pipe 36-inch and greater in diameter.

D. Amount of Trench Opening

1. Not more than 50 feet of trench shall be open at one time in advance of the pipe unless permitted by the Engineer. The length of street that may be occupied by the construction work at any one time shall be subject to the direction of the Engineer and will be based on requirements of the use of the street by the public. No more than 600 consecutive feet of street length shall be occupied at one time, and vehicle traffic through the street shall not be entirely stopped without permission of the Engineer. After placement of the utility line, the Contractor shall backfill the trench promptly in order to minimize the length of open trench and avoid any unsafe conditions.

E. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3. Cut and protect roots according to requirements in Division 01 Section "Temporary Tree and Plant Protection."

3.10 SUBGRADE INSPECTION

A. Notify Engineer when excavations have reached required subgrade.

B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.11 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Engineer.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Engineer.

3.12 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

2. Do not store in protection zones, 100-year floodplain, or wetlands, as identified on the plans.

3.13 TRANSPORT OF NATIVE MATERIALS OFFSITE

A. If the Contractor encounters good materials (sand, gravel, topsoil, etc.) during the course of construction, he shall not be allowed to transport these materials offsite without the written approval of the Engineer. Wherever possible, suitable native sands and gravels shall be used as backfill rather than transporting them offsite and replacing them with non-native materials of a lesser quality.

3.14 STONE REFILL FOR TRENCH UNDERCUT

A. In locations where soil at the bottom trench is unstable, the Contractor shall excavate (undercut) below the trench bottom and place stone refill.

3.15 DIVERTING EXISTING SEWERS

A. Where existing sewers or drains are encountered in the work, adequate provision shall be made for diverting flow in the existing sewers so that the excavation will be kept dry during the progress of the construction work. Upon completion of the construction work, the existing sewers shall be restored or otherwise provided with an adequate outlet as directed by the Engineer.

3.16 SHEETING, BRACING, SHORING

A. Where required to properly support the surfaces of excavations to protect the construction work, adjacent work or workers, sheeting, bracing and shoring shall be provided. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he may order such additional supports at the expense of the Contractor, but neither the placing of such additional supports by the order of the Engineer nor failure of the Engineer to order such additional supports placed shall release the Contractor from his responsibility for the sufficiency of such supports and the integrity of the work. In removing the sheeting and bracing after the construction has been completed, special care shall be taken to prevent any caving of the sides of the excavation and injury to the completed work or to the adjacent property.

3.17 SHEETING LEFT IN PLACE

A. Sheeting, bracing and shoring shall not be left in place after completion of the work except as required by the Engineer. Where sheeting, bracing, and shoring must be left in place in order to protect the work, adjacent structures, or property, it shall be cut off or left not less than two (2) feet below the established surface grade. If sheeting, shoring or bracing must be left in place, then it shall be paid for at the contract unit bid price that is shown on the Bid Form. If a pay item was not included on the Bid Form, then a work order shall be negotiated.

3.18 CROSSING EXISTING STRUCTURES AND PIPES

A. During construction, it may be necessary to cross under certain sewers, drains, culverts, water lines, gas lines, electric conduits and other underground structures. Every effort shall be made to prevent damage to such structures. Wherever such structures are disturbed or broken, they shall be restored to good condition. Specified granular backfill shall be placed as described in the section pertaining to backfilling. MDOT Grade S3 concrete shall be utilized where directed by the Engineer at no additional cost to the project. Either granular backfill or concrete shall be brought to the spring line of the higher utility.

3.19 TUNNELING TREES

A. Trees eight (8) inches in diameter or less will require a minimum tunnel length of eight (8) feet. Trees over eight (8) inches in diameter, measured four (4) feet above the ground surface, will require a minimum tunnel length equal to one foot for each inch of tree diameter.

Trees shall be tunneled whenever any portion of an excavation approaches within a distance equal to one-half the required tunnel length except as otherwise noted on the plans.

Tunneling under trees may be accomplished by one of the following:

1. Boring and jacking casing pipe along with placement of a carrier pipe.

2. Boring and jacking of sewer pipe or water main without a casing pipe.

3. Jacking sewer or water main without boring and without a casing pipe.

Plan notes or existing field conditions shall indicate which method may be used for the tree tunneling work.

3.20 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.

2. Surveying locations of underground utilities for Record Documents.

3. Testing and inspecting underground utilities.

4. Removing concrete formwork.

5. Removing trash and debris.

6. Removing temporary shoring and bracing, and sheeting.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

C. Where called for on the plans, the Contractor shall backfill trenches and/or other excavations with suitable excavated material (not including gray or blue clay) replaced into the trench or excavation and compacted to not less than 95 percent of maximum unit weight as determined at existing moisture content during backfilling. Compaction shall be provided by means of suitable mechanical compaction equipment.

If the moisture content of cohesive backfill material exceeds the optimum moisture content for maximum density by more than three percent (3%), the Contractor shall dry the material to meet the foregoing moisture content limitation or provide, at his own expense, MDOT Granular Material Class III. No sloppy or wet backfill will be allowed.

Maximum unit weight will be determined by current methods of Test for Compaction and Density of Soil, AASHTO Designation T-180 or by the Cone Density Method developed by MDOT, as the material may require.

The Engineer shall make compaction tests at all locations requiring granular backfill.

Any depression resulting from settlement of any backfill prior to the date of final payment for all work under this contract shall be brought to the proper grade and surface and made to match the adjacent surface.

D. Compaction

Backfill material shall be placed in layers not to exceed 12 inches in thickness unless the Contractor can demonstrate to the satisfaction of the Engineer that he can consistently attain the specified density on thicker lifts.

Specified compaction shall be obtained with the use of a bulldozer, sheepsfoot roller, mechanical tamper or other similar and effective equipment. Specified compaction means not less than 95 percent (not average 95 percent) of maximum unit weight when tested in accordance with current MDOT Specifications.

If excavated material is not suitable to obtain 95 percent minimum compaction, the Contractor shall, at his expense, remove unsuitable materials or add granular materials, or both, to obtain ninety-five percent (95%) minimum compaction as specified.

Compaction tests will be made by a representative of the Owner and paid for by the Owner, unless otherwise specified in the Contract Documents.

E. Backfilling Trenches

1. Bedding

The type of bedding required is shown on the detail drawings.

Bedding shall be worked under the haunches of the pipe to provide firm continuous support.

Bedding placed on the sides of and above the pipe shall be compacted by machine tamping to not less than ninety-five percent (95%) of maximum unit weight in layers not exceeding 12 inches in depth.

2. Trench or Excavated Area

All trenches in paved streets, shoulders, traveled roadways, parking areas and driveways shall be backfilled with suitable excavated backfill or granular backfill, as shown on the drawings from one (1) foot above top of pipe up to the required subgrade elevation which will allow for placement of the required gravel base and/or pavement surface. The approved excavated backfill or granular backfill shall be placed and thoroughly and uniformly compacted by machine tamping to the specified compaction.

With the approval of the Engineer, water jetting may be accepted in lieu of tamping for granular backfill only.

Specified compaction shall be required of the entire trench when the edge of trench is within three (3) feet of edge of pavement. On road crossings, specified compaction shall extend ten (10) feet beyond the edge of pavement for paved roadways with gravel shoulders or shall extend three (3) feet beyond the back of curb for roadways with curb.

Trenches under concrete sidewalks and bike paths shall be backfilled from one foot above top of pipe to a level four (4) inches below finished grade of the sidewalk with approved suitable excavated backfill or granular backfill and compacted to ninety-five percent (95%) maximum density.

Trenches not in paved streets, shoulders, traveled roadways, parking areas, driveways or under sidewalks, shall be backfilled from one (1) foot above the top of the pipe up to the ground surface with suitable excavated backfill and shall require compaction equal to adjacent undisturbed earth.

Wherever gas mains, water mains, sewers, or other utilities are located in the trench area, granular backfill shall be used for backfill from bottom of the trench up to the springline of the pipes. Granular backfill shall be placed across the full trench width and extend far enough either side of the existing pipe to allow specified compaction so as to thoroughly support the pipe within the trench area.

F. Backfilling Around Structures

As soon as practicable after concrete structures have set, forms and debris shall be removed and the surface of the concrete pointed. After the structure has been checked and approved, the excavated area around the structure shall be backfilled up to specified subgrade with granular material or suitable excavated material as called for on the drawings for the adjacent trench. The fill shall be thoroughly compacted by machine tamping. No large boulders or masonry shall be placed in backfill. No backfill will be placed against manhole walls within 48 hours after the plaster coat has been applied to the outside of the walls nor shall backfill be placed about concrete structures until concrete has attained at least 75 percent of its design strength and approval of the Engineer has been obtained.

3.21 PLACING AND COMPACTING EMBANKMENT

A. Embankment material for fill work shall be in accordance with Section 2.05. 03 of the MDOT Standard Specifications for Construction.

3.22 DISPOSAL OF EXCAVATED MATERIAL

A. After all suitable excavated material has been used on site, the Contractor shall be responsible for properly removing and disposing of the excess.

The Contractor shall also be responsible for disposing of all other excavated materials that are unsuitable for use as fill or backfill. Unsuitable materials may include, but are not limited to, broken concrete, asphalt, rock, stone, and other related debris. The Contractor shall be required to obtain his own disposal areas and permits and shall receive no additional compensation for this disposal work.

Surplus or unsuitable material shall not be disposed of either temporarily or permanently beyond the plan grading limit line or across any wetland or flood plain unless the plans provide for such placement.

Any agreements that the Contractor makes with local residents concerning the placement of fill on private property shall be the sole responsibility of the Contractor . The Owner will not become involved with any such agreements and will not be liable for damages that the Contractor may cause to private property.

Placement of fill on private property may require that the resident or Contractor obtain a grading permit or fill permit from the Owner.

3.23 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Unpaved Areas: Plus or minus 1 inch.

2. Walks: Plus or minus 1 inch.

3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

D. Final Cleanup and Grading: Upon completion of the construction, and before final payment is made, the Contractor shall restore his working area to as clean a condition as existed before his operations were started. He shall go over the entire line and refill any place that may have settled. He shall then re-grade and put in shape all backfilled trenches, all fills he may have made from excess excavated materials, and all other areas that may have been disturbed through all operations.

3.24 SUBSURFACE DRAINAGE

A. Subdrainage Pipe: As specified on drawings or per Owner standard.

B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

C. Drainage Backfill: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a course of filter material on subsurface drainage geotextile equal to half the pipe diameter to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and extend in subsurface drainage geotextile, as noted on the plans.

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698.

3.25 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Install separation geotextile on prepared subgrade according to plans and manufacturer's written instructions, overlapping sides and ends.

2. Place base course material over subbase course under hot-mix asphalt pavement.

3. Shape subbase course and base course to required crown elevations and cross-slope grades.

4. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.

5. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.

6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698 and ASTM D 1557.

3.26 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.

2. Determine that fill material and maximum lift thickness comply with requirements.

3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.27 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.28 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

3.29 CONTACTOR SAFETY REQUIREMENTS

The excavation and trenching operations shall be conducted by the Contractor in a manner that will provide safe working conditions for all persons on the site who may be affected by the Work. The Contractor shall also conduct his operations in a manner that will protect adjacent property from damage.

Trench sides shall be either cut back to the slope as necessitated by soil and ground water conditions which will provide stable sides, or supporting systems shall be installed that are capable of restraining the earth sides from movement. A qualified employee of the Contractor shall design the trench supporting systems.

The Contractor shall employ, at all times at the site of the work, a qualified person who will be responsible for the safety of both the work and workmen, and who will make all the decisions relevant to the stability of trenches, the adequacy of any and all protective devices, proper operation of equipment, and all other matters related to safety.

The Contractor shall not store, along and adjacent to the trench, excavated material, heavy equipment, backfill materials, sewer pipe, or other construction materials which may impose too great a load on the earth and cause displacement or caving of the earth. The Contractor shall, at all times, provide a safe means of emergency exit from all trench excavations.

END OF SECTION 31 20 00

SECTION 32 10 00 – BASES AND PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work shall include the furnishing of all labor, materials, tools, equipment, and services necessary for the restoration of the surfaces shown on the drawings and/or as herein required.

Disposal of excess or unsuitable materials shall be considered as part of the work. All such work shall be in accordance with the best modern practice, the Owner's standards, and as specified herein. No permanent surface restoration shall be performed until all underground work has been approved.

B. This Section includes the following:

1. Aggregate base course.

C. Related Sections

1. Division 31 Section “Earth Moving” for excavation, filling and backfilling, and rough grading.

1.3 SUBMITTALS

A. Prior to performing work under this section, the Contractor shall submit to the Engineer for approval his construction methods and design mixes, sieve analysis, and/or certification of compliance with the 2012 Michigan Department of Transportation (MDOT) Standard Specifications for Construction except where otherwise noted.

1.4 QUALITY ASSURANCE

A. References to the Michigan Department of Transportation (MDOT) Specifications shall pertain to the 2012 Standard Specifications for Construction.

PART 2 **- PRODUCTS**

1.1 AGGREGATE

A. Gravel Approaches and Roads: Natural aggregate shall be used for gravel approach (driveways) and road construction and shall meet the requirements of MDOT 21 AA or MDOT 22A as shown in Table 902-1 of the MDOT Standard Specifications for Construction.

B. Shoulders: Natural aggregate shall be used for shoulders and shall meet the requirements of MDOT 21 AA, 22A, or 23A as shown in table 902-1 of the MDOT Standard Specifications for Construction.

C. Base Course: Natural aggregate shall be used for base course construction and shall meet the requirements of MDOT 21A, 21AA, or 22A as shown in table 902-1 of the MDOT Standard Specifications for Construction.

PART 3- **EXECUTION**

3.01 GENERAL:

A. The aggregate and pavement thicknesses shown in the following sections are intended to be a guideline for minimum thicknesses. Thicker sections may be required depending upon the requirements of the Owner or the controlling agency. In pavement restoration areas, all pavements shall be restored to the elevation and section that existed prior to construction.

3.02 GRAVEL SHOULDERS and APPROACHES

3.03 AGGREGATE BASE COURSES

A. Aggregate courses shall be placed level with the existing asphalt surface. The city will complete the final asphalt repair with their upcoming paving contract. Compaction of aggregate shall be as described in Section 30 2. 03 of the MDOT Standard Specifications for Construction. Unless otherwise indicated in the Contract Documents, aggregate base courses shall be compacted to a minimum density of ninety-eight (98) percent of the maximum unit weight.

3.04 SAWCUTTING

A. All pavement, curb and gutter, and sidewalk removals shall be accomplished by sawcutting with a power-driven concrete saw. Sawcutting shall be full depth for all pavements (concrete, bituminous, concrete with bituminous overlay).

B. In bituminous pavement, sawcut lines shall be parallel with pavement joints. Sawcuts shall not be nearer than five (5) feet to a transverse joint, to the center of pavement, or to the edge of pavement such that no existing or replacement pavement section shall be less than five (5) feet in width. If the proposed sawcut is nearer than five (5) feet to a joint or centerline of a pavement, then removal and replacement shall be extended to said joint or centerline.

END OF SECTION 32 10 00

SECTION 32 92 00 - TURF AND GRASSES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Work shall include the furnishing of all labor, materials, tools, equipment, and services necessary for the restoration of the surfaces shown on the drawings and/or as herein required.

Disposal of excess or unsuitable materials shall be considered as part of the restoration work. All such work shall be in accordance with the best modern practice, the Owner's standards, and as specified herein. In the event that these specifications conflict with those of the Owner or the controlling agency, the more stringent requirements shall govern. No permanent surface restoration shall be performed until all underground work has been approved.

B. Section Includes:

1. Seeding.

2. Sod.

3. Erosion-control material(s).

4. Meadow grasses and wildflowers.

C. Related Sections:

1. Division 31 Section "Site Clearing" for topsoil stripping and stockpiling.

2. Division 31 Section "Earth Moving" for excavation, filling and backfilling, and rough grading.

1.03 DEFINITIONS

A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

B. Finish Grade: Elevation of finished surface of planting soil.

C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

F. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete or top surface of a fill or backfill before planting soil is placed.

H. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

I. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to this Project.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for meadow grasses and wildflowers. Include identification of source and name and telephone number of supplier.

C. Qualification Data: For qualified landscape Installer.

D. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of meadows during a calendar year. Submit before expiration of required initial maintenance periods.

E. Before the Contractor orders any restoration materials that he is proposing to use as substitutes for specified items, he shall submit details of the substitutes to the Engineer for consideration and approval.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful meadow establishment.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

2. Pesticide Applicator: State licensed, commercial.

B. Soil-Testing Laboratory Qualifications: An independent laboratory with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of the soil.

1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.

2. The soil-testing laboratory shall oversee soil sampling, with depth, location, and number of samples to be taken per instructions from Engineer. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.

D. Preinstallation Conference: Conduct conference at Project Site.

E. References to the Michigan Department of Transportation (MDOT) Specifications shall pertain to the 2012 Standard Specifications for Construction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways, protection zones, 100-year floodplain, wetlands and pavements, or on existing plants, as specified on plans.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

1.07 PROJECT CONDITIONS

A. Planting Restrictions: Plant between May 15 and September 30. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.08 MAINTENANCE SERVICE

A. Initial Meadow Maintenance Service: Provide full maintenance by skilled employees of landscape installer. Maintain as required in Part 3. Begin maintenance immediately after each area is

planted and continue until acceptable meadow is established, but for not less than 40 days from date of planting completion.

PART 2 - PRODUCTS

2.01 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

B. Seed shall meet the following requirements (percent mixture proportions by weight).

1. Maintained lawn areas.

a. Seed: MDOT Type THM Mix (20% Perennial Rye, 30% Kentucky Blue,50% Red Fescue) applied at 220 lbs./acre)

2. Fields, slopes, ditch banks.

a. MDOT Type THV Mix (30% Perennial Rye, 15% Kentucky Blue, 45% Red Fescue, 10% Fults Salt) applied at 220 lbs./acre

C. Seed shall have not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed.

D. All grass seeding shall meet the requirements for purity and germination as called for in the MDOT Standard Specifications for Construction Table 917-1 for Seed Mixtures. Seed shall be delivered in durable containers which show the manufacturer’s name, lot number, weight, contents, purity, and germination. Other seeding mixtures shown in MDOT Tables 816-1 and 917-1 may be used where approved by the Engineer.

2.02 Fertilizer shall meet the following requirements.

1. Maintained lawn areas.

a. MDOT Class A, 228 lbs./acre

2. Fields, slopes, ditch banks.

a. MDOT Class B, 120 lbs./acre

2.03 PLANTING SOILS

A. Planting Soil: ASTM D 5268 topsoil, with pH range of 5.5 to 7, a minimum of 6 percent organic material content; free of stones 1-inch or larger in any dimension and other extraneous materials harmful to plant growth.

B. Planting Soil: Existing, native surface topsoil formed under natural conditions with the duff layer retained during excavation process and stockpiled on-site. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

1. Supplement with another planting soil when quantities are insufficient.

2.04 TOPSOIL

A. Topsoil shall be screened and shall consist of loose black-colored soil that is suitable for the growth of grass seed or sod. The topsoil shall be obtained from the upper layer of an existing fertile soil and be free of limbs, twigs, rocks, stones, muck, roots and debris, etc. and contain organic matter rich in nutrients with negligible clay content.

B. Topsoil shall meet the following requirements.

1. The pH range shall be from 6.0 to 7.5. Topsoil outside of this range shall be amended by the addition of pH adjusters as approved by the Engineer.

2. The organic matter content shall range between 2% and 6% (by dry sample weight).

3. The soil texture shall be a sandy loam, silt loam, or loam where the sand, silt, and clay contents (by dry sample weight) fall within the following ranges:

a. Sand .....40% to 65%

b. Silt.....25% to 60%

c. Clay .....5% to 15%

4. The gradation shall be as follows:

	Sieve designation	% Passing
b.	1-inch screen	100
c.	0.25-inch screen	97-100
d.	No. 10 U.S.S. mesh sieve	95-100
e.	No. 140 U.S.S. mesh sieve	15-35

5. The soil salinity as measured by the electrical conductivity of a saturated soil sample shall not exceed 2dS/m (decisiemens/meter).

6. Topsoil samples may be taken from stockpiles by the Engineer for submission to a testing laboratory. Topsoil that does not meet the required specifications shall be removed from the project site by the Contractor and shall be replaced with suitable topsoil that meets the testing requirements.

2.05 MULCH and MULCH BLANKETS

A. Loose Mulch: Mulching material shall consist of any straw or march hay in an air-dry condition. Hay in an air-dried condition will be permitted only when straw mulch or marsh hay is unavailable. Mulch materials shall be undamaged, rot free, clean, substantially free of weed seed and other objectionable foreign matter.

