SECTION 5
SPECIFICATIONS

STRUCTURE EXCAVATION AND BACKFILL
ITEM 100

WORK INCLUDED: (Sec. 100.01)

The Contractor shall provide all necessary labor, equipment and materials required to complete the installation of structures, manholes and pump stations including ancillary or incidental earthwork, excavation, backfill, dewatering and excavation support to meet the intent of the plans and the specifications. Unless otherwise noted on the plans, vaults and manholes shall include a 6" foundation cushion and pump stations shall include a 12' thick foundation cushion consisting of #57 limestone (no recycled).

If a bidder requires subsurface information in addition to the information provided by the County in order to provide a responsible bid, the Contractor shall coordinate with the County regarding site access. The elevations of the ground levels shown on the Drawings are believed to be reasonably accurate but are not purported to be absolutely accurate. The Contractor shall satisfy himself as to the existing elevations and the work involved.

Prior to excavation, the Contractor is responsible for the development of a Dewatering, Excavation and Support plan that is to be provided to the County. The excavation support plan shall also address the need for settlement monitoring and vibration control/monitoring. The geotechnical report (if available), the nature of the soils and the installation/removal of shoring shall be considered during the preparation of the plan. Dewatering, excavation support and monitoring of adjacent property is considered incidental to excavation activities.

The Contractor shall make reasonable efforts to not "over-dewater" and impact wells located adjacent to the project site. Dewatered water wells shall be addressed under separate pay items.

RELATED ITEMS: (Sec. 100.02)

Subgrade Repair, As Directed	Item 105
Rock Excavation	Item 110
Backfill Materials	Item 130
Removal of Trees and/or Stumps	Item 150
Manholes	Item 500
Pavement, Curb and/or Gutter and Sidewalk	Item 600
Temporary Water Service	Item 950
Small Well Replacement	Item 955
Submersible Type Pump Stations	Item 1800
Dry Pit Pumping Stations	Item 1810
Grinder Pump Stations	Item 1820

MATERIALS: (Sec. 100.03)

Structure, manhole and pump station backfill shall be granular backfill per Item 130 – Backfill Materials. Slag, recycled concrete and/or recycled asphalt shall not be used as structure backfill.

GENERAL: (Sec. 100.04)

All materials excavated may be temporarily deposited along the excavation and beyond the reach of slides. Excavation spoils not required or suitable for embankment shall be hauled away and disposed of as directed by the plans at the Contractor's expense. If the plans do not direct the location for the deposition of surplus excavation spoils, the Contractor shall remove and dispose of the materials at a legal off-site location.

All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Fire hydrants, valve pits, manhole covers, valve boxes, curb stop boxes, inlets, fire and police call boxes, or other utility controls shall be unobstructed and shall be fully accessible until the work is completed. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural water courses shall not be obstructed.

All compaction requirements in this specification and on the standard drawings are based on the relative density expressed as a percentage for granular soils and the percent of the max dry density (standard proctor) for cohesive soils.

Voids beneath foundations or utilities resulting from unauthorized excavation, failure to support excavation walls or over-excavation shall be refilled with compacted foundation cushion, granular backfill, or concrete as directed by the Sanitary Engineer, at no cost to the Owner.

All excavation, material, backfilling and other work resulting from slides, cave-ins, dewatering, excavation support failure, settlement, swelling or upheavals shall be at the Contractor's cost and expense.

If directed by the Sanitary Engineer, unsuitable, soft or spongy material encountered at the bottom of an excavation or discovered as a result of proof-rolling shall be removed and the void backfilled with compacted foundation cushion or approved granular material. The cost of the removal and replacement of unsuitable subgrades shall be paid for under Item 105 – Subgrade Repair, As Directed. Payment for Subgrade Repair, As Directed shall be based on the cubic yards of materials removed and replaced.

DEWATERING, EXCAVATION AND SUPPORT PLAN: (Sec. 100.05)

The Contractor shall prepare a Dewatering, Excavation and Support Plan. The Plan shall discuss the proposed means of excavation support, support removal, the potential impacts to adjacent structures and property and the need for settlement monitoring and vibration monitoring. The need to perform pre-construction structural surveys shall also be discussed. If an excavation is deeper than 20' (or as required by OSHA regulations), the Contractor shall hire a licensed engineer experienced in excavation support design to design excavation support system(s). The plan shall be provided to the County for a general review of the proposed work. The County will not approve excavation support and monitoring plans.