B. Mulch Blankets (for moderate runoff condition): Mulch blankets shall be one of the following or an approved equal:

1. S1 Erosion Control Blanket – BonTerra America

2. Contech ERO-MAT – Contech Construction Products

3. Erosion Control Blankets DS-75 – North American Green

C. High Velocity Mulch Blankets (for medium to heavy runoff condition): High velocity mulch blankets shall be one of the following or an approved equal:

1. S2 Erosion Control Blanket – Bon Terra America

2. Contech High Velocity ERO-MAT – Contech Construction Products

3. ECS High Impact Excelsior Blanket – Erosion Control Systems, Inc.

4. ECS High Velocity Straw Mat – Erosion Control Systems, Inc.

5. Erosion Control Blanket DS-150 – North American Green

2.06 PESTICIDES

A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.07 SOD

A. Sod shall meet the requirements of Section 91 7. 13 of MDOT Standard Specifications for Construction. The Contractor shall keep the sod watered until a vigorous growth is established.

Sod must be an upland mineral soil sod. Sod must be grown on loam soils. Sod grown on peat is not acceptable for use.

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall furnish and place topsoil, seed, or sod, and fertilizer for all areas that were disturbed during construction. Seed and sod shall be installed in accordance with the seasonal limitations that are described in Section 81 6. 03 of the MDOT Standard Specifications of Construction unless directed otherwise by the Engineer.

3.02 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel,

paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.

2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.

3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.

4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Engineer and replace with new planting soil.

3.03 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, 100-year floodplain, wetlands, and plantings from damage caused by planting operations.

1. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties, walkways, 100-year floodplain and wetlands.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Engineer’s acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.04 PREPARATION FOR EROSION-CONTROL MATERIALS

A. For erosion-control mats, install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.

B. Fill cells of erosion-control mat with planting soil and compact before planting.

C. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.

D. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.05 TOPSOIL

A. Unless otherwise called for on the plans, a minimum of three (3) inches of topsoil shall be placed for areas that are to be restored with seeding or sod. Topsoil shall be placed on a prepared earth bed in accordance with Section 81 6. 03A of the MDOT Standard Specifications for Construction.

B. The existing earth bed shall be graded such that the placement of topsoil and sod will meet the final plan grades.

3.06 SEEDING

A. Seeding shall be sown in accordance with Section 81 6. 03C of the MDOT Standard Specifications for Construction. The application rate for the seeding shall be as specified in the Products section.

B. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged.

2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

C. Rake seed lightly into top 1/8-inch of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets installed and stapled according to manufacturer's written instructions.

E. Protect seeded areas with erosion-control mats where shown on Drawings; install and anchor according to manufacturer's written instructions.

F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.

3.07 MULCH AND MULCH BLANKETS

A. Mulch and mulch blankets shall be placed over seeded areas as called for in Section 81 6. 03E through H of the MDOT Standard Specifications for Construction. If mulch blankets must be secured to a slope, then biodegradable earth staples shall be used.

B. Mulch anchoring shall be considered as incidental to mulch placement unless a pay item for mulch anchoring has been included in the Bid Form.

3.08 SOD

A. Sod shall be placed in accordance with Section 81 6. 03D of the MDOT Standard Specifications for Construction.

B. A sod cutter shall be used to establish a smooth vertical edge when new sod is to abut existing sod.

3.09 FERTILIZER

A. Fertilizer shall be placed in accordance with Section 81 6. 03B of the MDOT Standard Specifications for Construction. The application rate for the fertilizer shall be as specified in the Products section.

3.10 RESTORATION

A. Restore existing grass areas.

B. Restore existing areas damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

1. Reestablish areas where settlement or washouts occur or where minor regrading is required.

2. Install new planting soil as required.

C. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.

D. Mow, de-thatch, core aerate, and rake existing turf.

E. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

F. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

G. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.

H. Apply soil amendments and initial fertilizers required for establishing new grass areas and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.

I. Apply seed and protect with straw mulch.

J. Water newly planted areas and keep moist until new turf is established.

3.11 TURF MAINTENANCE

A. It is the responsibility of the Contractor to regularly water new seed and sod in order to establish a dense lawn of permanent grasses that is free from mounds and depressions. Any portion of a sodded area that “browns-out” or does not firmly knot to the soil base, or any portion of a seeded area that fails to show a uniform germination, shall be re-sodded or re-seeded. Such re-sodding or re-seeding shall be at the Contractor’s expense and shall continue until a dense lawn is established.

B. Watering seed and sod shall be considered as included in the turf establishment work unless a pay item for water has been included in the Bid Form.

C. Maintain and establish grass by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.

2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.

3. Apply treatments as required to keep grass and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

D. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

2. Water turf with fine spray at a minimum rate of 1-inch per week unless rainfall precipitation is adequate.

E. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

3.12 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Engineer:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

3.13 MEADOW

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged.

B. Sow seed at a total rate of 5 oz./1000 sq. ft.

C. Brush seed into top 1/16 inch of soil, roll lightly, and water with fine spray.

D. Water newly planted areas and keep moist until meadow is established.

3.14 MEADOW MAINTENANCE

A. Maintain and establish meadow by watering, weeding, mowing, trimming, replanting, and performing other operations as required to establish a healthy, viable meadow. Roll, regrade, and replant bare or eroded areas and remulch. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and meadow damaged or lost in areas of subsidence.

2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.

3. Apply treatments as required to keep meadow and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, land meadow-watering equipment to convey water from sources and to keep meadow uniformly moist.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

3.15 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.16 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by restoration work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

C. Remove non-degradable erosion-control measures after grass establishment period.

3.17 PROGRESS OF FINAL RESTORATION

A. If in the judgment of the Owner, adequate site restoration efforts are not being expended, then the Owner will take the necessary steps to perform such restoration and shall charge the Contractor for all of the costs until proper order is restored.

3.18 DRAINAGE STRUCTURES, CULVERTS, and DITCHES

A. As part of restoration, the Contractor shall be responsible for cleaning out all drainage structures, culverts, and ditches that are located within the area of construction. All ditches shall be restored such that drainage will flow freely. The cost of this work shall be considered as included in the pay items for restoration work.

END OF SECTION 32 92 00

SECTION 33 01 30

POST-REHABILITATION SANITARY SEWER CCTV INSPECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Perform all sewer line closed circuit television (CCTV) inspection work after the CIPP, rehabilitation or pipe replacement for the mainline and any lateral replacement or relining has been performed.

B. Perform all CCTV inspection work for new sewer lines after constructing the mainline and any lateral reconnection/replacement has been performed for upgrades.

1.2 REFERENCES

A. National Association of Sewer Service Companies (NASSCO)

1. Pipeline Assessment and Certification Program (PACP) Reference Manual

2. Recommended Specifications for Sewer Collection System Rehabilitation Standard (2006)

1.3 RELATED WORK

A. Sewer line cleaning is included in Section 33 35 20.

B. Pre-rehabilitation CCTV Sewer Inspection is included in Section 33 01 38.

C. Sewer Flow Control is included in Section 33 01 48.

D. Sanitary Sewerage Utilities is included in Section 33 31 00.

1.4 DEFINITIONS

A. Television Inspection - A necessary operation to complete a true-color audio-visual inspection to verify existing internal sewer line conditions. Furnish labor, materials, equipment, tools, and other incidental services for CCTV inspection.

B. MPEG - is an acronym for Moving Pictures Expert Group, which is a family of international standards used for coding audio-visual information in a digital compressed format. For this Section, digital audio-visual coding has a 352 pixels (x) by 240 pixels (y) resolution and a 30 frames per second interlaced frame rate. MPEG coding shall be named using “.mpg” as the file extension.

C. Acceptable media for the video recordings are external hard drive electronic media for data transfer.

1.5 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01 33 00.

B. Submit a description for procedures to be used.

C. Submit product literature for all digital video equipment including, but not limited to, cabling, camera, monitor, footage counter, digital video titling device, and recorder.

D. Submit a written/printed copy of television inspection logs to the Construction Manager. Logs shall record defects according to NASSCO's Pipeline Assessment and Certification Program (PACP) or/and Manhole Assessment and Certification Program (MACP).

E. Submit 2 copies of visual and audio recording to the Construction Manager in electronic format.

1. The Construction Manager will review the inspections to ensure that the required information is provided and the recording quality is acceptable, but will not review the inspections for content accuracy.

2. If the Construction Manager determines the recording is defective or not adequate quality, the Contractor shall perform the CCTV inspection again at the Contractor's expense.

1.6 QUALITY ASSURANCE

A. Comply with requirements in Section 01 43 00.

B. Comply with all codes, laws, ordinances, and regulations of governmental authorities having jurisdiction over this part of the work.

C. The television inspection shall be performed one section of line at a time. An individual digital video file and data file shall be developed for each manhole-to-manhole section.

D. The inspection shall be performed in accordance with NASSCO's Pipeline Assessment and Certification Program (PACP) and/or Manhole Assessment and Certification Program (MACP).

E. Review all videos and data before they are submitted to the Construction Manager for compliance with the requirements of the Contract.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish the television inspection studio, television camera, audio-visual digital encoding equipment/software, and other necessary equipment, materials, electricity, labor, technicians, as may be needed to perform the television inspection.

2.2 TELEVISION INSPECTION EQUIPMENT

A. The television inspection equipment shall be able to inspect 1,000 feet minimum sewer line

when entry into the sewer can be accessed from the upstream and downstream manholes. When entry is at one end only, the inspection equipment shall be able to inspect 750 feet by a self-propelled unit. The inspection equipment shall be able to clearly televise the interior of 6- inch and larger diameter sewers.

B. Transport the television equipment in a stable condition through the sewer line to be inspected. Throughout the inspection, position the camera equipment with the camera directed along the sewer's longitudinal axis.

2.3 TELEVISION CAMERA

A. Use a television camera specifically designed and constructed for sewer pipeline inspection.

1. The camera shall be waterproof and able to operate in any conditions encountered in the inspection environment.

2. Provide a color pan, tilt, and zoom camera to facilitate inspecting service laterals and sewer line to clearly view manhole defects and construction features.

3. The television camera shall be capable of 360-degree rotational scan indicating salient defects.

4. The tilt arc shall not be less than 225 degrees unless otherwise approved by the Construction Manager.

5. The focus and iris adjustment shall provide a minimum 3-inch focal range in front of the camera's lens.

B. The distance along the sewer in focus from the initial observation point shall be a minimum of twice the sewer's vertical height.

C. The illumination shall allow an even light shadowing distribution.

1. The view seen by the television camera shall be transmitted to an 11-inch or larger color monitor.

2. The television camera shall be able to receive and transmit a picture having not less than a 352(x) by 240(y) resolution.

3. The television inspection camera travel speed through the sewer shall be uniform and shall not exceed 30 feet per minute maximum speed.

D. The television inspection equipment shall be a quality to achieve the following:

1. The CCTV monitor display shall incorporate an automatically updated record in feet and tenths of a foot for the distance along the line from the cable calibration point to the camera's or transducer's center point, whichever unit is being used.

2. The relative positions for the two center points should also be noted.

3. Use a metering device that enables the cable length to be accurately measured; this shall be accurate to 6-inches.

4. Demonstrate that the tolerance is being achieved by tape measurement between manholes on the surface. This taped measurement must be included on each written and digital television log.

5. The CCTV camera shall be calibrated for accurate length measurements at least once per week with above ground markings every 25 feet for up to 100 feet. The accuracy should be within 0.2 foot for every 100 feet.

6. If the Contractor fails to meet the required accuracy standard, the Construction Manager will instruct the Contractor to provide a new device to measure the footage. The Construction Manager may instruct the Contractor to resurvey those sewer lengths first inspected with the original measuring device using the new measuring device.

7. Audio-visual recordings and collected data made during the television inspection shall become property of the city. Submit the digital data to the Construction Manager within two weeks from completing the television inspection.

2.4 TELEVISION STUDIO

A. The television studio shall be large enough to accommodate four people for viewing the television monitor while the inspection is in progress.

B. The television studio shall be insulated against noise and temperature extremes and shall have the means to control external and internal light sources to ensure the monitor screen display is in accordance with this Section's requirements.

C. The Construction Manager shall have access at all times to view the television screen.

PART 3 - EXECUTION

3.1 WASTEWATER FLOW DIVERSION

A. Sewer Flow Control is presented in Section 33 01 48.

3.2 TELEVISION INSPECTION

A. Inspect sewer pipelines with pan, tilt and zoom conventional television imagery to record relevant pipeline features and defects. Pipeline inspection shall be carried out in a format reviewed by the Construction Manager. Perform cleaning in accordance with contract document requirements.

B. CCTV operators shall be NASSCO PACP certified and have a current certification. Prior to beginning work, submit NASSCO's PACP certification for all CCTV operators performing this work on the project. Contractor shall not commence work until such certification is provided.

C. If television inspection for an entire section cannot be successfully performed from one manhole, perform a reverse setup to obtain a complete television inspection.

D. Perform sewer televising work, as necessary, using NASSCO PACP coding to thoroughly document the condition for all sewers, service lateral connections, manhole corbel, barrel, and cone-sections in the study area. To achieve this, the CCTV camera operator shall stop the camera in each manhole invert and shall pan and zoom up the manhole to obtain the

best possible image of the manhole, including the cone and corbel section(s).

E. The quality and coding for all work specified in this Section shall meet or exceed the National Association of Sewer Service Companies (NASSCO) Recommended Specifications for Sewer Collection System Rehabilitation (latest edition) requirements. Applicable Section portions which inadvertently fall below those standards shall be corrected and maintained at the NASSCO standards as a minimum requirement, at no additional cost to the city.

F. Document all internal sewer inspections via digital video recordings, television logs, digital photos, and a database compatible with the NASSCO PACP coded, Granite XP, exchange database version 4.6.1 with a Hansen interface or newer, if applicable.

1. If the video is poor quality due to the chosen media, the city reserves the right to require re-submittal on a different media. No payment will be made until an acceptable video and audio recording is made and submitted to and accepted by the Construction Manager.

2. Create separate MPEG files for each sewer line segment.

3. In a reverse setup, store such inspection in a separate MPEG file.

G. Digital video shall be defined as ISO-MPEG Level 1 (MPEG-1) coding with a 352-pixel (x) by 240-pixel (y) (minimum) resolution and a 30 frames per second encoded frame rate.

1. The digital recording shall include audio and video information which accurately reproduces the original video inspection picture and sound.

2. The digital recording's video portion shall be free from electrical interference and shall produce a clear and stable image.

3. The audio portion shall produce a clear and discernible oral report, sufficiently free from background and electrical noise.

H. Separate digital video recordings shall be made for each sewer section and shall be properly identified via continuous on-screen display and voice-over recording with the following:

1. Project name and number

2. Upstream manhole ID and downstream manhole ID number

3. Sewer segment being inspected

4. Inspection date

5. Distance along the reach from the entering manhole

I. Contractor shall coordinate with Construction Manager prior to commencing work to ensure identification is accomplished in a manner acceptable to the Engineer.

J. Inspection software to be used shall be Cues Granite XP unless otherwise approved by the Engineer. If software other than Granite XP is used, compile all video recordings, digital photos, and databases in Granite XP software before submitting to the Construction Manager.

K. The CCTV equipment/software shall be able to produce digitized images for all sewer line defects, manhole defects, and sewer line service connections in .jpeg format. Be prepared to take digital still images of each defect, construction features, and service connections to clearly depict them. More images may be required depending upon the lined pipe condition of the lined pipe.

L. Provide CCTV inspection data via external hard drive. Data shall be recorded and provided in a current version of the NASSCO PACP Exchange format. The data shall specifically include video indexing for all observations. Data to be submitted shall include:

1. NASSCO PACP exchange database file

2. .jpeg files (still photos)

3. MPG-1 files (video) for each pipe segment

M. Provide a complete television inspection for the upstream and downstream manholes. The CCTV operator shall pan and zoom up the manhole from the invert for each manhole and obtain the best possible image of the manhole including cone and corbel sections. In addition, 3 still digital photos shall be taken for each pipe connection within each manhole. The CCTV operator shall zoom in on each pipe connection so the photos capture the each pipe connection's size, location, and approximate elevation.

N. Whenever prevailing conditions allow, position the camera head to reduce the risk of picture distortion. In circular sewers, position the camera lens centrally (i.e., in prime position) within the sewer. In noncircular sewers, picture orientation shall be taken at mid-height, unless otherwise agreed, and centered horizontally. Direct the camera lens along the sewer's longitudinal axis when in prime position. A +/- 10 percent positioning tolerance of the vertical sewer dimension shall be allowed when the camera is in prime position.

O. Perform television inspections during low flow conditions. The Construction Manager will reject any television inspection that does not produce an effective sewer pipe survey due to flow conditions or for any other reason. Sewer flow shall be controlled so that the invert of rehabilitated pipe is fully visible.

P. Do not pull a cleaning device in front of the television inspection camera while taping the sewer line.

3.3 DIGITAL AUDIO/VISUAL RECORDING

A. Take continuous digital video recordings of the inspection view as it appears on the television monitor. A digital video recording shall be made for the complete television inspection of the sewer lines comprising this project. The recording shall also be used as a permanent record for defects and shall be MPEG file format. The recorded video information replay, when reviewed by Windows Media Player™, shall be free from electrical interference and shall produce a clear, stable image.

B. The inspection camera equipment shall be on the specific run encountered, synced with the audio, and shall be continuously connected to the television inspection or monitoring equipment. The recording and monitoring equipment shall have the built-in capability to allow the Construction Manager to instantly review the recording's audio and video quality

during the television survey. Playback speed shall be continuously adjustable from 1/3 normal speed for slow-motion viewing to normal playback speed.

C. Name the MPEG files according to the following file specification: Upstream Manhole Number_Downstream Manhole Number_Month_Day_Year.mpg

D. One final video record shall be submitted for each rehabilitated line segment.

3.4 TELEVISION INSPECTION REPORTS

A. Prepare a television inspection report covering the television inspection work and the information acquired. Prior to beginning work, submit a sample hardcopy television inspection report to the Construction Manager for review.

B. Report sewer defects in accordance with the National Association of Sewer Service Companies (NASSCO) program known as Pipeline Assessment and Certification Program (PACP). The Construction Manager reserves the right to refuse any inspection report that does not comply with the PACP program.

3.5 QUALITY CONTROL

A. Operate a quality control system that will effectively gauge the accuracy of inspection reports produced by the operator.

B. The Construction Manager shall be entitled to audit the control system and be present when sewer integrity assessments are being determined for rehabilitated or upgraded pipe. When requested, provide sufficient details and information for such audit assessment. Should any report fail to achieve a margin the Construction Manager deems satisfactory, the Contractor, without any additional compensation, shall recode and resubmit any data or reports.

3.6 MEASUREMENT AND PAYMENT

A. Measurement

a. The quantity for this Item will be per linear foot based on the number of linear feet of pipe CCTV inspected.

B. Payment

a. The payment for this Item will be full compensation for all labor, materials, equipment, tools and incidentals required to complete post construction CCTV inspection of the pipe, including laterals. Payment will be made upon receipt of acceptable Post Construction CCTV Inspection of all Work.

3.7 CLOSEOUT ACTIVITIES

A. Provide in accordance with Section 01 77 00.

END OF SECTION

SECTION 33 01 31– SEWER REPAIR BY CHEMICAL GROUTING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Provide all labor, materials, tools, equipment and incidentals as shown, specified, and required for testing sewer pipe joints by applying a positive air pressure to the joints, monitoring and recording the pressure in the void. The intent of joint & connection testing is to identify those sewer joints, lateral connections and laterals that are not watertight and that can be successfully sealed by packer injection grouting. All Repairs shall be completed with by-pass pumping. No temporary flow control with plugs or other methods will be allowed. This document can be utilized for the following applications:

1. Test all joints in a mainline segment
2. Test all service lateral connections from the sewer main to a predetermined distance up the sewer lateral.
3. Test all joints within a predetermined distance in laterals directly connected to manholes.

B. Provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to grout pipeline joints, joints in laterals connected to manholes and lateral connections to the mains using the packer injection method.

1. Packer injection grouting is used to reduce the infiltration within the pipeline, seal annular space between liners and host pipes at lateral connections, seal pipe joints that have failed the joint test criteria, provide external pipe support, but not a structural rehabilitation, by stabilizing soils outside the pipe and prevent further loss of pipe bedding into the pipe.
2. Packer injection grouting shall be accomplished by pressure injection of chemical grout into the soils encompassing the exterior of pipe joint. Chemical grouts shall be designed to be injected into the soil surrounding the pipe, which stabilizes the soil and forms a permanent impermeable seal called a grout/soil ring, and into the annular space between liners and host pipes. Adequate volumes of grout must be injected to form an effective seal. Adequate amounts of grout are based generally upon pipe size and field conditions. This application will be through structurally sound joints and lateral connections through penetrations from within the pipe by using the packer method in tandem with a closed circuit television (CCTV) inspection system.

1.2 REQUIREMENTS

A. Contract requires work in active sewers. CONTRACTOR shall follow all federal, state and local requirements for safety in confined spaces and uniform traffic controls.

B. Additional safety considerations including safely handling, mixing, and transporting of chemical grouts should be provided by the grout manufacturer/supplier, and should include safe operating practices and procedures, appropriate personal protective equipment (PPE) for the various grouting operations, and proper storage, transportation, mixing, and disposal of grouts, additives, and their associated containers.

C. Require completion of grout handling and mixing training certification from the grout manufacturer/supplier for personnel working with chemical grouts and additives.

1.3 QUALIFICATIONS

A. Qualified bidder will have at least 3 years' experience in grouting service laterals, and at least 5 years' experience in pressure testing and grout-sealing sanitary sewer mainline joints with acrylamide monomer chemical grout. Qualified bidder shall employ experienced personnel, and bid submittal shall include resume of operator who shall be responsible for execution of Work under this Contract. Assigned operator shall have at least 3 years of experience as equipment operator of chemical grout packing equipment, including at least 2 years of testing and sealing sanitary sewer laterals. Assigned operator shall be responsible for all aspects of field operation, including grout mixing and testing, and grouting equipment set-up, testing, and operation, and shall be on site during all phases of Work performed under this Contract. Operator shall personally perform all calibration, testing, mixing, and other critical operations requiring high level of expertise.

B. Bid submittal shall contain at least 5 references, including telephone numbers and contact names, of municipalities or wastewater utilities where bidder has done service lateral grout sealing in past 3 years.

1.4 SUBMITTALS

A. The CONTRACTOR shall provide a minimum 48-hour advance written notice of proposed testing schedules and testing procedures for review and concurrence of the ENGINEER.

B. Chemical Grout information:

1. Description of chemical grout materials to be used per sections 2.3.
2. Description of proposed additives to be used per sections 2.4.
3. Manufacturers recommended procedures for storing, mixing, testing and handling of chemical grouts.
4. MSDS sheets for all materials to be used.

C. Identify the manufactures & models of the packers to be utilized on the project.

D. Upon completion of each pipe segment, submit to ENGINEER a report showing the following data for each joint and/or lateral connection tested, grouted or attempted to be grouted as required by PACP.

1. Identification of the sewer pipe section tested by assigned sewer ID or address and street, and length.
2. Type of pipe material, diameter & depth of pipe to the surface at manholes.
3. Length of pipe sections between joints.
4. Test pressure used and duration of test.
5. Pass/fail results for each joint/connection tested.
6. Location stationing of each joint/connection tested and location of any joints/connections not tested with an explanation for not testing.
7. Volume of grout material used on each joint or connection.
8. Gel set time used (cup test results from tanks)
9. Grout mix record of the batches mixed including amount of grout and catalyst, additives, temperature of the grout solution in tanks.

10. Operator conducting testing and sealing shall be noted on the reports.
11. Video recordings
    i. Video recording shall include testing and sealing operations for each joint/lateral (including inflation and deflation over the joint/lateral) displaying the final air test of joints or laterals as well as video after all work in that run is complete to verify all equipment and materials have been removed from the main..
    ii. Additional final recording, if specified, shall include inspection of the pipe or lateral after all grouting work is complete.

1.5 REFERENCE STANDARDS TO BE USED

A. National Association of Sewer Service Companies (NASSCO) prepared *Pipeline Assessment and Certification Program (PACP)*, TV inspection form and sewer condition codes

B. ASTM F2304 Standard Practice for Rehabilitation of Sewers using Chemical Grouting (latest revision)

C. ASTM F2454 Standard Practice for Sealing Lateral Connections and lines from the Mainline Sewer Systems by Lateral Packer Method, Using Chemical Grouting (latest revision)

PART 2 - PRODUCTS

2.1 TESTING EQUIPMENT & GROUTING EQUIPMENT

A. The basic equipment used for mainline pipe joints and for laterals connected to the mainline shall consist of a remotely operated color television camera capable of pan and tilt, joint testing device (referred to hereafter as a packer), and test monitoring equipment. The equipment shall be constructed in such a way as to provide means for introducing air under pressure into the void area created by the expanded ends of the packer against the host pipe and a means for continuously measuring, viewing and recording the actual static pressure of the test medium and grout within the void area only. The packer shall be of a size less than the diameter of the host pipe, with the cables at either end used to pull it through the line and may be constructed in such a manner as to allow a restricted amount of sewage to flow at all times. Packer shall be expanded by air pressure. Packers shall be of low void space construction with void volume given by the packer manufacturer.

B. The device for testing lateral connections shall consist of inflatable mainline end elements and a lateral grouting plug that creates a void area extending beyond the main connection. Whenever possible, use a lateral grouting plug sized to match the diameter of the lateral being grouted with an effective sealing length no greater than 3 feet. Where the lateral is capped, utilize alternate lateral grouting plug or equipment sized appropriately for the capped lateral. In cases were the lateral transitions from 6” to 4” in diameter, use a 4” lateral grouting plug. However, it is possible that due to physical restrictions the lateral plug may not launch and thus the service may not be able to be grouted.

C. The basic equipment for 4-inch and 6-inch laterals connected to manholes shall consist of a flexible push-type packer and mini-push camera. The device for testing lateral pipe

connected to the manhole shall be capable of testing the joints no greater than 3 feet of the lateral or to the cleanout, whichever comes first, from the manhole toward the building. If the lateral contains a transition, CONTRACTOR may change out diameters of push packer or grout lateral using only a 4-inch push packer.

D. Void pressure data shall be transmitted from the void area to the monitoring equipment or video picture of a pressure gauge mounted on the packer and connected to the void area. All test monitoring shall be above ground and in a location to allow for simultaneous and continuous observation of the televising monitor and test monitoring equipment.

E. Grouting equipment shall consist of the packer, appropriate pumping and hosing systems capable of supplying an uninterrupted flow of sealing materials to completely fill the voids. Grout pumping system shall be sized to deliver a mixed volume of grout at a minimum of 3 gpm and 30 gallons of uninterrupted flow within 10 minutes.

F. Volume of mixed grout pumped must be capable of being measured and recorded for each grouted joint/connection. Generally, the equipment shall be capable of performing the specified operations in sewers where flows do not exceed 25 percent of pipe diameter unless permitted by ENGINEER.

G. Connection and lateral service sealing shall be accomplished using the lateral grouting plugs and push packers specified above. Provide back-up bladders for each packer on-site at all times during grouting procedures.

H. Equipment for cleaning lateral blockages shall be readily available while any lateral grouting work is being performed.

2.2 GROUTS - GENERAL

A. All grout materials must have the following characteristics:

1. While being injected, the grout must be able to react /perform in the presence of water (groundwater).
2. The ability to increase grout mix viscosity, density and gel strength by increased concentration of constituents or the use of approved additives.
3. The cured grout must withstand submergence in water without degradation.
4. The resultant grout formation must be homogeneous and prevent the passage of water (infiltration) through the pipe joint.
5. The grout must not be biodegradable.
6. The cured grout should be chemically stable and resistant to organics found in sewage.
7. Residual grout shall be easily removable from the sewer line to prevent blockage of the sewage flow.
8. Handle, mix, and store grout in accordance with the manufacturer's recommendations. The materials shall be delivered to the site in unopened original manufacturer's containers.

2.3 CHEMICAL GROUTS

A. Water based chemical grouts shall have the following characteristics:

1. A minimum of 10% acrylamide base material by weight in the total grout mix. A higher concentration of acrylamide base material is recommended to increase strength or offset dilution during injection.
2. The ability to tolerate some dilution and react in moving water during injection.
3. A viscosity of approximately 2 centipoise, which can be increased with approved

additives.

4. A controllable reaction time from 10 seconds to 1 hour.
5. A reaction (curing) that produces a homogenous, chemically stable, non-biodegradable, firm, flexible gel.
6. The ability to increase mix viscosity, density and gel strength by increased concentrations of the mix constituents or by the use of approved additives.
7. Product Manufacturer:
    a. Avanti AV-100, Avanti AV-118; or ENGINEER approved equal.

B. Acrylate base grout shall have the following characteristics:

1. A minimum of 10% acrylate base material by weight in the total grout mix.
2. The ability to tolerate some dilution and react in moving water during injection.
3. A viscosity of approximately 1-3 centipoise, which can be increased with approved additives.
4. A controllable reaction time from 10 seconds to 1 hour.
5. A reaction (curing) that produces a homogenous, chemically stable, non-biodegradable, firm, flexible gel.
6. The ability to increase mix viscosity, density and gel strength by the use of approved additives.
7. Product Manufacturer:
    a. DeNeef AC-400,
    b. DeNeef Gelacryl SR,
    c. Avanti AV-160;
    d. or ENGINEER approved equal.

2.4 ADDITIVES

A. At the CONTRACTOR'S discretion and according to field conditions, additives may be selected and used within the manufacturers recommended quantities.

B. Strengthening Agents

1. For joint grouting, a latex or “diatomaceous earth” additive may be added to increase compressive and tensile strength. The quantity of strengthening agent additive shall be as recommended by the manufacturer and approved by ENGINEER.
2. Product Manufacturer:
    a. Avanti AV-257 Icoset, DeNeef Reinforcing Agent; or equal.

C. Root Inhibitor

1. When roots are present, for joint and lateral connection joint grouting, a root deterrent chemical shall be added to control root re-growth. The quantity of inhibitor shall be as recommended by the manufacturer and approved by ENGINEER.
2. Product Manufacturer:
    a. Avanti AC-50W; or equal.

D. Dye - A manufacturer approved water soluble dye without trace metals may be added to the grout tank(s) for visual confirmation.

E. Gel Time Modifier - A gel time extending agent may be used in accordance with the manufacturer’s recommendations to extend gel time as necessary.

F. Freeze/Thaw - In those lines where the grouting material may be exposed to a freeze-thaw cycle, ethylene glycol or other ENGINEER approved additive shall be used to prevent

chemical grout cracking once set

PART 3 - EXECUTION

3.1 CONTROL TESTS

A. Packer Tests - Demonstrate the acceptable performance of air test.

1. To insure the accuracy, integrity and performance capabilities of the testing equipment, a demonstration test will be performed in an above-ground 8” nominal diameter test cylinder suitable to contain the full length of the packer and sustain the void test pressure. The test cylinder shall be equipped with a void release valve to exercise a controlled release of pressurized air from the void area to test the packer under both sound and leaking conditions. The test cylinder shall also be equipped with a local pressure gauge (0-25 psi) within the void space.
    a. With the void release valve sealed, inflate the packer and air test void at 7-10 psi. The observed void pressure at the test cylinder pressure gauge must be within ±1.0 psi of the reading in the control center/studio void pressure gauge and follow both up and down pressure changes (allowing time for pressure equalization).
    b. If above test is passed, crack the release valve to simulate a very small leak. The cylinder shall be equipped with a void release valve to exercise a controlled release of the test media with the associated pressure drop to be equally displayed ±1.0 psi of the cylinder gauge and test monitoring equipment.

B. After entering each pipeline segment with the test equipment, but prior to the commencement of joint testing, position the packer on a section of sound sewer pipe between pipe joints, and perform a test as specified. The equipment shall hold a 7-10 psi test pressure for a period of 15 seconds with a pressure drop of less than 1 psi. In the event of a failed test, repair any defective equipment and re-test to verify proper operation of all equipment at no additional compensation. Should it be found that the surface or porosity conditions of the barrel of the sewer pipe cannot meet the joint test requirements, then the performance testing shall be waived or modified as determined by the ENGINEER.

C. If air testing cannot be performed successfully, repair or otherwise modify air test equipment and repeat the tests. This test may be required at any other time during the performance of joint testing work if the ENGINEER suspects the testing equipment is not functioning properly.

D. Pump Tests - At the beginning of the contract, prior to application of grout, perform a pump test to determine if proper ratios are being pumped from the grout component tanks at the proper rates and to measure pump rates. Use separate containers to capture the discharges from each of the grout component hoses, to simulate the actual volumes of each component through the interconnect hoses, hose reel and length of grout hose and confirm accuracy of grout pump totalizer. Take corrective action if ratios or rates are not within manufacturer’s recommended standards.

E. Grout Tests - Perform and record a grout gel test in the presence of the ENGINEER by recording the grout tank solution temperature, catalyst tank solution temperature, ambient air temperature in truck, and gel time of the sample whenever the following conditions occur:

    a. At the beginning of each day; the material in the hoses shall be recycled to the tanks and a sample shall be taken.
    b. When new batches of grout are mixed.

c. Whenever the temperature in the tanks or ambient temperature have changed by more than +/- 10°F from the previous gel test.

3.2 PIPE PREPARATION

A. Prior to the application of the chemical grouting materials, the CONTRACTOR shall thoroughly clean the sewer designated to receive the chemical grouting. Cleaning shall constitute removal of all loose debris & solids which inhibit proper seating of the packer. If mineral deposits or protruding taps are present, they shall be removed and paid for per the applicable items on the Schedule of Prices. Removal of other hardened materials such as concrete shall be considered beyond the scope of this work.

B. The OWNER shall have cleared the designated sewer line(s) of obstructions such as dropped joints, protruding lateral connections, and broken pipe / crushed pipe which will prevent the use of the grouting equipment. If the CCTV inspection reveals a condition for which an applicable pay item has not been included on the Schedule of Prices, the CONTRACTOR shall inform the ENGINEER. The ENGINEER may choose to make a point repair or will direct the CONTRACTOR to abandon the section of pipe scheduled for test & seal.

3.3 ROOTS AND LOOSE DEBRIS IN LATERAL CONNECTIONS

A. Remove all roots and loose debris from laterals connected to manholes for the length of lateral to be tested/grouted.

B. During mainline sewer cleaning or joint testing, document all lateral connections containing roots, mineral deposits or obstructive conditions that are either (a) greater than fine roots or (b) of a nature to prevent testing and sealing of connection. For each such connection, submit a screen shot image clearly showing the extent of roots or obstructive condition to the ENGINEER. Submit images in electronic format, labeled and organized in a manner to easily retrieve the image for the lateral connection in question. The list of lateral connections with roots shall include upstream and downstream manhole numbers and stationing. ENGINEER will review the list of lateral connections containing roots and obstructions and direct CONTRACTOR as to which laterals are to be (a) cleaned and grouted, (b) grouted without cleaning – in which case such lateral connection would be excluded from warranty testing, or (c) removed from the scope of work – in which case no payment for such lateral will be made. Cleaning of lateral connections will be paid per the applicable item on the Schedule of Prices.

3.4 GROUT PREPARATION

A. Follow the manufacturer's recommendations for the mixing and safety procedures.

B. Adjust gel time as necessary to compensate for changes in temperature in grout component tanks or hoses. The addition of dilution water to extend gel times is not acceptable unless resulting base grout tank only material exceeds 20% by weight for solution grouts.

C. During the grouting process, the Grouting Technician shall monitor the grout component tanks to make sure that proper ratios are being pumped. If unequal levels are noted in the tanks, repeat the pump test as described above and correct any defective equipment.

D. Gel times shall be calculated using the following formula unless CONTRACTOR experience and/or field conditions dictate otherwise. Any alterations of the gel time formula shall be approved by the ENGINEER.

$$\textit{Gel Time} = \left(\frac{Volume\ of\ Pipe\ /\ PackerVoid\ Space\ (gal)}{Pumping\ Rate\ (gpm)}\right)\left(\frac{60\text{sec}}{1\text{min}}\right)\text{+20sec(+/-5 sec)}$$

Packer/Pipe void shall be defined as the volume between the inflated packer and the inside pipe wall when the packer is inflated per manufacturer recommendations.

For example: an 8" pipe with a packer void space of 0.3 gallons and a 3 gpm pumping rate would provide

Gel Time $= \left(\frac{.3(gal)}{3(gpm)}\right)\left(\frac{60\text{sec}}{1\text{min}}\right)$+(20sec)=26sec(+/-5 sec)

3.5 TESTING AND GROUTING DEFECTS

A. Testing and grouting will not be required on pipe exhibiting the following conditions or characteristics:
    1. Longitudinally cracked, fractured or broken pipe.
    2. Sections of the pipe with structural defects between joints.
    3. Any sections of pipe or joints that are in such poor structural condition that in the judgment of ENGINEER, significant structural damage of the pipe would occur as a result of the pressure test.
B. Any structurally undamaged joint that structurally fails (breaks) during testing and grouting that are documented on video to have been done under normal pressure conditions shall be the OWNER's responsibility and cost to repair.
C. Grout all circumferential cracks and fractures or other defects as specified or as directed by ENGINEER. Do not test or grout any other pipe defects unless so specified or shown, or directed by ENGINEER to do so. Any structurally failed pipe or joint that is grouted at the ENGINEER's direction that further fails/breaks during testing and grouting that are documented on video to have been done under normal pressure conditions shall be the OWNER's responsibility and cost to repair. Promptly repair any other sewer damage resulting from the CONTRACTOR's operations at no additional compensation.

3.6 JOINT TESTING

A. Joint testing pressure shall be equal to 0.5 psi per vertical foot ground water evidenced over the pipe plus 4 psi; however, test pressure shall not exceed 10 psi without the approval of the ENGINEER.
B. Test joints in laterals which are directly connected to manholes to a distance of 10 feet.
   If there is a transition in the laterals connected to manholes test the transition. Direct visual observation and measured cable lengths shall be used to position the lateral packer for laterals directly connected to manholes.
C. Individually test each sewer pipe joint at the above-specified pressure (and retest after sealing) in accordance with the following procedure:
    1. Air Test Procedure
        a. The packer shall be positioned within the pipe in such a manner as to straddle the joint to be tested.
        b. The packer ends shall be expanded so as to isolate the joint from the remainder of the pipe and create a void area between the packer and the pipe joint. The ends of the testing device shall be expanded against the pipe as per manufacturer's recommendations. If all attempts to isolate the joint fail, pump grout in an attempt to seal the leak around the packer end elements. The CONTRACTOR shall be paid the unit price for grout to seal the packer unless the ENGINEER determines that the sewer was inadequately cleaned or the packer is not performing properly, but will not be paid the unit price for joint grouting for this activity.
        c. After the void pressure is observed to be equal to or greater than the

required test pressure, the air flow shall be stopped. If the void pressure decays by more than 1.0 psi within 15 seconds, the joint will have failed the test and shall be sealed.

D. Upon completing the testing of each individual joint, the packer shall be deflated with the void pressure meter continuing to display void pressure. Should the void pressure meter fail to drop to 0.0 +/- 0.5 psi, clean the test equipment of residual grout material or make the necessary equipment repairs to provide for an accurate void pressure reading.

3.7 LATERAL CONNECTION TESTING PROCEDURE

A. Lateral connection joint testing pressure shall be equal to 0.5 psi per ground water evidenced over the pipe plus 4 psi; however, test pressure shall not exceed 10 psi without approval of the ENGINEER.

B. Air testing lateral connections shall be accomplished by isolating the area to be tested with the lateral connection packer and by applying positive pressure into the isolated void area. A pan and tilt camera shall be used to position the lateral packer for laterals directly connected to the mainline sewer. The lateral bladder shall be inverted from the mainline assembly into the lateral pipe and inflated. The mainline elements shall then be inflated to isolate the lateral connection and the portion of the lateral to be tested. A sensing unit shall monitor the pressure of the packer void and will accurately transmit a continuous readout of the void pressure to the control panel at the grouting truck or to a pressure gauge on the packer recorded by the CCTV camera.

C. The test procedure will consist of applying a controlled air pressure into each isolated void area. Air shall then be slowly introduced into the void area until a pressure equal to or greater than the required test pressure, but in no cases greater than 2 psi above the required test pressure, is observed on the pressure monitoring equipment. Once the designated pressure in the isolated void is displayed on the meter of the control panel, the application of air pressure will be stopped and a 15 second waiting period will commence. The void pressure will be observed during this period. If the void pressure drop is greater than 2.0 psi within 15 seconds, the lateral shall be considered to have failed the air test and shall be grouted and retested.

D. After completing the air test for each individual lateral specified herein, deflate the lateral packer, with the void pressure meter continuing to display void pressure. If the void pressure does not drop to 0.0 +/- 0.5 psi, the equipment shall be adjusted to provide a zero void pressure reading at the monitor.

3.8 GROUTING - GENERAL

A. Grout all joint and lateral connections that failed the pressure test by the injection method. This shall be accomplished by forcing grout through a system of pumps and hoses into and through the joints of the sewer from the packer within the sewer pipe.

Remove excess grout from pipe and laterals. Excess grout shall be defined as a thickness of grout that given its location, size and geometry, could cause a blockage. Flush or push forward to the next downstream manhole, remove from the sewer system, and properly dispose of excess grout.

3.9 PIPE JOINT SEALING BY PACKER INJECTION GROUTING FOR MAINLINE SEWERS AND LATERALS CONNECTED TO MANHOLES

A. Position the mainline packer over the joint or defect to be sealed by means of a CCTV camera in the line. Position the push/pull packer over the joint or defect to be sealed by a means of visual observation, marked push rod, or where a cleanout is available, through a CCTV camera in the lateral. For push packers, start work at the most distant point to be grouted. Take an accurate measurement of the location of the defect to be sealed using a portion of the packer as a point of reference for positioning the injection area of packer over the defect.