The work of dewatering trenches and excavations and the control of all surface and ground water whether by temporary ditches, grading, pumping, bailing, well pointing or otherwise is the responsibility of the Contractor. The Contractor shall protect the site and soils from inclement weather. Dewatering and control of water of both ground and surface water are considered incidental to structure and manhole excavation; no separate payment. Conditions created by the failure to control water shall not be eligible for extra compensation. In general, excavations shall be dewatered to a level two feet (2') below the bottom of the excavation. When the dewatering discharge contains silt, the Contractor shall discharge the water removed from the excavations to a siltation basin prior to discharge to the receiving stream or pipe. The Contractor must comply with all local and County requirements regarding discharges and run-off associated with construction activity.

All support plans shall address settlement of adjacent pavement, utilities and buildings. At a minimum, existing structures whose footings fall within a 1.5 H:1V zone of influence line of an excavation shall be monitored for movement. Elevations of control points shall be obtained at least 3 times (once per 24 hours) prior to any excavation or shoring activities to establish baseline data. No fewer than two control points shall be placed and monitored for each building. Control points shall be distinct, solid points such as survey nails in concrete, screws extending from lag shields in block walls or other points not subject to interpretation. Control points shall be checked at the beginning and end of each work day and subsequent to any activity or occurrence which may have caused or indicated ground movement outside of the limits of the excavation support. The plan shall also address the removal of trench support and any special precautions to be taken if removal of the trench support is deemed possible. The need for vibration control and monitoring shall be discussed in the Excavation Support Plan. The above requirements are minimum requirements and may be expanded as required by the Contractor or the excavation support design engineer based on specific site conditions or the selected means and methods. The excavation support plan shall be provided to the County for a general review of the proposed work. The County will not approve excavation support or monitoring plans.

VIBRATION CONTROL AND MONITORING: (Sec. 100.06)

If specified in the contract documents or deemed appropriate by the Contractor's excavation support and monitoring plan, the Contractor shall provide vibration control and monitoring per ODOT item 208.15, except the specialist's experience does not need to be specific to rock blasting. The Contractor's specialist shall provide the range of acceptable particle velocities.

PRECONSTRUCTION STRUCTURE SURVEY: (Sec. 100.07)

If required by the contract documents or the Contractor's vibration specialist, the Contractor shall conduct a pre-construction survey of the selected buildings, structures and utilities. Inspection shall consist of contacting potentially affected structure owners to schedule inspections, photographs and/or videos of structures (interior and exterior) to note existing conditions including a narrative of structural defects or the lack thereof. The property owner should be afforded the opportunity to accompany the inspection and provide comments regarding pre-construction conditions. The property owner shall be provided a copy of the final summary document and supporting documentation upon request. Copies of said inspection documentation shall be provided to the County.

STRUCTURAL EXCAVATION: (Sec. 100.08)

The Contractor shall excavate to a width and depth sufficient to construct the proposed structure or perform the required work. The sides of the excavation shall be supported by use of sheeting, cofferdams, braces, shoring, or other means to fully protect all workmen, the work, adjacent structures, conduits and property. No instructions will be given to the Contractor relative to the use, type or means or when to use such protection, but such use and when to use such protection shall be the sole responsibility of the Contractor. In the event sheeting, piling or bracing is ordered left in place by the Engineer the same will be paid for at the unit price bid for Item 700 - Sheeting and Timber Left in Place.

Mechanical excavation shall be made to a level two (2) inches above the bottom of all slabs, footers and foundation cushions (whichever is lowest in the particular area of excavation). The remaining two (2) inches shall be leveled and removed by hand to a firm unyielding foundation. The in-situ subgrade shall be compacted and the field bearing capacity verified prior to the installation of the foundation cushion or formwork as appropriate.