B. Pneumatically expand the packer sleeves such that they seal against the inside periphery of the pipe to form a void area at the joint now completely isolated from the remainder of the pipe line.

C. Pump grout materials, in stages if needed, into this isolated area to refusal until and the void or surrounding soil has been filled or solidified with the goal of applying 0.25 to 0.5 gallons of grout per inch-diameter per pipe joint. Refusal is when the packer void pressure during grout pumping instantaneously rises or “spikes” by 4 to 5 psi or more above the normal void pressure experienced during grout pumping operation. Refusal may also be revealed when pumping void pressure exceeds the holding pressure of the packer end elements as evidenced by “blowby” past the packer sealing end elements. Refusal shall mean, when the joint will not accept any more grout because it has flowed throughout the void, through any joint failure and into the surrounding soil; gelled or filled the available void space; and formed a cohesive seal stopping further grout flow, then the joint will have then been sealed. Record the amount of grout pumped on the sealing log. If sealing is not achieved refer to para.3.9.E

D. Upon completion of the injection, deflate the packer to break away from the ring of gel formed by the packer void. The packer should then be re-inflated and the joint retested at a pressure equal to the initial test pressure. If the joint fails this air test, repeat the grouting procedure at no additional cost to the OWNER, except for the additional grout used. Repeat this sequence of air testing, grouting and subsequent air testing until either the joint is sealed or it is determined that the grout consumption is too high (see section 3.9.E). The final determination to stop subsequent attempts to seal a joint will be made jointly between the ENGINEER and the CONTRACTOR. Should the void pressure meter not read zero ± 0.5 psi, clean the equipment of residual grout or make the necessary equipment repairs/adjustments to produce accurate void pressure readings.

E. If a mainline or lateral joints require more than 0.5 gallon of grout per inch-diameter per pipe joint, modify grouting procedure to perform stage grouting by pumping additional grout in up to 4 gallon increments, waiting 1 gel set cycle time or 1 full minute, whichever is greater between stages. Maximum number of stages shall not exceed two stages of 4 gallons each unless approved by ENGINEER.

3.10 LATERAL CONNECTION SEALING FROM THE MAINLINE BY PACKER INJECTION GROUTING

A. Lateral connection sealing begins if the lateral connection does not pass the air test, shows evidence of leakage, has been successfully cleaned to remove roots, or where CONTRACTOR has been directed. The lateral packer shall remain in position during the

pressure test, thus maintaining the isolated void. Pressure inject grout through the lateral packer into the annular space between the lateral grouting plug and the lateral pipe.

When pumping grout, operate the pumps until the mixed grout has flowed through any joint failure, through any annular space, and into the surrounding soil; gelled or filled the available void space; formed a cohesive seal stopping further grout flow; and minimum of 8 psi back pressure is achieved while pumping. As grout pumping continues the void pressure will slowly rise to a range of about 2 to 4 psi, continue pumping until a point where there is a sudden increase in the void pressure. This increase from 2 to 4 psi to over 8 to 10 psi takes place in a matter of a few seconds. If the grout pumped exceeds 1 gallon per foot of lateral bladder plus 3 gallons, it will be suspected that there are significant voids on the outside of the pipe or that the packer is not properly sealed. Check that the packer is sealed properly. If it is, modify grouting procedure to stage grouting by pumping additional grout equivalent to1 gallon plus

B. 0.25 gallon per foot of lateral bladder, waiting 1 full minute, and retesting. The maximum number of stages shall not exceed two stages unless authorized by ENGINEER.

C. Upon completion of the lateral connection sealing procedure, deflate the lateral bladder, re-inflate and air test the lateral connection a second time to confirm the sealing of the connection in accordance with the air testing procedure. If the lateral connection fails this air test, repeat the grouting procedure at no additional cost to the OWNER, except for the additional grout used. Air tests after grouting laterals containing roots is not required.

D. Confirm lateral flow after sealing of each lateral connection. If a grout blockage exists, the CONTRACTOR shall immediately clear the lateral at no additional cost to the OWNER. Blockages in the lateral that are not the result of grouting operations shall not be the responsibility of the CONTRACTOR.

E. After grouting lateral connections (with the appropriate size lateral bladder), a thin residual grout film may be present inside the lateral wall. The amount of residual grout film present is dependent on the lateral bladder used, geometry of the lateral and positioning of the packer. This thin layer of cured grout is normal and will eventually peel off the sidewall of the pipe. The residual chemical grout film is not “sandwiched” between two structures and will eventually peel off the sidewall of the pipe. This residual chemical grout film is not considered excess grout. Removal of residual grout shall be requested by the ENGINEER and incidental to joint grouting.

3.11 JOINT SEALING VERIFICATION

A. Record grouting of joints in conjunction with the testing of joints. Record the void pressure drop continuously on video and in writing immediately before sealing, and immediately after grouting. After the packer is deflated and moved, record on video the visual inspection of the joint.

B. Use of standardized test and seal data sheets and PACP data codes is highly recommended.

3.12 DISPOSAL

A. Collect and properly dispose of cleaning materials used in the cleaning of the grouting equipment.

3.13 POST-CONSTRUCTION INSPECTION

A. After grouting is complete, all pipe sections shall be final inspected by means of a color CCTV system. The inspection shall be conducted as per the NASSCO Pipeline Assessment and Certification Program. One set of DVD's and reports shall be submitted.

3.14 QUALITY CONTROL

A. Conduct warranty CCTV inspection of mainline sewers on all of the pipe sections which contain joint or lateral grouting. This work shall be completed during conditions of high ground water and shall commence a minimum of 11 months after substantial completion and be completed a maximum of 18 months after final completion. Any joints or lateral connections which were originally sealed and are observed to be leaking shall be re-sealed at no cost to the OWNER.

END OF SECTION 33 01 30

SECTION 33 01 36 – MANHOLE LINING AND SEALING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This work shall include the furnishing of all labor, materials, tools, equipment, accessories and services necessary for providing and installing the items as shown on the Contract Documents or as herein required.

B. Manhole wall surfaces to be rehabilitated shall be examined by the Contractor to ensure final product will adhere to the inside manhole wall. The Contractor shall not begin repairs until unacceptable conditions have been corrected

C. Section Includes:

1. Sanitary manhole interior lining.

2. Sanitary manhole sealing spot leaks with injectable grout.

D. Related Sections:

1. Division 01 Section "Temporary Facilities and Controls" for temporary utility services, construction and support facilities, security and protection facilities, and temporary erosion- and sedimentation-control measures.

2. Division 33 Section “Sanitary Sewer Manholes” for construction methods and testing requirements.

1.03 REFERNCE STANDARDS

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following standard specifications:

1. ANSI – American National Standards Institute

2. ASTM – American Society for Testing and Materials

3. AWWA – American Water Works Association

4. AASHTO – American Association of State Highway Transportation Officials

1.04 SUBMITTALS

A. When required by the Engineer, shop drawings shall be furnished as prescribed under the General Conditions.

B. Before the Contractor orders any pipe or other appurtenances that he is proposing to use as substitutes for specified items, he shall submit design details of the substitutes to the Engineer for consideration and approval.

1.05 CERTIFICATIONS

A. All materials delivered to the job shall be accompanied by certification papers showing they have been tested in accordance with applicable specifications and that they meet the specifications for the project.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Calcium Aluminate Interior Lining

1. All calcium aluminate manhole liner materials shall be cement based, poly-fiber reinforced, shrinkage compensated, and enhanced with chemical admixtures and siliceous aggregates.

2. The materials to be utilized in the lining of manholes shall be designed and manufactured to withstand the severe effects of hydrogen sulfide in a wastewater environment.

3. Liner materials shall be mixed with water per manufacturer's specifications and applied using equipment specifically designed for either low-pressure spray or centrifugal spin casting application of cement mortars.

4. All liner materials shall conform to the following 28-day minimum physical properties.

a. ASTM 4541 – Adhesion.

b. ASTM D412 - Tensile Strength (PSI).

c. ASTM D2240 - Tear Strength (PLI)

d. ASTM D2240 – Hardness

e. Permeability (AASHTO T-277) not to exceed 400 couloumbs.

f. ASTM D522 – Flexibility

g. Freeze-Thaw (ASTM C666) no damage in minimum 300 cycles.

h. Material wet density minimum of 140 PC ASTM D4060 - Taber Abrasion.

5. Thickness of calcium aluminate liner shall be a minimum of ½ inch.

B. Polyurea Interior Lining

1. All materials used in the manhole must be inert to hydrogen sulfide from damaging the manhole structures.

A. Hydraulic Water Plugs.

a. Rapid setting hydraulic water plug to plug active leaks prior to other rehabilitation work.

2. Initial Set Time at 70 degrees F: 60 to 90 seconds.

3. Final Set Time at 70 degrees F: One hour.

4. Compressive Strength (ASTM C109) at 28 days:

a) Per manufacturer's recommendation.

b) Minimum acceptable "or equal" products: 4,000 psi.

5. Length Change (ASTM C157): 0 percent.

B. Oil-free Oakum Water Plugs.

1. Rapid setting oil-free oakum and hydrophilic grout to plug active water leaks prior to other rehabilitation work.

2. Oil-free oakum meeting Federal Specification HH-P-117.

3. Two-part urethane resin.

4. Initial set time: 5 to 10 minutes.

a) Use accelerator to decrease initial set time.

5. Approved Manufacturers:

a) Avanti International, Oil-free Oakum (AV-219) and Multigrout (AV-202).

b) DeNeef, Inc., Oil-free Oakum and Hydro Active Sealfoam or Hydro Active Flex LV grout.

c) Or Equal.

C. Manhole Liners.

1. Spray on Polyurea Liners.

a) Two part material to protect concrete and steel from chemical attack.

2. Multi-component stress panel liner: 500 mils.

a) Tensile Strength (ASTM D412): Minimum 3,500 psi.

b) Tear Strength (ASTM D624): Minimum 550 psi.

c) Elongation (ASTM D412): >300%

3. Approved Manufacturers:

a) SpectraShield Liner System

b) Or equal

b. Manhole Frames and Covers.

1. Any repairs or replacements on manhole frames and covers scheduled for work shall be completed prior to manhole rehab

C. Spot Leak Seal with Injectable Grout

1. All materials used in the manhole must be inert to hydrogen sulfide from damaging the manhole structures.

2. General: All chemical sealing materials used in the performance of the work specified should possess properties as described in APWA publication "Assessment of Sewer Sealants" (September 1980, Office of R&D, U.S.EPA, Cincinnati, OH 45268).

3. Acrylamide base gel sealing material:

a. A minimum of 10% acrylamide base material by weight in the total sealant mix. A higher concentration (%) of acrylamide base material may be used to increase strength or offset dilution during injection.
b. The ability to tolerate some dilution and react in moving water during injection.
c. A viscosity of approximately 2 centipoise which can be increased with additives.
d. A constant viscosity during the reaction period.
e. A controllable reaction time from 10 seconds to 1 hour. F. A reaction (curing) which produces a homogeneous, chemically stable, nonbiodegradable, firm, flexible gel.
f. The ability to increase mix viscosity, density and gel strength by the use of additives.

4. Acrylic base gel chemical sealing material:

a. A minimum of 10% acrylic base material by volume in the total sealant mix. A higher concentration (%) of acrylic base material may be used to increase strength or offset dilution during injection.
b. The ability to tolerate some dilution and react in moving water during injection.
c. A viscosity of approximately 2 centipoise which can be increased with additives. A constant viscosity during the reaction period.
d. A controllable reaction time from 5 seconds to 6 hours.
e. A reaction (curing) which produces a homogeneous, chemically stable, nonbiodegradable, flexible gel.
f. The ability to increase mix viscosity, density and gel strength by the use of additives.

5. Urethane base gel chemical sealing material:

a. 1 part urethane prepolymer thoroughly mixed with between 5 and 10 parts of water by weight. The recommended mix ratio is 1 part urethane prepolymer to 8 parts of water (11% prepolymer).
b. A liquid prepolymer having a solids content of 77% to 83%, specific gravity of 1.04 (8.65 pounds per gallon), and a flash point of 20°F.
c. A liquid prepolymer having a viscosity of 600 to 1200 centipoises at 70°F that can be pumped through 500 feet of 1/2-inch hose with a 1000-psi head at a flow rate of 1 ounce per second. The water used to react the prepolymer should have a pH of 5 to 9.

d. A cure time of 80 seconds at 40°F, 55 seconds at 60°F, and 30 seconds at 80°F when 1 part prepolymer is reacted with 8 parts of water only. Higher water ratios give longer cure times.
e. A cure time that can be reduced to 10 seconds for water temperatures of 40°F to 80°F when 1 part prepolymer is reacted with 8 parts of water containing a sufficient amount of gel control agent additive.
f. A relatively rapid viscosity increase of the prepolymer/water mix. Viscosity increases from about 10 to 60 centipoises in the first minute for 1 to 8 prepolymer/water ratio at 50°F.
g. A reaction (curing) which produces a chemically stable and nonbiodegradable, tough, flexible gel.
h. The ability to increase mix viscosity, density, gel strength and resistance to shrinkage by the use of additives to the water.

6. Urethane base foam chemical sealing material:

a. Approximately 1 part of urethane prepolymer thoroughly mixed with 1 part of water by weight (50% prepolymer).
b. A liquid prepolymer having a solids content of 82% to 88%, specific gravity of 1.1 (9.15 pounds per gallon), and a flash point of 20°F.
c. A liquid prepolymer having a viscosity of 300 to 500 centipoises at 72°F that can be pumped through 500 feet of 1/2-inch hose with a 500-psi head at a flow rate of 1 ounce per second.
d. A cure time of 15 minutes at 40°F, 8.2 minutes at 70°F, and 4.6 minutes at 100°F when the prepolymer is reacted with water only.
e. A cure time of 5.5 minutes at 40°F, 8.2 minutes at 70°F, and 2.6 minutes at 100°F when the prepolymer is reacted with water containing 0.4% accelerator.
f. During injection; foaming, expansion, and viscosity increase occur.
g. Physical properties of the cured foam of approximately: 14 pounds per cubic foot density, 80 to 90 psi tensile strength, and 700% to 800% elongation when a mixture of 50% prepolymer and 50% water undergoes a confined expansion to five times its initial liquid volume.

7. Hydrophobic Urethane
a. Dual component cartridge system with check valve in static mixer with 100% solids content, less than 1% water absorption, reaction time of 1 to 3 seconds, compressive strength of 45 psi at 3# and 800 psi at 15#, shear strength of 50 psi, and tensile strength of 75 psi.
b. Single component pre-catalyzed hydrophobic urethane with 100% solids, 20:1 expansion rate, compressive strength of 125 psi, tensile strength of 75 psi, and shear strength of 50 psi.

PART 3 - EXECUTION

3.01 CONSTRUCTION

A. General

1. Install manhole liners and sealants in strict accordance with the manufacturer's recommendations and these Specifications.

B. Manhole Cleaning and Preparation

1. The floor and interior walls of the manhole shall be thoroughly cleaned and made free of all foreign materials including dirt, grit, roots, grease, sludge and all debris or material that may be attached to the wall or bottom of the manhole.

2. High pressure water blasting with a minimum of 3500 psi shall be used to clean free all foreign material within the manhole.

3. When grease and oil are present within the manhole, an approved detergent or muriatic acid shall be used integrally with the high pressure cleaning water.

4. All materials resulting from the cleaning of the manhole shall be removed prior to application of the lining.

5. All loose or defective brick, grout, ledges, steps and protruding ledges shall be removed to provide an even surface prior to application of lining.

6. After completion of surface preparation, perform the seven point check list, which is the inspection for:

    a. Leaks

    b. Cracks

    c. Holes

    d. Exposed Rebar

    e. Ring and Cover Condition

    f. Invert Condition

    g. Inlet and Outlet Pipe Condition

7. All manhole steps are to be removed as part of the cleaning procedure. Removed manhole steps are not to be replaced following the application of liner material.

8. After the defects in the structure are identified, repair all leaks with a chemical or hydraulic sealant designed for use in field sealing of ground water. Severe cracks shall be “repaired with a urethane based chemical” sealant. Product to be utilized shall be as approved by owner/engineer prior to installation. Repairs to exposed rebar, defective pipe penetrations or inverts, etc. shall be repaired utilizing non-shrink grout.

C. Temporary Sealing Active Leaks

1. The work consists of hand applying a dry quick-setting cementitious mix designed to instantly stop running water or seepage in all types of concrete and masonry structures until the manhole can be lined. The applicator shall apply material in accordance with manufacturer’s recommendations and following specifications.

2. The area to be repaired must be clean and free of all debris per the guidelines set forth in Section B Manhole Cleaning and Preparation.

3. Once cleaned, prepare crack or hole by chipping out loose material to a minimum depth and width of ¾ inch.

4. With gloved hand, place appropriate of the dry quick-setting cementitious material to the active leak, with a smooth fast motion, maintaining external pressure for 30 seconds, repeat until leak is stopped.

5. Proper application should not require any special mixing of product or special curing requirements after application.

6. Temporary sealing of leaks will not be paid separately unless the leak exceeds 2 gallons per minute.

D. Invert Repair

1. The work consists of hand mixing and applying a rapid setting, high early strength, non-shrink patching material to fill all large voids and repair inverts prior to spray lining of the manhole. For invert repairs, flow must be temporarily restricted by inflatable or mechanical plugs prior to cleaning.

2. The area to be repaired must be cleaned and free of all debris per the guidelines set forth in Section B Manhole Cleaning and Preparation.

3. Mix water shall be clean potable water and require no additives or admixtures for use with cementitious patching materials.

4. Cementitious material shall be mixed per manufacturer's specifications. Material should be mixed in small quantities, to avoid setting prior to placement in voids or inverts.

5. Once mixed to proper consistency, the materials shall be applied to the invert or void areas by hand or trowel. In invert applications, care should be taken to not apply excessive material in the channel, which could restrict flow. Once applied, materials should be smoothed either by hand or trowel in order to facilitate flow.

6. Flows in inverts can be reestablished within 30 minutes of material placement.

E. Application of Calcium Aluminate Cement Manhole Liner

1. The work consists of spray applying and/or centrifugally spin casting a cementitious based liner to the inside of the existing manhole. The necessary equipment and application methods to apply the cementitious based liner materials shall be only as approved by the material manufacturer.

2. Material shall be mixed with water in accordance with manufacturer's specifications. Once mixed to proper consistency, the materials shall be pumped via a rotor-stator style progressive cavity pump through a material plaster hose for delivery to the appropriate and/or selected application device.

3. Spray application of the cementitious material.

   a. Material hose shall be coupled to a low-velocity spray application nozzle. Pumping of the material shall commence and the mortar shall be atomized by the introduction of air at the nozzle, creating a low-velocity spray pattern for material application.

   b. Spraying shall be performed by starting at the manhole invert and progressing up the wall to the corbel and chimney areas.

c. Material shall be applied to a specified uniform minimum thickness no less than ½ inches. Material shall be applied to the bench area in such a manner as to provide for proper drainage without ponding.

4. Centrifugal spin casting application of the cementitious material.

a. Material hose shall be coupled to a high speed rotating applicator device. The rotating casting applicator shall then be positioned within the center of the manhole at either the top of the manhole chimney or the lowest point elevation corresponding to the junction of the manhole bench and walls.

b. The high speed rotating applicator shall then be initialized, and pumping of the material shall commence. As the mortar begins to be centrifugally cast evenly around the interior of the manhole, the rotating applicator head shall be raised and/or lowered at a controlled retrieval speed conducive to providing a uniform material thickness on the manhole walls.

c. Controlled multiple passes are then made until the specified minimum finished thickness is attained. If the procedure is interrupted for any reason, simply arrest the retrieval of the applicator head until flows are recommenced.

d. Material thickness may be verified at any point with a depth gauge and shall be no less than a uniform ½ inch. If additional material is required at any level, the rotating applicator head shall be placed at that level and application shall recommence until that area is thickened.

5. Material shall be applied only when manhole is in a damp state, with no visible water dripping or running over the manhole walls.

6. The low-velocity spray nozzle and the centrifugal spin casting head may be used in conjunction to facilitate uniform application of the mortar material to irregularities in the contour of the manhole walls and bench areas.

7. Troweling of materials shall begin immediately following the spray application. Initial troweling shall be in an upward motion, to compress the material into voids and solidify manhole wall. Precautions should be taken not to overtrowel.

8. Curing will take place once the manhole cover has been replaced. It is important that the manhole cover is replaced no more than 10-20 minutes after troweling is complete to avoid moisture loss in the material due to sunlight and winds.

9. Material shall not be applied during freezing weather conditions. Material shall not be placed when the ambient temperature is 37 degrees Fahrenheit and falling or when the temperature is anticipated to fall below 32 degrees Fahrenheit during 24 hours.