BACKFILLING AROUND STRUCTURES: (Sec. 100.09)

As the structures are completed, the Contractor shall backfill the excavation with granular backfill per Item 130 - Backfill Material. In locations where pipes and conduits enter the structure above the bottom slab and through backfilled areas, the area beneath the conduits or pipes shall be well consolidated so that undue shearing forces will not be induced in the pipe or conduit. Care must be taken while installing and compacting any material adjacent to a structure to prevent uneven loading and movement of or damage to the structure. Place fill in lifts around all sides of the structure and advance the fill evenly.

The maximum backfill lift shall be 8" for hoe-mounted tampers and 4" for walk behind compaction equipment.

Structure design, backfilling and dewatering must be coordinated by the Contractor to prevent floatation or shifting due to hydraulic uplift pressures. Structures exhibiting floatation must be removed to allow base correction and structural damage to be remedied.

CLEAN-UP: (Sec. 100.10)

The Contractor shall clean and remove all residual stones, mud, dirt and other materials from any and all existing pavements, driveways, or lawns which are a result of any of his operations under this contract. The Contractor is responsible for filling and maintaining all settlements due to the trench excavation for the period of the contract and the Maintenance Bond period.

The cleanup and disposal of material shall be completed as soon as practical. However, cleanup work shall not fall behind the pipe laying more than five hundred (500) feet in uncongested areas and one hundred (100) feet in congested areas and intersections. In residential or business areas, the project shall be swept at least weekly with a closed faced broom and receive calcium chloride as directed per ODOT Item 616. Should the Contractor not keep his cleanup work within the aforementioned distance, the Contractor shall be required to cease further pipe laying until such cleanup is accomplished.

MEASUREMENT: (Sec. 100.11)

Measurement of excavation and backfill quantities will not be used as a basis of payment, however the locations, thicknesses and compactive efforts associated with these items will be monitored to assure compliance with the requirements of the contract documents. The payment for excavation, backfill and dewatering activities and the associated tasks required in Item 100 shall be included with the structure, manhole or pump station that required these tasks.

PAYMENT: (Sec. 100.12)

Unless separately itemized and directed in the project bid documents, payment for activities required and described by Item 100 - Structure Excavation and Backfill shall be included with and paid for under the bid item(s) which required excavation and backfill. The exceptions are cited below:

Item 100 – Vibration Control and Monitoring, As Directed (Lump)
Item 100 – Preconstruction Structure Survey, As Directed (Lump)

SUBGRADE REPAIR, AS DIRECTED

ITEM 105

WORK INCLUDED: (Sec. 105.01)

If directed, the Contractor shall excavate unsuitable subgrade materials, provide and install granular backfill materials, re-grade the disturbed area and provide all necessary compaction, labor and equipment required to remove and replace weak, soft, wet or unstable subgrade.

RELATED ITEMS: (Sec. 105.02)

Structure Excavation and Backfill	Item 100
Grading	Item 103
Foundation Cushion	Item 120
Backfill Materials	Item 130
Manholes	Item 500

MATERIALS (Sec. 105.03)

As Directed, the repair material shall be #57 crushed limestone, ODOT Item 304 limestone or No. 1 / No. 2 aggregate per ODOT 703.19. No slag, No recycled concrete. Repair materials shall be spread in successive loose layers, not to exceed 8 inches in thickness. The layers thus placed shall be compacted to 90% relative density.

If directed by the Engineer, a geogrid shall be placed in areas of subgrade repair. Geogrid shall be sized appropriately for the aggregate and be Tensar Triax, US Fabrics Basegrid or ADS BX Series.

GENERAL: (Sec. 105.04)

Excavated spoils shall be hauled away and disposed of as directed by the plans at the Contractor's expense. If the plans do not direct the location for the deposition of surplus excavation spoils, the Contractor shall remove and dispose of the materials at a legal off-site location.

The General requirements of Item 100 – Structure Excavation and Backfill apply to this section.

MEASUREMENT: (Sec. 105.05)

Payment shall be based on field approved and field measured quantities.