F. Application of Polyurea Manhole Liner

1. A sufficient dry time after cleaning procedures have been performed shall be allotted to allow for proper adhesion between the manhole and the material as per the Manufacturer.

2. Application procedures shall conform to recommendations of the manufacturer, including materials handling, mixing, environmental controls during application, safety and spray equipment. Spray equipment shall be specifically designed to accurately ratio and apply the liner system.

3. Application of multi-component liner system shall be in strict accordance with manufacturer's recommendation. Final installation shall be a minimum of 500 mils. A permanent identification and date of work performed shall be affixed to the structure in a readily visible location.

4. Liner thickness shall be tested using a sharp pointed tool, such as a scribe or awl, inserted into the just coated area to confirm the thickness of all layers meets or exceeds the 500 mil minimum standard. This test is a destructive test in that it created a holiday or void. Such testing must be performed within 10 minutes of completion so that the repair of the holiday or void can be performed before the system fully cures.

5. Provide final written report to owner/engineer detailing the location, date of report, and description of repair.

G. Sealing Spot Leaks with Injectable Grout

1. The work consists of permanently sealing spot leaks in manholes by injecting grout material until the leak is properly sealed. The necessary equipment and application methods to apply the injectable grout material shall be only as approved by the material manufacturer.

2. The floor and interior walls of the manhole shall be thoroughly cleaned and made free of all foreign materials including dirt, grit, roots, grease, sludge and all debris or material that may be attached to the wall or bottom of the manhole.

3. Drill a 5/8 inch diameter hole to intersect the leak path and inject approved grout material into the drilled hole, as specified by the manufacturer, until the voids are filled and the spot leak is properly sealed.

3.02 MANHOLE ACCEPTANCE TESTS

A. General

1. All lined and/or sealed manholes shall be subjected to vacuum or exfiltration tests or high voltage Holiday detection test (per NACE RPO 188-99), or a combination thereof prior to final acceptance by the Owner. Final liner system shall be completely free of pinholes, voids, or holidays.

2. All sanitary sewer acceptance tests shall be performed no sooner than thirty (30) days after the sewer installation is complete.

3. The Engineer shall be present for all testing operations. If testing is to be done by the Contractor, only properly trained personnel shall be allowed to perform the testing work. If testing is to be done by municipal agency work forces, then the Contractor shall be responsible for coordinating with the construction observer in order to schedule the testing.

4. In the event that the manhole fails any of the required tests, the Contractor shall be responsible for repairing the manhole and repeating the test until acceptable results are achieved.

5. The method of testing and measurement shall be approved by the Engineer. The Contractor shall provide all necessary equipment and labor for making the tests and cost of same shall be incidental to the unit price bid for sewer.

B. Material Testing

1. One 2 inch by 2 inch sample cube shall be taken for every 50 bags of material used. Samples shall be sprayed from nozzle, identified and sent to an independent laboratory for compression strength testing as described in ASTM C-109 and as directed by the Engineer.

END SECTION 33 01 36

SECTION 33 01 38 – CURED-IN-PLACE PIPE LINING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This work shall include the furnishing of all labor, materials, tools, by-pass pumping, equipment, accessories and services necessary for providing and installing Cured-In-Place Pipe (CIPP) Liner as detailed in the Contract Documents or as required herein.

B. Section Includes:

1. Cured-In-Place Pipe (CIPP) Lining.

C. Related Sections:

1. Division 33 “Sanitary Sewers”

2. Division 31 “Earth Moving”

1.03 REFERENCE STANDARDS

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following standard specifications:

1. ANSI – American National Standards Institute

2. ASTM – American Society for Testing and Materials

3. AWWA – American Water Works Association

4. AASHTO – American Association of State Highway Transportation Officials

B. Specific ASTM references detailing CIPP operations are the following:

1. ASTM F1216 (Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube)

2. ASTM F1743 (Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe

3. ASTM D5813 (Cured-in-Place Thermosetting Resin Sewer Pipe

4. ASTM D790 (Test Methods for Flexural Properties of Un-reinforced and Reinforced Plastics and Electrical Insulating Materials

5. D2990 (Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics

1.04 SUBMITTALS

A. When required by the Engineer, shop drawings shall be furnished as prescribed under the General Conditions.

B. Before the Contractor orders any pipe or other appurtenances that he is proposing to use as substitutes for specified items, he shall submit design details of the substitutes to the Engineer for consideration and approval.

1.05 QUALIFICATIONS

A. Contractor qualifications shall be as shown in the bidding section.

1.06 MDOT STANDARDS

A. References to the Michigan Department of Transportation (MDOT) Specifications shall pertain to the 2012 Standard Specifications for Construction.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Tube

1. The sewn tube shall consist of one or more layers of absorbent non-woven felt fabric and meet the requirements of ASTM F1216 or ASTM F1743, Section 5.1. The tube shall be constructed to withstand installation pressures, have sufficient strength to bridge missing pipe, negotiate bends, and stretch to fit irregular pipe sections.

2. The tube shall have a uniform thickness so that it will meet or exceed the design thickness when compressed at installation pressures.

3. The tube shall be sewn to a size that will tightly fit the internal circumference and length of the original pipe. Allowance should be made for circumferential stretching during inversion. Overlapped layers of felt in longitudinal seams that cause lumps in the final product shall not be allowed. Seams in the tube shall be stronger than the non-seamed felt.

4. The outside layer of the tube (before wet out) shall be coated with an impermeable, flexible membrane that will contain the resin and facilitate monitoring of resin saturation during the resin impregnation (wet out) procedure.

5. The tube shall be homogeneous across the entire wall thickness and shall contain no intermediate or encapsulated elastomeric layers. No material shall be included in the tube that may cause delamination in the cured CIPP. No dry or unsaturated layers shall be evident.

6. The wall color of the interior pipe surface of CIPP after installation shall be a light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made.

7. The outside of the tube shall be marked for distance at regular intervals along its entire length, not to exceed 25 ft. Such markings shall include the manufacturer's name or identifying symbol. The tubes must be manufactured in the USA.

B. Resin

1. The resin shall be a general purpose, unsaturated, styrene based, thermoset resin and catalyst system, an epoxy resin and hardener, or a thermoset polyurethane that is compatible with the inversion process being used.
2. The resin shall meet the requirements of ASTM F1216 and must be able to cure in the presence of water with the initiation temperature for cure being less than 180° F (82.2° C).
3. The resin shall produce CIPP which will comply with the structural and chemical resistance requirements of this specification.

2.02 MINIMUM WALL THICKNESS

A. Minimum wall thicknesses for partially deteriorated gravity flow pipes are shown in Appendix A. Minimum wall thicknesses for fully deteriorated gravity flow pipes are shown in Appendix B.

B. If the exiting pipe conditions differ significantly from the various scenarios that are shown in Appendices A and B, it may be necessary to develop a customized solution that is based upon the design guidelines that are shown in ASTM Specification F1216.

2.03 STRUCTURAL REQUIREMENTS

A. Strength Properties

1. The CIPP shall be designed per ASTM F1216. The CIPP design shall assume no bonding to the original pipe wall.
2. The CIPP shall conform to the following minimum structural properties:

Table CIPP-1
Cast-In-Place Pipe

Property	Test Method	Minimum Value
Flexural Strength	ASTM D790	4,500 psi
Flexural Modulus of Elasticity	ASTM D790	250,000 psi
Tensile Strength (Gravity Pipe)	ASTM D638	2,500 psi
Tensile Strength (Pressure Pipe)	ASTM D638	3,000 psi

PART 3 - EXECUTION

3.01 Preparation

A. General

1. The Contractor shall carry out his operations in strict accordance with all OSHA and the manufacturer's safety requirements. Particular attention is drawn to those safety requirements involving working with scaffolding and entering confined spaces.

2. The Contractor shall also provide traffic control in accordance with applicable requirements of the Michigan Manual of Uniform Traffic Control Devices and the Michigan Department of Transportation.

3. It shall be the responsibility of the Owner to locate and designate all manhole access points that will be open and accessible for the work and to provide rights of access to these points. If a street must be closed to traffic because of the orientation of the sewer, the Contractor shall institute the actions necessary to do this for the mutually agreed time period. The Owner shall also provide access to water hydrants for cleaning, inversion and other work items requiring water.

B. Cleaning Existing Sewer Lines

1. The Contractor shall be required to remove all existing internal debris from the sewer line with the use of water jet equipment or mechanical cleaning equipment as approved by the Owner.

2. The cleaning operation shall remove all existing debris so that the joint pipe can be thoroughly inspected.

3. All sludge, dirt, sand, rocks, grease, and other solid or semi-solid material resulting from the cleaning operation shall be removed at the downstream manhole of the section being cleaned. Passing material from one manhole section to another shall not be permitted.

4. All such debris resulting from cleaning operations shall be removed from the site and disposed of in a proper manner. The Contractor shall bear all costs associated with testing of debris and proper dumping. Dumping of the debris shall be in accordance with all local, state, and federal regulations. The Owner will negotiate for costs associated with material disposal if hazardous wastes are encountered during preparatory cleaning.

5. At the end of each work day, all debris shall be removed from the downstream manhole and from the construction site. No debris shall be left at the construction site unattended by the Contractor and under no circumstances will the Contractor be allowed to accumulate debris beyond the end of the work day. In the event the Contractor leaves debris unattended at the construction site beyond the end of the work day, he will not be allowed to proceed with the pipe rehabilitation work until the debris is properly removed.

6. During all sewer cleaning operations, satisfactory precautions shall be taken to protect the sewer lines from damage that could be caused by improper use of cleaning equipment. Precautions shall be taken to ensure that the cleaning operation will not cause any damage or flooding to public and/or private property being served by the sewer line section involved. The Contractor shall bear full costs associated with any basement flooding or damage to structures that was caused by his cleaning operations.

C. Bypassing Sanitary Sewer

1. The Contractor shall provide for the flow of wastewater around the section or sections of pipe that are designated for rehabilitation. The bypass shall be made by plugging the line at an existing upstream manhole or adjacent system and then pumping the wastewater via the bypass line to a manhole or other suitable outlet that is located downstream from the rehabilitation section. The pump and bypass lines shall be of adequate capacity and size to handle the flow. Bypassing must include all mainline and service line flows affected by construction. Pumped wastewater shall not be allowed to spill onto lawns, roadways, open excavations, or into undersized piping.

D. Inspection of Sewer Lines

1. Inspections of pipelines shall be performed by experienced personnel who are trained in locating breaks, obstacles, and service connections by closed circuit television. The

inspection of pipelines shall also determine active service connections and which addresses they serve. The interior of the pipeline shall be carefully inspected to determine the location of any conditions which may prevent proper installation of the CIPP. These conditions shall be recorded and submitted to the Owner prior to the commencement of construction so that these conditions can be corrected. A video tape and suitable log shall be kept for later reference by the Owner.

E. Line Obstructions

1. It shall be the responsibility of the Contractor to clear the line of obstructions such as solids and roots that will prevent the insertion of the CIPP. If pre-installation inspection reveals an obstruction such as a protruding service connection, dropped joint, collapsed pipe or obstruction that will adversely affect the inversion process and cannot be removed by conventional sewer cleaning equipment, then the Contractor shall make a point repair open-cut excavation to remove or repair the obstruction. If a pay item for point repair work is not included in the proposal form, then the Owner will negotiate with the Contractor for costs associated with this work.

F. Public Notification

1. The Contractor shall make every effort to maintain service usage throughout the duration of the project. In the event that a sewer will be out of service, the maximum amount of time of no service shall be 10 hours for any property served by the sewer or main. A public notification program shall be implemented before the start of work. As a minimum, the Contractor shall be responsible for contacting each home or business connected to the affected sewer or main and informing them of the work to be conducted, as well as when the sewer will be off-line. The Contractor shall also provide the following:

2. Written notice to be delivered to each home or business on the day prior to the beginning of work being conducted on the section, and a local telephone number of the Contractor that the property owner can call to discuss the project or any problems which could arise.

3. Personal contact with any home or business that cannot be reconnected within the time stated in the written notice.

3.02 Installation

A. Installation of CIPP shall be in accordance with the current versions of ASTM F1216 section 7 or ASTM F1743 Section 6 with the following modifications:

1. Resin Impregnation
   a. The tube should be vacuum-impregnated with resin (wet-out) under controlled conditions.
   b. The volume of resin used shall be sufficient to fill all voids in the tube material at nominal thickness and diameter.
   c. The volume shall be adjusted by adding 5-10% excess resin to allow for the change in resin volume due to polymerization and to allow for any migration of resin into the cracks and joints in the original pipe.
   d. The quantities of the liquid thermosetting materials shall be per manufacturer's standards to provide the wall thickness specified. To insure thorough resin saturation throughout the length of the felt tube, the point of vacuum shall be no further than 25 feet from the point of initial resin introduction.
   e. After vacuum in the tube is established, a vacuum point shall be no further than 75 feet from the leading edge of the resin. The leading edge of the resin slug shall be as near to perpendicular as possible. A roller system shall be used to uniformly distribute the resin throughout the tube. If the Contractor uses an alternate method

of resin impregnation, the method must produce the same results. Any alternate resin impregnation method must be proven.

2. Tube Inversion

   a. The wet out tube shall be positioned in the pipeline using either inversion or a mechanical pull-in method. Inversion may be accomplished by using hydrostatic head or by air pressure. If pulled into place, a power winch should be utilized and care should be exercised not to damage the tube as a result of pull-in friction.
   b. The tube should be inverted or pulled-in through an existing manhole or approved access point and fully extend to the next designated manhole or termination point.
   c. The hydrostatic head or air pressure should be adjusted to cause the impregnated tube to invert from the point of inversion to the point of termination. The hydrostatic head or air pressure should turn the tube inside out and hold the tube tight to the wall while producing dimples at lateral connections. Care shall be taken to avoid overstressing the fabric. The tube manufacturer shall provide information on the maximum allowable tensile stress for the tube. This information shall also indicate what the minimum required pressure is to hold the tube tight against the existing sewer or main as well as what the maximum allowable pressure is so as not to damage the tube. Once the inversion has started the pressure shall be maintained between the minimum and maximum pressures until the inversion has been completed. If the pressure range is not maintained, the tube shall be removed from the sewer.

3. Curing By Heated Water or Steam

   a. Prior to the start of the inversion process, the Contractor shall furnish information to the Owner which outlines the resin manufacturer's recommended cure temperatures.
   b. After inversion has been completed, the inversion water shall be uniformly raised above the temperature required to affect a cure of the resin as recommended by the manufacturer. The inversion water shall be recirculated by means of a pump throughout the tube and temperature monitors shall be placed on the ingoing and outgoing lines to determine that the correct temperature is maintained. Additionally, a temperature gauge shall be installed between the tube and the pipe invert at the termination point to determine temperatures during cure.
   c. The recommended temperature shall be held for the length of time recommended by the resin manufacturer. Initial cure occurs during heat up and is indicated when the exposed portions of the tube appear to be hard and sound and the remote temperature sensor(s) indicate that the temperature is of a magnitude to realize an exotherm or cure in the resin. The temperature should then be raised to post cure temperatures and held for the duration recommended by the resin manufacturer.
   d. Pressure shall be maintained as per the manufacturer's recommendations to hold the flexible tube tight against the existing sewer or main. This pressure shall be maintained until the cure has been completed. The contractor shall provide a continuous log of the designated temperatures and pressures during the time of the cure and cool down.

4. Cool Down

   a. The new liner pipe shall be cooled down to a temperature below 100° F for the heated water curing method (113° F for the steam curing method) before relieving the internal pressure. Cool down may be accomplished by introducing cool water into the section as the water and/or steam is drained off through a small hole in the downstream end. Care must be taken to avoid causing a vacuum that could damage the newly installed pipe.

B. Additional Installation Activities

1. Lubricant

a. A lubricant may be used to reduce friction during inversion. The lubricant shall be a nontoxic, oil-based product that has no detrimental effect on the tube and does not support bacteria growth or affect the general characteristics of the fluid to be transported.

2. Workmanship and Finish

a. The finished CIPP shall be continuous over the entire length between manholes and be free from visual defects such as foreign inclusions, dry spots, lifts, pinholes, or delamination. The new pipe shall be free of leaks and any defects that will affect the integrity or strength of the CIPP. If any defects are found, then they shall be repaired at the Contractor's expense in a manner that is acceptable to the Owner.

3. Sealing CIPP at Manholes

a. If the CIPP fails to make a tight seal at the manhole walls, the Contractor shall apply a resin mixture seal at that point. The resin seal shall be compatible with the resin mixture of the CIPP.

4. Service Connections

a. After the new pipe has been cured in place, the Contractor shall reconnect all existing active service connections. This shall be done without excavation by means of a television camera and cutting device or by man entry and a cutting device. The services shall be restored to not less than 95% of their original capacity and shall be free of any sharp edges or protrusions, which could cause paper, rags or debris to accumulate. No service connection shall remain out of service for more than 10 hours without the Contractor providing some suitable temporary facilities.

3.03 INSPECTION AND TESTING

A. Flexural and Tensile Testing

1. Physical properties of the CIPP shall be tested with two CIPP samples being prepared for each inversion length. Samples shall be cut from a cured section of CIPP at an intermediate manhole or at the termination manhole where the inversion tube has been passed through a section of like diameter pipe. The sample must be large enough to provide a minimum of three specimens (five recommended) for flexural testing and tensile testing. (Tensile testing is only required for pressure pipe applications.) Testing shall be done in accordance with Section 8 of ASTM F1216 and test results shall meet or exceed the requirements that were indicated previously in Table I.

B. Leakage Testing

1. If required by the Owner, the Contractor shall test the new CIPP installation for leakage.
2. Gravity pipe shall be tested using an exfiltration method as discussed in Section 8.2 of ASTM F1216.
3. Pressure pipe shall be tested using a hydrostatic pressure method as discussed in Section 8.3 of ASTM F1216.

C. Chemical Resistance Testing

1. The CIPP shall meet the chemical resistance requirements of ASTM F1216, Appendix X2. CIPP samples for testing shall consist of a tube and resin system similar to the materials that were used for actual construction.

D. Video Taping

1. Upon successful completion of flexural, tensile, chemicals, and leakage testing, the Contractor shall provide a videotape of the CIPP. Final video shall be performed no sooner than one week after all work on that run is complete. Typical items to be reviewed on the videotape will include pipe deflection, pipe settlement, lead connections, groundwater infiltration, obstructions, and general cleanliness. If the videotape reveals unsatisfactory conditions, the Contractor shall correct the problems(s) at his own cost and shall re-videotape the affected pipe section(s) for review by the Owner.

E. Clean Up and Restoration

1. Upon completion of the CIPP work, the Contractor shall clean up and restore the site to match the original site conditions. This work shall include restoration of items such as grass, shrubs, fences, and paved surfaces as well as manholes or other appurtenances that were affected by the CIPP work.

SECTION 33 01 48

FLOW CONTROL OF SEWER LINES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section includes all materials, labor, and equipment required to provide bypass flow control for sanitary sewer lines construction, upgrade, or rehabilitation.

B. Also, furnish all power, maintenance, etc. to implement the bypass flow control and diversion pumping to divert the existing flow around the work area for the work's duration. If the duration of the work coincides with conditions that have a potential to cause higher flows than the minimum, the contractor shall be at risk for containing all flows.

C. The design, installation, and operation for the temporary bypass pumping system shall be solely the Contractor's responsibility. The Contractor is to plan and perform his construction work for the supporting diversion pumping operations to reduce risk, avert overflows, minimize exposure durations and address variable season and event sewer flow rates.

D. Bypass Pumping Operation Checklist

1.2 PERFORMANCE AND PENALTIES

A. The Contractor shall ensure:

1. All temporary sewer bypass pumping activities for the work are completed in full compliance with the applicable stormwater management regulations, and no water quality or quantity compliance issues are encountered.

2. No illicit pollutant discharges to (or to a location that would create contaminated water runoff to) a storm sewer, a stormwater conveyance, or a water body within the project area shall occur.

3. All temporary sewer bypass pumping activities for the work are completed in full compliance with the Tennessee Department of Environment and Conservation and the U.S. EPA regulations, and no water quality or quantity compliance issues are encountered.

B. No discharge of sewage or debris shall be released to the environment. Should the Contractor's actions cause a sewage or debris overflow or bypass to the environment, site cleanup will be the Contractor's responsibility consistent with the regulators directions. All overflow or bypass environmental cleanup activities shall be immediately commenced and prosecuted continuously by the Contractor. Any associated fines or penalties enacted by the Tennessee Department of Environment and Conservation, the U.S. EPA, and/or any other regulatory groups or programs will be borne solely by the Contractor.

1.3 SUBMITTALS

A. At least 4 weeks prior to commencing work including plugging any line, bypass pumping, or similar actions, the Contractor shall submit to the Construction Manager a detailed (Plan), as

further described in these specifications, for review and approval. Plan approval does not relieve the Contractor from any responsibility for the Plan's adequacy or proper execution. The Contractor is responsible for conducting his work in a manner which will not cause overflows or system backups that could damage private and/or public property.