PAYMENT: (Sec. 105.06)

Item 105 – Subgrade Repair, As Directed (CY)
Item 105 – Geogrid for Subgrade Repair, As Directed (SY)

ROCK EXCAVATION

ITEM 110

WORK INCLUDED: (Sec. 110.01)

The Contractor shall provide all labor, material, equipment and tools to excavate, within the lines and grades shown on the plans all material classified as Rock Excavation and shall satisfactorily remove and dispose of all rock and boulders resulting from the excavation. The quantity of rock excavation shall be the minimum amount required to construct the work and provide at least 6" of clearance for piped utilities and 12" of clearance for structures.

RELATED ITEMS: (Sec. 110.02)

Structure Excavation and Backfill	Item 100
Manholes	Item 500
Gravity Sewers	Item 1000
Forcemains	Item 1845

MATERIALS: (Sec. 110.03)

Material to be classified as rock under this contract will be sandstone, limestone, granite or other consolidated bedrock in its original position. Rock Excavation shall include the removal of material which cannot be broken and removed by ordinary excavation equipment sized to excavate ten feet below the lowest anticipated excavation depth. The need for rippers or power operated jack hammers is considered rock excavation.

Loam, sand, gravel, hardpan, clay, shale or other overlying material will not be classified as rock, even though portions of it may be stratified or laminated. Disintegrated, weathered, soft or rotten material that can be removed by an excavator is not rock excavation. The removal of areas of cobbles and small boulders that can be removed by the excavator described above bedrock shall not be considered rock excavation.

Elevations shall be taken on the surface determined to be rock after the removal of overburden.

The decision of the Sanitary Engineers as to location of the plane delimiting rock shall be final and binding on the Contractor. The location of the auger refusals obtained from the soil investigation will be strongly considered when determining the rock plane.

BLASTING: (Sec. 110.04)

Prior to blasting, the Contractor must obtain the approval of the Sanitary Engineer. Extreme care shall be used wherever blasting is permitted. The Contractor shall follow all rules and regulations that may be imposed by the County, or State or any public authorities, relative to the storing and handling of explosives and the loading and firing of any blast. Blasts shall not be fired until all persons in the vicinity are known to have reached positions out of danger therefrom.

Blasting will not be permitted within fifty (50) feet of any structure unless the proper precautions are taken to insure that the structure and the material surrounding and supporting the same shall not be damaged. All blasts in open cut shall be well covered and provisions made to protect pipes, conduits, sewers, structures, and persons and property adjacent to the site of the work.

Where rock is to be removed from sheeted excavations, all braces and whalers shall be fastened securely in place to prevent movement during blasting.

Blasting will not be permitted between the hours of 5 P.M. and 8 A.M. except with special permission from the Sanitary Engineers. No blasting shall be done at any time except by experienced persons.

Explosives in sufficient quantity to prevent delay of work, but not excessive, shall be kept on hand by the Contractor. A daily record shall be kept showing the amounts of explosives on hand, the quantities received and issued, and the purpose for which issued. All explosives shall be transported, stored, handled and used in accordance with local ordinances and applicable provisions of the laws of the state in which the work is performed.

The Contractor shall conform with all requirements of Rule Number 4121:1-3-15, "Explosives and Blasting", by the State of Ohio, the Industrial Commission entitled "Specific Safety Requirements of the Industrial Commission of Ohio Relating to Construction", or the latest issue thereof.

All blasting necessary on this contract shall be done with the express provision that the Contractor shall be and is hereunder responsible for any and all damages and claims arising therefrom or by accidental explosions, and for the defense of all actions arising from such causes. A video of precondition surveys may be required by the County.

In the event injury occurs to any portion of the work, or to the material surrounding or supporting the same, through blasting, the Contractor at his own expense shall remove such injured work and shall rebuild the same and/or shall replace the material surrounding or supporting the same. Any damage whatever to any existing structure due to blasting shall be promptly repaired by the Contractor at his own expense.

MEASUREMENT: (Sec. 110.05)

All rock excavation to be paid for under this Item shall be measured as cut and will be paid for based on the amount of rock removed as measured in the excavation. Quantities of the resulting rubble will not be used as a basis of measurement. Material handling and disposal shall be included in the unit cost for Rock Excavation. Unless otherwise indicated, excavation above or below the rock will be paid for under the Item which required the excavation. Unless otherwise indicated, payment for the backfill at locations of rock excavation shall be paid for under the pay item(s) that required the excavation and backfill (i.e. pipe, manhole, structure etc.). Payment will be made for rock excavation within the lines and grades identified in the field.