B. Submit the following in accordance with Section 01 33 00.

1. The Bypass Sewage Pumping Plan shall contain, at minimum, the following:

a. Staging areas for pumps

b. Sewer plugging method and plug types

c. Size and location for manholes or access points for suction and discharge hose or piping

d. Size for pipeline or conveyance system to be bypassed

e. Number, size, material, location, and method for installing suction piping

f. Number, size, material, location, and method for installing discharge piping

g. Provide bypass pump sizes, capacity, number of each size to be on site, and power requirements. Pump sizing shall clearly indicate compliance with requirements in this Section.

h. Calculations for static lift, friction losses, and flow velocity (pump curves showing pump operating range)

i. Standby power generator size, location, and spill prevention and control measures

j. Downstream discharge plan

k. Method to protect discharge manholes or structures from erosion and damage

l. Thrust and restraint block sizes and locations

m. Sections showing suction and discharge pipe depth, embedment, select fill, and special backfill

n. Noise control method for each pump and/or generator

o. Any temporary pipe supports and anchoring required

p. Design plans and computations for access to bypass pumping locations indicated on the Drawings

q. Calculations for selecting bypass pumping pipe size

r. Schedule for installing and maintaining bypass pumping lines

s. Plan indicating selection for bypass pumping line locations

t. Plan indicating monitoring location selections

u. All items related to testing, inspection, maintenance, and monitoring as described in this Section

v. All other incidental items necessary and/or required to ensure facilities are properly protected, including protecting the access and bypass pumping locations from damage due to the discharge flows and compliance with the requirements and permit conditions specified in the Contract Documents

w. For sewer rehabilitation by lining methods, generic plans may be developed for typical situations and various sizes to be implemented.

PART 2 - PRODUCTS

2.1 BYPASS EQUIPMENT

A. All equipment used for bypass pumping shall be specifically designed for that intended purpose. All piping, pumps, etc. in contact with sanitary sewage shall be manufactured with materials designed for use in a sewage environment.

B. All pumps used shall be fully automatic self-priming units which do not require foot valves or vacuum pumps in the priming system.

C. The pumps shall be electric, hydraulic, or diesel powered.

D. All pumps used shall be constructed to allow dry running for long periods of time in order to accommodate for the effluent flows of cyclical nature.

E. Above-ground pumps and/or power units shall be located inside a temporary portable berm to contain any fuel or sewage that may spill during the normal course of operation.

F. Hard discharge piping shall be butt-(TDH) HDPE with a minimum pressure rating of 2.5 times the total dynamic head of the pump.

G. Under no circumstances will irrigation type piping or glued PVC pipe be allowed.

H. A discharge hose may be allowed on rehabilitation projects for short-term setups (less than or equal to 48 hours) on short sections with approval of the Construction Manager. Hoses shall have no leaks, and all couplings shall be quick connect type with gaskets.

I. The multiple pump header system shall have check valves to facilitate pump removal, service, and/or replacement while the system remains operational.

J. The discharge location (the point where the bypass main reenters the gravity sewer system) shall be constructed with adequate sealant materials to minimize sewer gas and odor release to the maximum extent possible.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Provide bypass sewage pumping, as required, around the section in which work is to be performed. Bypass pumping shall be the Contractor's full responsibility. The bypass system shall be of sufficient capacity to handle a minimum of 2.0 times the dry weather daily peak flow, as determined by historical records for trunk lines, of the pipeline section being bypassed. Peak flows and pipe capacities at key locations may be provided in a Table on the Drawings. Performance of extended pumping duration in or immediately following precipitation events and/or with precipitation events in the forecast will require greater pumping system capacities to accommodate the potentially higher flows. As listed in the table, these flows are significantly higher than the minimum of 2.0 times the dry weather daily peak flow. Bypass pumping systems sized for smaller flows than are listed in the full flow capacity for wet weather conditions may be entertained if, at the discretion of the Construction Manager, sufficient evidence and planning is provided to show that the full capacity is not necessary and that a plan can be implemented in time to accommodate all flows if actual or forecasted conditions change.

B. At least 10 days prior to the desired start date of construction requiring bypass pumping, submit a detailed description of the method proposed for bypass pumping to the Construction Manager for review and approval. The description shall include capacity calculations, operational conditions, conditions of performance relative to precipitation and antecedent conditions, all materials and equipment to be used, personnel, spare equipment, and sketches showing proposed pump-around setups. No work shall commence until the Construction Manager approves.

C. Bypass pumping equipment shall include pumps, conduits, engines, and related equipment necessary to divert sewage flow around the section in which work is to be performed. Backup pumps shall be online and isolated from the primary system by valves. Include 100% mechanical redundancy installed online with a float or ultrasonic type system to switch to the standby system automatically if the primary system fails.

D. Piping redundancy may be required for relatively long bypass piping lengths or large diameter bypass pipes as deemed necessary by the Construction Manager. Special design considerations shall be made for pump suction lifts greater than 23 feet.

E. Make all arrangements for bypass pumping when the main is shut down for any reason. The system shall overcome any existing force main pressure on discharge.

F. Suction and discharge points shall only be located at manholes.

G. If at any time the Contractor is unable to properly bypass pump the sewage, construction will be stopped until the Contractor can continue work in an acceptable manner. Additional contract time for delays caused by improper equipment, labor, or breakdowns will not be considered.

H. Service shall be maintained at all times. Surcharges due to plugging the sewer line for bypass pumping shall be monitored and maintained to prevent service backups and overflows anywhere in the system.

I. For rehabilitation projects and only with the Construction Manager's approval, a hose may be used for 48 hours or less. If the anticipated bypass time exceeds 48 hours, use hard piping only. If using a hose when the bypass time reaches 48 hours, the Contractor may either install hard piping to accomplish the bypass or restore flow until an approved bypass method can be employed. No modifications to the bypass system shall be made without Construction Managers' approval.

J. The bypass or diversion pumping system shall be able to pump all of the sewage in the existing line regardless of the performance period's weather and seasonal conditions. All pumping equipment to be used shall be submitted to the Construction Manager for review and approval.

K. Bypass pumping systems are required to be operated and continuously monitored 24-hours per day for flow diversion.

L. The bypass pumping must be initiated at one manhole upstream and continue to one manhole downstream of the line being rehabilitated in order to use flow-through plugs at the insertion and end points. The liner bag may not be used as part of the bypass pumping system or as a plug in the line.

M. For bypass or diversion pumping in overnight operations greater than 2 days, portable lighting systems must be provided and maintained as needed for monitoring and operation activities at the bypass pumping site(s).

N. The temporary diversion pumping system shall be placed in operation prior to the commencement of work in the areas being bypassed. Minimum times of operation prior to the commencement of work are 1 hour for small diameter CIPP lining and 4 hours for any other major system work such as trunk sewer diversion, large diameter sewer lining, or pumping station work.

O. Protect the bypass lines from damage in the areas of backhoe and excavation operations.

P. Provide the necessary stop/start controls and a visual alarm indicating a pump malfunction for each pump. Each pump shall have a 0-30 inch Hg vacuum gauge on the inlet and a 0-60 psi pressure gauge on the outlet.

3.2 PERFORMANCE REQUIREMENTS

A. It is essential for the operation of the existing system being bypassed that no interruptions in the flow occur throughout the project's duration. Provide, maintain, and operate all temporary facilities such as dams, plugs, pumping equipment (primary and backup units as required), conduits, all necessary power, and all other labor and equipment necessary to intercept the incoming flow before it reaches the point where it would interfere with the work, carry it past the work area, and return it to the existing system downstream of the work.

B. The temporary pumping system's design, installation, and operation shall be the Contractor's responsibility. The bypass system shall meet all codes and requirements for regulatory agencies having jurisdiction.

C. The temporary pumping system's design, installation, and operation shall address system flow variations for diurnal peaks and low flows during the pumping period.

D. Provide all necessary means to safely convey the sewage past the work area. The Contractor will not be permitted to stop or impede the sewer main flows under any circumstances.

E. No flow diversion around the work area shall be performed in a manner that will cause damage to or the surcharging of any portion of the sewer system. The diversion shall protect public and private property from damage and flooding.

F. Protect water resources, wetlands, and other natural resources.

3.3 FIELD QUALITY CONTROL AND MAINTENANCE

A. Prior to actual operation, test the bypass pumping discharge hard piping system for leaks and pressure using clean water. Bypass hard piping shall be hydrostatically tested following each setup and prior to flow diversion or bypass to a minimum pressure 2.5 times the pump(s) total dynamic head. The Construction Manager shall be given a 24-hour notice prior to testing.

B. Inspect the bypass pumping system on a continuous basis to ensure the system is working properly. A daily checklist for physically inspecting the piping shall be required. The checklist shall contain all bypass pumping system components and shall be specifically developed to be applicable to relevant aspects of the individual project. The daily checklist shall be submitted to by the Construction Manager. The completed daily checklists will be maintained on site and will be available for review and approval throughout the project's duration. A sample checklist is included in this Section.

C. Ensure that the temporary bypass pumping system is properly maintained and that a responsible operator shall be readily available at all times when pumps are operating.

D. Monitoring

1. During bypass pumping, continuously monitor all bypass pumping system components.

2. A telemetry system or designated personnel to maintain 24-hour onsite monitoring shall be required to alert the Contractor to system malfunctions or high liquid levels in manholes.

3. If bypass pumping activities are conducted waters of the state or in other locations or circumstances where the potential exists for a sewage release to potentially enter state waters by other than direct means, an in-line stream monitoring system shall be used to measure real-time conductivity and dissolved oxygen (DO) concentrations in 30-minute intervals, at a minimum. The system shall be mounted in the receiving stream in the immediate downstream area(s) adjacent to the location(s) of the bypass piping system discharge to the gravity conveyance system. The system shall have web-portal capabilities with alarm functions for conductivity and DO. The alarm function shall be equipped with battery power and solar charging provisions and shall be able to send e-mail and text messaging alarms to at least five devices.

E. Additional Materials

1. Spare parts for pumps and piping shall be kept on site as required.

2. Adequate hoisting equipment for each pump and accessories shall be maintained on site.

3. Keep an HDPE fusion machine on site for the duration of bypass pumping to facilitate immediate repairs to hard piping.

F. Preparations and Precautions

1. Locate any existing utilities in the area selected for the bypass pipelines. Locate the bypass pipelines to minimize any disturbance to existing utilities and obtain approval for

the pipeline locations. Pay all costs associated with relocating utilities and obtaining all approvals.

2. During all bypass pumping operations, protect the existing sewer system (pumping stations, conveyance system, etc.) as applicable from damage caused by any equipment. The Contractor is responsible for all physical damage to the system caused by human or mechanical failure.

G. Installation and Removal

1. Remove manhole sections or make connections to the existing conveyance system. Construct temporary bypass pumping structures only at the access location(s) indicated on the Drawings and as may be required with Construction Manager's approval to provide adequate suction conduit.

2. Plugging or blocking flows shall incorporate a primary or secondary plugging device. When plugging or blocking is no longer needed for work performance and acceptance, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge flows to prevent surcharging or causing other major disturbances downstream.

3. When working inside manholes, sewers, or force mains, exercise caution and comply with all applicable OSHA requirements.

4. Bypass pipeline installation is prohibited in all wetland areas. The pipeline shall be located, if possible, off streets and sidewalks and on road shoulders. If in easements, the bypass pipeline shall be within the easement area acquired for the project.

5. When the bypass pipeline crosses local streets and private driveways, place the bypass pipelines in trenches and cover with temporary pavement. Obtain property owner approval for placing the temporary pipeline.

3.4 CLEANUP

A. Upon acceptance of the installation work and testing, restore the project area affected by the operations to a condition at least equal to or better than that existing prior to the work.

3.5 MEASUREMENT AND BASIS OF PAYMENT

A. Temporary bypass sewage pumping will be considered incidental to the work with which it is associated and will not be measured for payment as a separate pay item.

3.6 CLOSEOUT ACTIVITIES

A. Provide in accordance with Section 01 77 00.

PART 4 - FORMS

1. Bypass Pumping Operation Daily Checklist
(see page below)

Bypass Pumping Operation Daily Checklist

Project No.: **Inspection Date:**

Project Name: **Inspection Time:** am/pm

Superintendents: **Inspector Name:**

Project Mgr/Admin: **Inspector Signature:**

No. of Pumps Running During Inspection:

Bypass Pumps/Floats	**Yes**	**No**	**N/A**	**Comments**
All suction hoses removed and impellers				
All pumps fueled up today				
Floats tied off to vertical pole				
Pumps on level ground for fuel intake				
Pump suction/discharge gauges working				

Bypass Plugs	**Yes**	**No**	**N/A**	**Comments**
Bypass pressure checked at suction manhole			**PSI:**	
Bypass pressure checked at discharge manhole			**PSI:**	
Bypass plug cables tied off and secure				
Air hose routed through and tied off to steps				

Bypass Line	**Yes**	**No**	**N/A**	**Comments**
Visually checked all suction lines				
Visually checked manifold				
Visually checked discharge lines				
Visually checked HDPE discharge line				
Visually checked discharge manhole				

Other	**Yes**	**No**	**N/A**	**Comments**
Visually checked 1st upstream manhole for normal liquid level				

ADDITIONAL COMMENTS:

END OF SECTION

SECTION 33 05 16 - SANITARY SEWER MANHOLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This work shall include the furnishing of all labor, materials, tools, equipment, accessories and services necessary for providing and installing the items as shown on the Contract Documents or as herein required.

B. Section Includes:

1. Sanitary manhole installation.

2. Sanitary manhole reconstruction.

C. Related Sections:

1. Division 01 Section "Temporary Facilities and Controls" for temporary utility services, construction and support facilities, security and protection facilities, and temporary erosion- and sedimentation-control measures.

1.03 REFERENCE STANDARDS

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following standard specifications:

1. ANSI – American National Standards Institute

2. ASTM – American Society for Testing and Materials

3. AWWA – American Water Works Association

4. AASHTO – American Association of State Highway Transportation Officials

1.04 SUBMITTALS

A. When required by the Engineer, shop drawings shall be furnished as prescribed under the General Conditions.

B. Before the Contractor orders manholes, appurtenances or other materials that he is proposing to use as substitutes for specified items, he shall submit design details of the substitutes to the Engineer for consideration and approval.

1.05 CERTIFICATIONS AND CHECKING

A. All precast structures delivered to the job shall be accompanied by certification papers showing they have been tested in accordance with applicable specifications and that they meet the specifications for the project.

B. All precast structures, brick, block and castings will be checked upon delivery to the job site. Any cracked, damaged, or broken pieces or sections will be immediately removed from the site at the Contractor's expense.

1.06 MDOT STANDARDS

A. References to the Michigan Department of Transportation (MDOT) Specifications shall pertain to the 2012 Standard Specifications for Construction.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Manholes shall be constructed at locations shown on the drawings and shall be of the size and type called for on the drawings. They shall be constructed of pre-cast reinforced concrete and shall conform to these specifications. The latest revision of ASTM standards shall apply.

B. Risers, cones, and base sections shall be precast reinforced concrete units conforming to ASTM C478. Base riser section shall be cast integral with the base slab. The minimum wall thickness for 4-foot diameter manholes shall be five (5) inches unless otherwise called for in the standard plan details.

C. Joints shall be modified groove tongue with rubber gaskets conforming to ASTM C443.

D. Grade rings shall conform to ASTM C478 and shall have a minimum thickness of three (3) inches.

E. Mortar for use in sanitary structures shall conform to MDOT Specification 702, Type R-2.

F. Gray iron castings shall be of the type, size and weight as specified in the Standard Details as manufactured by East Jordan Iron Works - 1040 AGS Heavy Duty.

G. Pipe openings shall be flexible rubber joints such as Press Wedge II as manufactured by Press-Seal Gasket Corporation, Res-Seal and manufactured by Scales Manufacturing Corporation, Kor-N-Seal as manufactured by National Pollution Control Systems, Link-Seal, or approved equal. All openings for pipe shall be fabricated at the time of manufacture.

H. Whenever existing sanitary manholes are to be tapped, the tap shall be made by coring. The Contractor shall place a Kor-N-Seal boot (or approved equal) after coring is completed.

PART 3 - EXECUTION

3.01 CONSTRUCTION

A. General

1. Excavation, bedding, and backfill for sewer structures shall be accomplished in accordance with requirements in Division 31 “Earth Moving” section.

2. Excavations shall be of sufficient width and depth to provide adequate room for the construction and installation of the sewer structures as called for on the drawings.

3. Install sewer structures in strict accordance with the manufacturer’s recommendations and these Specifications.

3.02 SANITARY STRUCTURES

A. Methods

1. Construction methods for sanitary structures shall conform to MDOT Specification 403.03 Drainage Structures except as herein provided.

B. Precast Structures

1. All precast sections shall bear the stamp of an approved laboratory as having been tested and delivered from tested stock of the manufacturer, at the expense of the Contractor.

2. Precast sections shall be constructed so that no more than fifty (50) percent of the circumference, measured on the inside face, is deleted on any horizontal plane for sewer pipe openings. There shall be no less than twelve (12) inches of residual concrete measured on any horizontal plane between pipe openings.

C. Excavation

1. Excavation shall be carried to the depth required to permit the construction of the base in accordance with the requirements of the Standard Details. The excavation shall be sufficiently wide to allow for shoring, bracing, or formwork, should any or all be necessary. Also, the excavation shall allow for accessibility in plastering the exterior of all brick masonry. The bottom of the excavation shall be trimmed to a uniform horizontal bed to receive the concrete base. The excavated section shall be completely dewatered before any concrete is placed therein.

D. Channels

1. The bottom of all sanitary structures shall be channeled to provide for smooth flow through the manhole in accordance with the Standard Details. Channels shall be formed using MDOT Grade S3 concrete.

E. Connections

1. Connections to manholes shall be properly supported and braced where not resting on original ground so that any settlement will not disturb the connection.

F. Drop Manholes

1. Drop manhole connections shall be constructed on sanitary manholes in conformance with the standard details whenever a sewer enters a manhole at an elevation of twenty-four (24) inches or more above the invert of the outlet sewer pipe.

G. Test Manholes

1. The first manhole upstream from the point of connection to the existing sanitary sewer system shall have a one (1) foot deep sump that shall be filled with concrete and channeled upon successful completion of infiltration testing.

2. The outlet pipe from this manhole shall be plugged with a waterproof stopper to prevent discharge to the existing system until acceptance of the new system by the Owner. The requirement to provide a sump may be waived by the Engineer where testing is to be done by either low pressure air testing or by exfiltration testing.

H. Final Grade – New Structures

1. Final grade adjustment of new structures shall be considered as incidental to the structure construction.

2. Where sanitary manholes are located outside of pavements and sidewalks, final grade adjustments shall be made with precast concrete grade rings.

3. Brick construction will not be allowed except where located in paved surfaces and approved by the Engineer.

4. The manhole casting frame and concrete adjustment rings shall be secured to precast cone section with a minimum of four (4) five-eighths (5/8) inch diameter cadmium coated threaded studs or bolts.

5. All joints in the assembly shall be sealed with either rubber “O” ring gaskets or butyl rope as called for on the Standard Details. The maximum allowable grade adjustment using grade rings shall be eighteen (18) inches.

6. Final grade adjustment for manholes located in pavements and sidewalks shall be made with brick and mortar. A minimum of three (3) or maximum of six (6) courses of brick shall be placed on top of the precast cone section.

7. The Contractor shall provide a WrapidSeal heat shrinkable external wrap, as manufactured by Canusa, or approved equal for water-tightness around the chimney. The external wrap shall be installed per the manufacturer’s specifications and as directed by the Engineer.

8. Raising buried manholes shall include adjustment rings and the final grade adjustment.

9. The minimum inside diameter of a sanitary sewer manhole for sewers up to 21 inches in diameter shall be 48 inches. For sanitary sewer 24 to 36 inches in diameter, the minimum inside diameter of the sanitary manholes shall be 60 inches. A larger diameter manhole may be required for right angle installation of sewers at the upper limit (i.e. 60 inch diameter manhole for 21 inch sewers at a right angle). Manholes shall be upsized to accommodate multiple pipes and maintain the structural integrity of the manhole between cored openings. Internal drops shall be provided on newly constructed manholes. The minimum inside diameter for manholes containing inside drop pipes shall be 60 inches. Diameters for manholes containing multiple internal drops shall be approved by the Municipal Engineer and the City. In general, a four foot diameter clear opening should be provided in manholes containing internal drop structures. External drops may be required for connections to existing manholes and shall be approved by the Municipal Engineer and the City.

END SECTION 33 05 16

SECTION 33 31 00 - SANITARY SEWER

PART 1 - GENERAL

1.1 SUMMARY

A. This work shall include the furnishing of all labor, materials, tools, equipment, accessories and services necessary for providing and installing the items as shown on the Contract Documents or as herein required.

In the event these Specifications conflict with those of the Owner's standards, the permit agency, or agency controlling the right-of-way where the sewer is being installed, the more stringent requirements will govern.

1.2 SECTION INCLUDES

A. This section includes sanitary sewer pipe and manholes.

1.3 REFERENCE STANDARDS

A. Unless otherwise specified, the Work of this Section shall conform to the applicable portions of the following standard specifications:
   1. ANSI – American National Standards Institute
   2. ASTM – American Society for Testing and Materials
   3. AWWA – American Water Works Association

1.4 SUBMITTALS

A. When required by the Engineer, shop drawings shall be furnished as prescribed under the General Conditions.

B. Before the Contractor orders any pipe or other appurtenances that he is proposing to use as substitutes for specified items, he shall submit design details of the substitutes to the Engineer for consideration and approval.

1.5 CERTIFICATIONS

A. All pipe and precast structures delivered to the job shall be accompanied by certification papers showing they have been tested in accordance with applicable specifications and that they meet the specifications for the project.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements
References to the Michigan Department of Transportation (MDOT) Specifications shall pertain to the 2012 Standard Specifications for Construction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading
All pipe and precast structures will be checked upon delivery to the job site. Any cracked, damaged or broken pieces or sections will be immediately removed from the site at the Contractor's expense.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Pipe

Sewer pipe shall be of the type and class designated for the specific locations or intended use shown or noted on the drawings. Any deviation from the type or class of pipe shown on the drawings will not be permitted, except upon receipt of written approval of the Engineer.

Any of the types of sanitary sewer pipe or joints listed below may be substituted upon approval of the Engineer provided that the flow capability and pipe strength (external load support) is equal to or exceeds that of the pipe specified on the drawings

Table SA-1
Sanitary Sewer Pipe Specifications

The intent of this table is to show the standards required for particular types of pipes and joints. The Owner may not accept all of these types. The Contractor must refer to the drawings, Owner's standard details, and bid forms to determine the type of pipe required for a particular project.

	Type of Pipe	Pipe Specification*	Allowable Type of Joint	Joint Specification*
a.	ABS Truss Pipe (size 8" thru 15")	ASTM D2680	Solvent cemented joint	ASTM D2680
b.	PVC Truss Pipe (size 8" thru 15")	ASTM D2680	Rubber gasket joint solvent cemented joint	ASTM D3212 ASTM D2855
c.	Reinforced Concrete			
	1. Size 18" thru 30"	ASTM C76	Tongue & groove with rubber gasket	ASTM C443
	2. Size 36" & larger	ASTM C76	Tongue & groove with rubber gasket and inside cement pointing	ASTM C443
d.	PVC (corrugated sewer pipe with smooth interior)	ASTM F949	Rubber gasket	ASTM D3212 ASTM F477
e.	Building Leads			
	1. 6" SDR 23.5 PVC	ASTM D3034	Rubber gasket joint solvent cemented joint	ASTM D3212 ASTM D2855
	2. 6" Schedule 40 PVC	ASTM D1785	Rubber gasket joint solvent cemented joint	ASTM D3212 ASTM D2855
	3. 6" ABS Solid Wall	ASTM D2751	Solvent weld joint	ASTM D2751
f.	Ductile Iron (aluminous cement lining; "SewperCoat" or approved equal)	AWWA C151	Rubber gasket joint	AWWA C111
g.	Vitrified clay pipe	ASTM C700	Compression joint	ASTM C425

* The latest revision of ASTM, AWWA or AASHTO Specifications shall apply.
ASTM stands for American Society of testing and Materials
AASHTO stands for American Association of State Highway and Transportation Officials
AWWA stands for American Water Works Association

B. Cement Mortar Pointing (Concrete Pipe Only)
Approved non-shrink cement mortar shall conform to MDOT Standard Specifications for Construction Type R-2 mortar.

C. Sanitary Sewer Structures

1. Manholes shall be constructed at locations shown on the drawings and shall be of the size and type called for on the drawings. They shall be constructed of pre-cast reinforced concrete and shall conform to these specifications. The latest revision of ASTM standards shall apply.

2. Risers, cones, and base sections shall be precast reinforced concrete units conforming to ASTM C478. Base riser section shall be cast integral with the base slab. The minimum wall thickness for 4-foot diameter manholes shall be five (5) inches unless otherwise called for in the standard plan details.

3. Joints shall be modified groove tongue with rubber gaskets conforming to ASTM C443.

4. Manhole steps shall be reinforced polypropylene plastic No. PS2-PFS as manufactured by M.A. Industries, Inc., cast iron No. 8500 as manufactured by East Jordan Iron Works, or approved equal.

5. Grade rings shall conform to ASTM C478 and shall have a minimum thickness of three (3) inches.

6. Mortar for use in sanitary structures shall conform to MDOT Specification 702, Type R-2.

7. Gray iron castings shall be of the type, size and weight as specified on the drawings. The castings shall conform to MDOT Specification 908.05. Covers to be EJIW 1040 AGS.

8. Pipe openings shall be flexible rubber joints such as Press Wedge II, Res-Seal, Link-Seal, Kor-N-Seal, or approved equal. All openings for pipe shall be fabricated at the time of manufacture.

9. Whenever existing sanitary manholes are to be tapped, the tap shall be made by coring. The Contractor shall place a Kor-N-Seal boot (or approved equal) after coring is completed

PART 3 - EXECUTION

3.01 CONSTRUCTION

A. General

1. Excavation, bedding, and backfill for sewers and related structures shall be accomplished in accordance with requirements in the Earth Moving section.

2. Excavations shall be of sufficient width and depth to provide adequate room for the construction and installation of the work to the lines, grades, and dimensions as called for on the drawings.

3. If the maximum trench width specified in the Earth Moving section is exceeded, unless otherwise shown on the drawings, the Contractor shall install, at his own expense, such

concrete cradling or other bedding as approved by the Engineer to support the added load of the backfill.

4. Install pipe, fittings and appurtenances in strict accordance with the manufacturer's recommendations and these Specifications.

B. Laying Pipe

1. Handling Pipe & Fittings

   All pipes and castings shall be unloaded and distributed along the line of work in such manner and with such care as will effectually avoid damage to any pipe or fitting. Dropping pipe or fittings directly from the truck will not be permitted. Care must also be taken to prevent abrasion of the pipe.

2. Placement of Pipe

   Each pipe shall be checked for defects prior to being lowered into the trench. The inside of the pipe and the outside of the spigot shall be cleaned of any dirt or foreign matter.

   Construction shall begin at the outlet end and proceed upgrade with spigot ends pointing in the direction of flow. Pipes shall be laid on a minimum four (4) inch sand bedding. A six (6) inch sand bedding shall be provided if called for on the plan details. If the subgrade has been disturbed so that refilling is necessary to bring the pipe to grade, such refilling shall be done with sand or gravel thoroughly tamped in place. Bell holes shall be excavated so that the full strength of the pipe barrel will bear uniformly on the sand bedding.

   Pipes shall be centered in bells or grooves and pushed tight together to form a smooth and continuous invert. After laying pipe, care shall be taken so as not to disturb its line and grade. Any pipe found off grade or out of line shall be relaid properly by the Contractor.

3. Line and Grade

   All pipe shall be laid to the line and grade called for on the drawings. Each pipe, as laid, shall be checked by the Contractor with line and grade pole or other device to insure this result is obtained. The finished work shall be straight and shall be sighted through the pipe between manholes.

4. Excavation to 18" Below Bottom of Pipe

   As a result of the Contractor's construction procedure or where excavation has not uncovered a stable foundation subgrade at depth of six (6) inches below the bottom of pipe, the Contractor shall continue to excavate downward to a maximum distance of 18 inches below the bottom of pipe to reach stable foundation soil. The space resulting from such excavation and the pipe beddings shall be filled and constructed in the same manner and using the same materials specified above. All costs for such construction shall be borne by the Contractor.

5. Excavation Below Limits Specified in Above Paragraph

   Where excavation has not uncovered a stable, foundation subgrade at depths eighteen (18) inches below the bottom of pipe, then the Contractor shall stop further excavation and immediately notify the Engineer of the condition and of his intent to make a claim for additional cost. The Engineer shall investigate the soils conditions and may direct the Contractor to continue excavating if it appears that a stable subgrade can be obtained. In this case, the additional excavation beyond eighteen (18) inches below the bottom of pipe

would be measured and paid for as trench undercut and backfill. Material for refill of the undercut area shall be as described in the Earth Moving section. In the event that soil conditions are extremely severe, then the Engineer and soils consultant shall investigate the site conditions and shall prescribe the appropriate pipe support system to be used. Within ten (10) days after the Engineer determines the appropriate pipe support system to be used, the Contractor shall submit a detailed estimate for additional cost, excluding the costs to be borne by the Contractor in the above paragraph. The estimate shall include only those additional costs necessary to construct the pipe support system as directed by the Engineer. It shall not include construction costs prior to the stoppage of work. Upon acceptance of the Contractor's estimate, the Engineer shall issue a change order.

6. Laying and Bedding of the PVC and ABS Pipe

   Bedding of PVC and ABS Pipe shall be in accordance with current ASTM specifications. Potential damage can occur to exterior walls of PVC and ABS pipe, particularly under cold weather conditions, if rocks, frozen material, or large objects strike the pipe. The Contractor shall carefully avoid dumping any materials other than approved bedding sand or stone on the pipe until a 12-inch cover is placed on it. Pipe walls and joints shall also be protected from abrasion and damage during handling, and shall be fully checked just prior to placing in the trench.

   Care shall be taken during bedding compaction to avoid distorting the shape of the pipe or damaging its exterior wall.

   Cutting of pipe where required, shall be performed using tools or equipment that will provide a neat, perpendicular cut without damage to the pipe material.
   Bowing or warping of pipe can occur with temperature fluctuations. The Contractor shall store and protect the pipe to minimize bowing. Nominal 12' - 6" pipe lengths that have deviations from straight greater than one (1) inch shall not be used.

7. Concrete Cradle for Pipe

   Where called for on the drawings, or otherwise required, pipe shall be installed with a concrete cradle of MDOT Grade S3 concrete.
   Each pipe shall rest on a six (6)-inch minimum thickness bed of dry mix concrete that is shaped to fit the bottom of the pipe. The dry mix concrete shall be MDOT Grade S3.
   After setting the pipe, the space between the outside of the pipe and the undisturbed trench bank shall be filled to a level equal to a point 1/3 of the diameter above the pipe invert with MDOT Grade S3 concrete. The concrete shall have a five (5) inch slump and be mechanically vibrated to insure complete filling of the annular space between the excavated face of the original ground and the outside face of the pipe.

8. Jointing

   Where pipe is laid in wet trenches, trenches with running sand, or in trench conditions where manual means will not allow pushing the pipe home, the Contractor shall provide and use mechanical means for pulling the pipe home and holding the pipe joints tight until completion of the line. Mechanical means shall consist of a cable placed inside the pipe with a suitable winch, jack, or come-along for pulling the pipe home and holding the pipe in position.
   All joints on pipe thirty-six (36) inches and larger shall be cement mortar pointed on the inside. On bituminous mastic joints the compound shall be removed to a depth of three-quarters (3/4) of an inch from the inside of the joint before pointing

9. Backfill

   Backfill shall be placed in accordance with the Earth Moving specifications.

C. SANITARY STRUCTURES

1. General

   Construction methods for sanitary structures shall conform to MDOT Specification 403.03 except as herein provided.

   All precast sections shall bear the stamp of an approved laboratory as having been tested and delivered from tested stock of the manufacturer, at the expense of the Contractor. Precast sections shall be constructed so that no more than fifty (50) percent of the circumference, measured on the inside face, is deleted on any horizontal plane for sewer pipe openings. There shall be no less than twelve (12) inches of residual concrete measured on any horizontal plane between pipe openings.
   Excavation shall be carried to the depth required to permit the construction of the base in accordance with the requirements of the Standard Details. The excavation shall be sufficiently wide to allow for shoring, bracing, or formwork, should any or all be necessary. The excavation shall allow for accessibility in plastering the exterior of all brick masonry. The bottom of the excavation shall be trimmed to a uniform horizontal bed to receive the concrete base. The excavated section shall be completely dewatered before any concrete is placed therein.
   With the exception of sanitary structures having sumps, the bottom of the structures shall be channeled to provide for smooth flow through the manhole. Channels shall be formed using MDOT Grade S3 concrete.
   Connections to manholes shall be properly supported and braced where not resting on original ground so that any settlement will not disturb the connection.

2. Drop Manholes

   Drop manhole connections shall be constructed on sanitary manholes in conformance with the standard details whenever a sewer enters a manhole at an elevation of twenty-four (24) inches or more above the invert of the outlet sewer pipe.

3. Test Manholes

   The first manhole upstream from the point of connection to the existing sanitary sewer system shall have a one (1) foot deep sump that shall be filled with concrete and channeled upon successful completion of infiltration testing.

   The outlet pipe from this manhole shall be plugged with a waterproof stopper to prevent discharge to the existing system until acceptance of the new system by the Owner. The requirement to provide a sump may be waived by the Engineer where testing is to be done by either low pressure air testing or by exfiltration testing.

D. FINAL GRADE ADJUSTMENTS

1. Final Grade – Existing Structures

   Adjustment of sanitary structures shall apply to all final vertical changes made on existing structures where the elevation of the cover is not changed by more than six (6) inches. Vertical changes in excess of six (6) inches will be treated as structure reconstruction.

2. Final Grade – New Structures

Final grade adjustment of new structures shall be considered as incidental to the structure construction.

Where sanitary manholes are located outside of pavements and sidewalks, final grade adjustments shall be made with precast concrete grade rings. Brick construction will not be allowed except where located in paved surfaces and approved by the Engineer. The manhole casting frame and concrete adjustment rings shall be secured to precast cone section with a minimum of four (4) five-eighths (5/8) inch diameter cadmium coated threaded studs or bolts. All joints in the assembly shall be sealed with either rubber “O” ring gaskets or butyl rope as called for on the Owner’s standard details. The maximum allowable grade adjustment using grade rings shall be fifteen (15) inches. Final grade adjustment for manholes located in pavements and sidewalks shall be made with brick and mortar. A minimum of three (3) or maximum of six (6) courses of brick shall be placed on top of the precast cone section.
If called for on the Owner’s standard details, the Contractor shall provide a rubber wrap, elastomeric seal, or approved equal for water-tightness around the chimney.

E. STUBS, CONNECTIONS, and BULKHEADS

The Contractor shall furnish all material and labor and shall install and/or construct stubs, connections, bulkheads, and related items of work as called for on the Contract Documents. Existing sewers shall be connected where called for on the drawings. Bulkheads shall be placed or removed where called for on drawings.

Unless otherwise noted on the drawings, stubs shall consist of one length of sewer pipe with a watertight stopper bulkhead or, where approved by the Engineer, a brick and mortar bulkhead. Pipe stubs shall be of the same material as the sewer to which they connect unless specified otherwise.

F. SERVICE LEADS

1. Wyes and Risers

Wye branches, tees, or stubs fitted with suitable stoppers shall be set for each lot shown, and at such other points as called for on the drawings.

Risers shall be six (6) inch pipe and shall be constructed where shown on the drawings. They shall connect to wye branches and shall be constructed as shown on the Owner’s standard detail sheet to a depth of six (6) feet below the surface of the ground unless otherwise instructed by the Engineer. A pipe stopper shall be placed in the top bell. Fittings and stoppers shall be equipped with the allowable type of joint used on the sewer. Backfill at all risers shall be carefully placed and tamped sufficiently to insure against damage from backfill settlement.

2. House Connections

The Contractor shall construct house connections as shown on the drawings. A pipe stopper shall be placed in the end of the connection. Pipe and stopper shall be equipped with the allowable type of joint used on the sewer.

The invert of the house connections at the point of terminus shall be a minimum of ten (10) feet below grade at the property line (for basement service) except where otherwise directed by the Engineer.

3. Markers

The Contractor shall also furnish and place a three (3) inch minimum diameter wood or plastic marking post, three (3) feet in length, to be set directly above the end of the house connection or riser. Each marker shall be set so it will be in a vertical position when backfill is completed. The top of marker shall be six (6) inches below the ground surface.

G. CLEANING

All sewers shall be thoroughly cleaned before final acceptance.

H. SANITARY SEWER ACCEPTANCE TESTS

1. General

All sanitary sewers shall be subjected to infiltration, exfiltration or low pressure air tests, or a combination thereof prior to final acceptance by the Owner. In addition, all PVC and ABS plastic sewers shall be subjected to deflection testing by means of a nine-point deflection test mandrel.

The Owner's construction observer shall be present for all testing operations. If testing is to be done by the Contractor, only properly trained personnel shall be allowed to perform the testing work. If testing is to be done by municipal agency work forces, then the Contractor shall be responsible for coordinating with the construction observer in order to schedule the testing.

Unless the Owner's test standards are more restrictive than the standards shown below, then the test standards shown in this specification shall apply.

In the event that the sewer pipe fails any of the required tests, the Contractor shall be responsible for repairing the pipe and repeating the test until acceptable results are achieved.

The method of testing and measurement shall be approved by the Engineer. The Contractor shall provide all necessary equipment and labor for making the tests and cost of same shall be incidental to the unit price bid for sewer.

2. Infiltration Test

All sanitary sewers that are over twenty-four (24) inches in diameter shall be subjected to an infiltration test. Also, all sanitary sewers that are twenty-four (24) inches in diameter and smaller and where the ground water level is more than seven (7) feet above the top of the sewer shall be subjected to an infiltration test.

The infiltration rate for all sanitary sewers shall not exceed a maximum of one hundred (100) gallons per inch diameter per mile of sewer per twenty-four (24) hours.

3. Low Pressure Air Test

All sanitary sewers that are twenty-four (24) inches in diameter or smaller and where the ground water level is seven (7) feet or less above the top of the sewer shall be subjected to a low pressure air test.

The procedure for air testing of sewers shall be as follows:

The sewer line shall be tested in increments between manholes. The line shall be cleaned and plugged at each manhole. Such plugs shall be designed to hold against the test pressure and shall provide an airtight seal. One of the plugs shall have an orifice through which air can be introduced into the sewer. An air supply line shall be connected to the orifice. The supply line shall be fitted with suitable control valves and a pressure gauge for continually measuring the air pressure in the sewer. The pressure gauge shall have a minimum diameter of three and one-half (3-1/2) inches and a range of 0 – 10 PSIG. The gauge shall have minimum divisions of 0-10 PSIG and accuracy of plus or minus (+/-) 0.04 PSIG.

The sewer shall be pressurized to 4 PSIG greater than the greatest back pressure caused by ground water over the top of the sewer pipe. At least two (2) minutes shall be allowed for the air pressure to stabilize between three and one half (3.5) and four (4) PSIG. If necessary, air shall be added to the sewer to maintain a pressure of 3.5 PSIG or greater.

After the stabilization period, the air supply control valve shall be closed so that no more air will enter the sewer. The sewer air pressure shall be noted and timing for the test begun. The test shall not begin if the air pressure is less than three and one half (3.5) PSIG, or such other pressure as is necessary to compensate for ground water level.

The time required for the air pressure to decrease one (1.0) PSIG during the test shall not be less than the time shown in the following Air Test Tables. The Contractor shall use the appropriate test table based upon the sewer pipe material.

Table SA-2
Air Test Table for Vitrified Clay and Concrete Pipe

Specification Time (min:sec) Required for Pressure Drop from 3-1/2 to 2-1/2 PSIG When Testing One Pipe Diameter Only																
		Pipe Diameter, Inches														
		4	6	8	10	12	15	18	21	24	27	30	33	36	39	42
Length of Line, Feet	25	0:04	0:10	0:18	0:22	0:27	0:32	0:36	0:45	0:54	1:03	1:12	1:21	1:30	1:39	1:50
	50	0:09	0:21	0:36	0:45	0:54	1:03	1:12	1:30	1:48	2:06	2:24	2:42	3:00	3:18	3:39
	75	0:14	0:32	0:54	1:08	1:21	1:34	1:48	2:15	2:42	3:09	3:36	4:03	4:30	4:57	5:29
	100	0:18	0:42	1:12	1:30	1:48	2:06	2:24	3:00	3:36	4:12	4:48	5:24	6:00	6:36	7:18
	125	0:22	0:52	1:30	1:52	2:15	2:38	3:00	3:45	4:30	5:15	6:00	6:45	7:30	8:15	9:08
	150	0:27	1:03	1:48	2:15	2:42	3:09	3:36	4:30	5:24	6:18	7:12	8:06	9:00	9:54	10:57
	175	0:32	1:14	2:06	2:38	3:09	3:40	4:12	5:15	6:18	7:21	8:24	9:27	10:30	11:33	12:47
	200	0:36	1:24	2:24	3:00	3:36	4:12	4:48	6:00	7:12	8:24	9:36	10:48	12:00	13:12	14:36
	225	0:40	1:34	2:42	3:22	4:03	4:44	5:24	6:45	8:06	9:27	10:48	12:09	13:30	14:51	16:26
	250	0:45	1:45	3:00	3:45	4:30	5:15	6:00	7:30	9:00	10:30	12:00	13:30	15:00	16:30	18:16
	275	0:50	1:56	3:18	4:08	4:57	5:46	6:36	8:15	9:54	11:33	13:12	14:51	16:30	18:09	20:06
	300	0:54	2:06	3:36	4:30	5:24	6:18	7:12	9:00	10:48	12:36	14:24	16:12	18:00	19:48	21:54
	350	1:03	2:27	4:12	5:15	6:18	7:21	8:24	10:30	12:36	14:42	16:48	18:54	21:00	23:06	25:33
	400	1:12	2:48	4:48	6:00	7:12	8:24	9:36	12:00	14:24	16:48	19:12	21:36	24:00	26:24	29:12
	450	1:21	3:09	5:24	6:45	8:06	9:27	10:48	13:30	16:12	18:54	21:36	24:18	27:00	29:42	32:51
	500	1:30	3:30	6:00	7:30	9:00	10:30	12:00	15:00	18:00	21:00	24:00	27:00	30:00	33:00	36:30

Note: Table SA-2 is taken from the National Clay Pipe Institute (NCPI) tables which are based upon ASTM C828 “Test Method for Low Pressure Air Test for Vitrified Clay Pipe Lines” and ASTM C924 “Standard Practice for Testing Concrete Pipe Sewer Lines by Low Pressure Air Test Method.”

Table SA-3
Air Test TableFor PVC and ABS Pipe
Minimum Specified Time Required for a 1.0 PSIG Pressure Drop
For Size and Length of Pipe Indicated for Q=0.0015 *

Pipe Dia., Inches	MinimumTime, (min:sec)	Length for Minimum Time, ft.	Time for Longer Length, seconds	Specified Time for Length (L) Shown, (min:sec)							
				100 feet	150 feet	200 feet	250 feet	300 feet	350 feet	400 feet	450 feet
4	3:46	597	0.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:43	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	203:46

Note: Table SA-3 is taken from ASTM F1417 “Standard Test Method for Installation and Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air Test.” ASTM F1417 conforms to Uni-Bell “Recommended Practice for Low Pressure Air Testing of Installed Sewer Pipe” (UNI-B-6-98).

- Q is the allowable leakage rate in cubic feet/minute/square foot of inside surface area of pipe

4. Exfiltration Test

   Exfiltration or leakage from the sewer line can be measured by recording the water level drop over a given period of time in a standpipe placed and connected in the upstream manhole. The measured drop in the time period can be converted by calculations to the leakage rate in terms of gallons per inch of pipe diameter per mile per day.

   Exfiltration tests may be substituted for low pressure air tests where approved by the Engineer. Exfiltration tests will not be allowed where the external water pressure exceeds four (4) feet.

   For the purpose of exfiltration testing, the internal water level shall be equal to the external water level plus four (4) feet as measured from the top of the highest pipe in the system being tested. This could be either a house lead or a lateral. However, the maximum total height of water above the invert of the pipe at the lower end shall not exceed sixteen (16) feet. A prospective test that would exceed this sixteen (16) foot limit should not be taken. The line under construction can be broken down into smaller sections such that the maximum head of sixteen (16) feet will not be exceeded.

The maximum exfiltration rate shall be the same as that permitted for the infiltration test. The exfiltration test procedure is summarized as follows:

a. All service laterals, stubs and fittings into the sewer line(s) being tested should be properly capped or plugged, and carefully braced to resist the thrust actions developed by the internal water pressure. In preparing the blocking of plugs or end caps, it is extremely important to recognize that the five (5) to ten (10) feet of head in the standpipe will exert considerable thrust against the plugs or caps.

b. A plug is inserted and tightened in the inlet pipe of the downstream manhole to which the water supply connection is made for filling the pipe.

c. The upper manhole is plugged and securely tightened for connection to the standpipe. The standpipe is then placed in this manhole and connected to the tapped plug. The standpipe must be capable of handling from five (5) to ten (10) feet of water head to determine the tightness and soundness of the sewer line, as specified and directed by the Engineer.

d. Water is introduced into the line at the downstream (lower) manhole until the standpipe in the upstream manhole has been completely filled. By filling the line from the lowest level, the air in the line is easily pushed ahead and, finally dispelled through the standpipe at the upper end of the test section. Care should be taken to minimize entrapped air that will give distorted test results. The rate of drop in the standpipe may be quite rapid until the air has been expelled.

e. After filling with water, the line must be allowed to stand for at least four (4) hours before beginning the test. During this time some water absorption into the manhole structures and sewer pipe will take place. After the water absorption has stabilized, the water level in the standpipe is checked and water added if necessary.

f. The test is now ready to begin. The drop in the standpipe is measured and recorded over a fifteen (15) minute period. To verify the first results, a second fifteen (15) minute test is suggested. This will also verify whether a stable condition exists in the line.

g. The measured drops in the standpipe are converted to leakage in terms of gallons per inch diameter per mile per day.

h. Another commonly used method of conducting water exfiltration testing is to utilize the manhole in lieu of a standpipe. The test procedure is exactly as outlined for using the standpipe. However, since the manhole is larger in diameter than the standpipe, this method normally requires a minimum two (2) hour test period in order to be able to record a measurable water level drop. Manhole leakage must also be considered in the leakage rate and test results.

i. Caution should be taken about conducting exfiltration tests on sewer lines laid on steep grades. Consideration must be given to the downstream portion of the system to prevent excessive pressures in these lower lines. For these installations and where the upstream manholes are very deep, it is not advisable to fill the standpipe or manhole to the top when performing the test.

5. Deflection Test for Plastic Pipe

The allowable maximum deflection shall be five (5) percent of internal pipe diameter. A deflection test gauge (Go, No-Go Gauge) as manufactured by Hurco Industries, Cherne Industries, or approved equal shall be used to verify that the maximum allowable deflection

standard is met. The test gauge must have a minimum of 9 points. Proving rings must be provided to verify the gauge diameter. The gauge must be pulled through manually. Force will not be allowed. Pipe with deflections greater than five (5) percent will be considered unacceptable and shall be re-laid by the Contractor.

6. Videotaping

As a means of insuring that pipe laying was properly done and that all joints are in a “home” position, the Contractor shall provide videotaping of all of the pipe laid that is thirty-six (36) inches in diameter and smaller. This videotaping shall be done no sooner than thirty (30) days after sewer installation is complete. The Contractor shall provide twenty-four (24) hours notice to both the Owner and Engineer prior to videotaping so that a representative may be present. A satisfactory review of the videotape by the Engineer shall be a condition for sewer acceptance by the Owner. Typical items to be reviewed on the videotape will include pipe deflection, pipe settlement, lead connections, joints and pipe cleanliness. If the videotape review reveals unsatisfactory conditions, the Contractor shall correct the conditions at his own cost and shall re-videotape the affected pipe sections for review by the Engineer.

END OF SECTION 33 31 00

SECTION 33 35 20

SEWER LINE CLEANING FOR PREPARATION OF SEWER REHABILITATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Clean all sewer pipe for proposed CIPP lining rehabilitation.

B. Cleaning shall include properly high-pressure water jetting, rodding, bucketing, brushing, and flushing sewers and manholes prior to inspection by closed circuit television (CCTV), pipeline rehabilitation or replacement, point repairs, manhole preparation, and testing operations.

C. The goal is to remove all debris, roots intruding services, deposits, and other blockages to a 95 percent minimum open area so the CIPP can be successfully installed without any significant installation issues or post lining defects. On all sewers, perform sewer cleaning work to an acceptable level as necessary to perform a thorough television inspection of the sewer and to install a CIPP liner. If the pipe condition is such that cleaning may cause a potential collapse, the pipe shall be televised without attempting to clean it to the 95 percent condition, pending Construction Manager's approval.

D. Cleaning may involve preparatory or light sewer cleaning (small amounts of debris and/or light root growth existing within the sewer line) or heavy sewer cleaning (large amounts of debris, grease, large size stones and bricks, and/or heavy root growth existing within the sewer line).

1. The bid price for pipeline replacement or rehabilitation shall include preparatory cleaning for all sewers completely. Preparatory or light cleaning is defined as all cleaning up to and including 3 high-pressure water-jetting passes.

2. If the sewer is still not clean after 3 high-pressure water-jetting passes, inform the Construction Manager about the condition and the reason(s) for the failure to fully clear the line. The Construction Manager may direct heavy cleaning of the problem sewer section. Alternatively, the Construction Manager may direct the Contractor to perform a point repair in the problem section.

E. Cleaning shall dislodge, transport, and remove all sludge, mud, sand, gravel, rocks, bricks, grease, roots, sticks, and all other debris from inside the sewer pipe and manholes.

1.2 RELATED WORK

A. Pre-rehabilitation sewer television inspection is specified in Section 33 01 38.

B. Cured-in-place pipe lining (CIPP) is specified in Section 33 01 38.

C. Manhole rehabilitation is specified in Section 33 01 36.

D. Flow maintenance in existing sewers is specified in Section 33 01 48.

PART 2 - PRODUCTS

2.1 MATERIALS

A. High Velocity Hydro-Cleaning Equipment shall have the following:

1. A minimum 750-foot high pressure hose

2. Two or more high velocity nozzles able to produce a scouring action from 15 to 45 degrees in all size lines to be cleaned

3. A high velocity gun for washing and scouring manhole walls and floor

4. Ability to produce flows from a fine spray to a long distance solid stream

5. A water tank, auxiliary engines and pumps and a hydraulically driven hose reel

6. Equipment operating controls located above ground

B. Mechanical cleaning equipment shall be either power buckets or power rodders manufactured by the Flexible Tool Division of Rockwell Manufacturing Co. or equal.

1. Bucket machines shall:

a. Be furnished with buckets in pairs and with sufficient dragging power to perform the work efficiently

b. Use V-belts for power transmission or have an overload device. No direct drive machines will be permitted.

c. Be equipped with a take up drum and a minimum 500-foot cable

2. Power rodding machine shall:

a. Be either sectional or continuous

b. Hold 750 feet minimum of rod

c. Have rods made from treated steel

d. Be fully enclosed and have an automatic safety throw out clutch

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Cleaning Precautions: During sewer cleaning operations, satisfactory precautions shall be taken when using cleaning equipment.

1. When hydraulically propelled cleaning tools (which depend on water pressure to provide their cleaning force) or tools which retard the flow in the sewer line are used, precautions shall be taken to ensure the water pressure created does not damage or

cause flooding of public or private property being served by the sewer.

2. When possible, sewage flow in the sewer shall be used to provide the necessary pressure for hydraulic cleaning devices.

3. When it is necessary to use water from fire hydrants in order to avoid delays in normal work procedures, the water shall be conserved and not used unnecessarily. No fire hydrant shall be obstructed. Access to the fire hydrant shall be available at all times.

B. Sewer Cleaning

1. The designated sewer manhole sections shall be cleaned using hydraulically propelled, high velocity jet, or mechanically powered equipment.

2. Cleaning equipment selection shall be based on the conditions of lines at the time the work commences.

3. The equipment and methods selected shall be satisfactory to the Construction Manager.

4. The equipment shall be able to remove dirt, grease, rocks, sand, and other materials and obstructions from the sewer lines and manholes.

5. If cleaning of an entire section cannot be successfully performed from one manhole, the equipment shall be set up on the other manhole and cleaning again attempted. If successful cleaning still cannot be performed or the equipment fails to traverse the entire manhole section, it will be assumed a major blockage exists, and the cleaning effort shall be repeated with other equipment types.

C. Cleaning equipment selection shall be based on the conditions of the manholes and sewer lines at the time the work commences based on the pre-construction CCTV inspection to be conducted.

1. Light cleaning (small amounts of debris existing within the sewer line)

a. Use high-pressure water jetting equipment (3 passes), brushes, and swabs.

b. “Light Cleaning” will be defined and managed as follows:

1) Sewer reaches that do not require heavy cleaning, as defined below, and produce little or no debris shall be categorized as “light cleaning.”

2) Costs related to cleaning such sewers shall be included in bid unit prices for CCTV and CIPP Lining.

2. Heavy cleaning (large deposits of debris or heavy root growth existing within the sewer line)

a. Use bucket machines, scrapers, hydraulic pressure jetting with special aggressive root cutting nozzles, or tools and augers. Cleaning requiring more than 3 passes with hydraulic cleaning equipment to achieve acceptable results shall be considered heavy cleaning.

b. Heavy cleaning will be conducted only with Construction Manager’s approval and

direction. “Heavy Cleaning” will be defined and managed as follows:

1) Sewer reaches requiring debris removal for depths up to 25 percent of the pipe height shall be categorized as “heavy cleaning.”

2) Sewer reaches requiring root removal for lengths up to 25 percent of the pipe segment shall be categorized as “heavy cleaning.”

3) Costs related to cleaning such sewers shall be included in bid unit prices for Heavy Cleaning.

4) Costs related to televising such sewers following heavy cleaning shall be included in bid unit prices for CIPP Lining.

5) Compensation for heavy cleaning a particular line will only be paid if:

   a) The Construction Manager has provided written authorization for the heavy cleaning prior to performing the work

   b) Contractor proves significant time AND effort were necessary to clean the line (i.e., the time required to clean and inspect the line must be at least 3 times the average time required to clean and inspect comparable length/ diameter sewers in the project area)

   c) Contractor shall provide adequate video proof that the blockage, debris, grit roots or grease build-up, or other condition exists

3. Contractor may obtain video proof for heavy cleaning by acquiring a “before” video for all accessible portions of the obstructed reach and submitting it to Construction Manager with the completed inspection. A submerged camera does not justify a need for heavy cleaning. Proof the submergence was due to a blockage and/or heavy debris and not a sag in the line will be required.

D. Provide appropriate screening to stop materials from passing into downstream sewers. All solid or semisolid materials dislodged during cleaning operations shall be removed from the sewer at the downstream manhole in the sewer section being cleaned. These materials shall be removed from the site at the end of each workday and shall be properly disposed. Passing dislodged materials downstream from the sewer segment being cleaned shall not be permitted. In such an event, as observed or detected by the Construction Manager, Contractor shall be responsible for cleaning the affected downstream sewers in their entirety, at no additional cost to the city.

E. Use properly selected equipment to remove all dirt, grease, rock, and other deleterious materials and obstructions.

F. Protect existing sewer lines from damage caused by improper using cleaning equipment.

G. Take precautions to avoid damage or flooding to public or private property being served by the line being cleaned.

H. Material Removal

1. Remove all solids and semi-solids at the downstream manhole in the section being cleaned.

I. Passing material from one line section to another will not be permitted.

J. Material Disposal

1. Remove from the site and properly dispose of all solids or semi-solids recovered during the cleaning operation.

2. The Contractor shall be responsible for properly disposing of all collected material.

3. Waste material removed from the sewer during the cleaning process may be disposed of by hauling it to the Metro Central Wastewater Treatment Plant complex's grit and solids woodchip mixing area off Cement Plant Road. Coordinate with Metro Water Services and obtain written permission prior to using this alternative.

4. Specifics regarding scheduling, monitoring, and approved methods and procedures for disposal must be arranged with Metro System Services Division prior to beginning cleaning operations.

K. No sewer cleaning shall take place in a particular sewer segment until all upstream pipe segments have been cleaned. If cleaning is performed in a downstream pipe segment to facilitate overall cleaning operations, the segment shall be re-cleaned at no additional cost, after all pipes upstream of that segment have been cleaned.

3.2 WATER

A. Water for all construction operations shall be available from designated White House Utility District (WHUD).

B. Water usage shall be in accordance with WHUD backflow and metering polices.

3.3 FIELD QUALITY CONTROL

A. Acceptance for this work portion shall depend on the results from the pre-rehabilitation television inspection.

B. The cleaning goal is to remove all necessary debris, roots intruding services, deposits, and other blockages to a 95 percent minimum open area so the CIPP can be successfully installed without any significant installation issues or post lining defects due to cleaning quality.

C. Lines not acceptably clean as to permit television inspection shall be re-cleaned and re-inspected at no additional cost to the city.

3.4 CLEANUP

Upon cleaning acceptance, restore the project area affected by the operations to a condition at least equal to that existing prior to the work.

3.5 MEASUREMENT & PAYMENT

A. Preparatory Sewer Cleaning of Mainline Sewer:

1. Measurement

a. The unit for this Item will be per foot based on the entire length of the pipe segment in which pipe cleaning occurs. It will be measured from center of manhole to center of manhole horizontally along the centerline of the pipe.

2. Payment

a. The unit price for this Item will be full compensation for providing all labor, materials, equipment, tools, and incidentals for all aspects of preparatory sewer cleaning as specified and shown.

3.6 CLOSEOUT ACTIVITIES

A. Provide in accordance with Section 01 77 00.

END OF SECTION

SECTION 33 35 21

OBSTRUCTION REMOVAL

PART 1 GENERAL

1.1 SECTION INCLUDES

This section includes clearing the sewer main from obstructions by one for the following methods:

A. Obstruction removal by remote device

1. To remove protruding taps (service lines that protrude greater that 1-inch into the sewer)

2. To remove other obstructions

B. Obstruction removal by excavation

1.2 UNIT PRICES

A. Obstruction removal by excavation will be paid as a lump sum for each.

B. Obstruction removal by remote device shall be paid on a lump sum basis for each.

C. Any cleaning of sanitary sewer due to broken pipe, roots, dirt, and loose deposits, etc. will be incidental to obstruction removal by both methods. If any TV inspection is involved, it will be incidental.

D. Removal and legal disposal of hard deposits, concrete, debris, pipes or any other material in the manhole or that is within outside wall of the manhole wall will be incidental.

E. Any bypass pumping associated with obstruction removal shall be considered incidental.

F. When extra length for obstruction removal by excavation occurs under pavement, the pavement removal and replacement and backfill shall be incidental.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 OBSTRUCTION REMOVAL BY REMOTE DEVICE

A. This method of obstruction removal shall be performed prior to rehabilitation. When a

T.V. tape of televised sanitary line identifies an obstruction which could cause a non-uniform liner pipe or obstruction during installation of the liner, it shall be removed.

B. To remove protruding taps prior to the rehabilitating with a liner, a power driven cutting device shall be utilized. The protruding tap shall be cut so that the protrusion is no greater than ¼ inch. In the event damage to the existing sewer line or service line occurs, a repair shall be done at the Contractor's expense and only a payment for the remote obstruction removal will be made. If the Contractor is unable to remove the protruding tap by this means, then a point repair may be performed at the Owner's Representative's direction.

C. To remove other obstructions, such as hanging gaskets, fixed debris, stabilized sand, hardened mineral deposits(includes tuberculation in cast or ductile iron pipes), heavy roots, etc., a remote device shall be utilized. The device(s) shall be pulled or driven from manhole to manhole up to a continuous length of 800-feet using a solid steel mandrel, porcupine, root saw, bucket, etc. to remove the obstruction. The device shall be adequately sized to remove the obstruction to the satisfaction of the Owner's Representative. Damage to the existing sewer line, service line or tap must be repaired by the Contractor and only a payment for remote obstruction removal will be made. The mechanical cleaning method, as described in Section 33 35 20, may be used to remove the obstruction when approved by the Owner's Representative. No separate payment shall be made for utilizing mechanical cleaning method to remove the obstructions. The Contractor shall be paid at the bid unit price for performing obstruction removal (other) irrespective of the method utilized to remove obstruction. Damage to the existing sewer line, service line or tap must be repaired by the Contractor at his expense. The cleaning of the pipe in preparation for rehabilitation is not considered obstruction removal.

3.2 OBSTRUCTION REMOVAL BY EXCAVATION

A. This method of obstruction removal shall be performed while installing the liner in sanitary sewer. If during the liner insertion operation, a collapsed sewer, off-set joint, or other obstruction is encountered which prevents or blocks the passage or insertion of any liner involved in the rehabilitation process, the Contractor shall notify the Owner's Representative for approval to make an excavation to uncover and remove the obstruction in the following manner:

1. Excavate at the point where there is an obstruction. A trench safety system shall be required for all excavations over 5-feet deep.

2. Break out the existing sanitary sewer pipe (carrier pipe), etc., as directed by the Owner's Representative. Remove only that amount of material which is causing the obstruction. The amount of "carrier pipe" to be removed shall be minimized. The minimum length of pipe to be removed shall be six (6) feet for all depths.

3. When the liner is completely in place, it shall be encased with cement stabilized sand as per Class “AA” modified bedding.

4. When obstruction removal by excavation occurs under a paved area, then backfill shall be clean #57 stone.

B. Under such conditions, replacement of the carrier pipe is not required. The existing sewer bedding should not be disturbed by the excavation work. However, if said bedding is disturbed during the obstruction removal procedure, the Contractor shall place cement stabilized sand beneath the liner; the minimum compacted thickness shall be 12-inches.

END OF SECTION