PAYMENT: (Sec. 110.06)

The unit price per cubic yard stipulated in the proposal for Rock Excavation shall include all labor, materials and equipment necessary to complete the work as shown on the Drawings and described by the specifications.

Upon approval by the Sanitary Engineer, unforeseen rock excavation shall be performed as directed on a time and material basis.

Item 110 – Rock Excavation (CY)

FOUNDATION CUSHION

ITEM 120

WORK INCLUDED: (Sec. 120.01)

The Contractor shall furnish and properly place at the locations shown on the Drawings, or wherever required by other Specifications, all material required to provide a compacted granular working surface for structures.

RELATED ITEMS: (Sec. 120.02)

Structure Excavation and Backfill	Item 100
Manholes	Item 500
Gravity Sewers	Item 1000
Pump Stations	Items 1800-1820
Forcemains	Item 1845

MATERIALS: (Sec. 120.03)

Foundation cushion shall be #57 crushed limestone. No recycled concrete.

PLACING: (Sec. 120.04)

Foundation cushion limits shall be according to the standard details or drawings. Standard foundation cushion has a thickness of 6" for manholes and vaults and 12" for pump stations. Foundation cushion shall be placed in 6 inch layers and compacted with a power driven vibrator which will deliver a minimum of 1700 pounds impacts at 5,000 cycles per minute. In areas too small for vibratory equipment, a power driven tamper shall be used which will deliver a minimum of 300 foot pounds of impact per second and deliver 450 blows per minute.

MEASUREMENT; (Sec. 120.05)

Unless otherwise directed in the field, limits for foundation cushion will be based on the plans and details. Based on field conditions, the Engineer may direct the Contractor to perform subgrade repair (see Item 105, Subgrade Repair, As Directed).

No foundation cushion or material required for filling or correcting unauthorized excavation, or excavation which has been carried too deep or too wide through fault of the Contractor, will be considered for additional payment. Materials to facilitate construction based on the Contractor's means and methods and to create stone walks and working surfaces for workers will be considered incidental to the structure installation; no separate payment.

PAYMENT: (Sec. 120.06)

Payment for Foundation Cushion shall be included in the manhole, vault, pump station or structure that required foundation cushion per the plans and details.

BACKFILL MATERIALS

ITEM 130

WORK INCLUDED: (Sec. 130.01)

Unless specifically noted otherwise in the Contract documents, all excavations within 5' of pavement, the 1:1 zone of influence of paved surfaces, the 1H:1.5H zone of influence of a foundation/footing, and all backfill associated with a manhole, structure or pump station shall be backfilled with granular backfill per Item 130 - Backfill Materials.

Unless otherwise indicated in the plans, suitable native soil or non-granular material may be used as backfill in other areas that are not under/adjacent to pavement, drives or foundations.

No backfill shall be placed that is frozen, contains debris or contains earth.

Pipe bedding and cover material shall be placed in 6" layers until pipes have 12" of cover. Special attention shall be used to compact bedding under and around the sides of plastic pipe (which rely on the backfill for strength) per the manufacturer's recommendations. The remainder of the pipe trench backfill shall follow the requirements of this section. Backfill can be placed in 12" lifts (loose) when proper compaction equipment is used. Plate hand tampers are only to be used for loose lifts of 6" or less.

All work and materials described by this section shall be paid for under the Item which required the installation of backfill.

RELATED ITEMS: (Sec. 130.02)

Structure Excavation and Backfill	Item 100
Subgrade Repair	Item 105
Foundation Cushion	Item 120
Gravity Sewers	Item 1000
Pump Stations	Item 1800-1820
Forcemains	Item 1845

GRANULAR BACKFILL: (Sec. 130.03)

Granular backfill material shall be all natural, angular material such as crushed stone or gravel meeting ODOT Item 703.17 (304) or #57 crushed stone or as indicated in the plans. Aggregate must be obtained from an approved source. Recycled concrete will not be permitted. If the plans do not indicate a specific material, the above gradations must be used for granular backfill. Bank-run sand is not an acceptable backfill material.

All compaction requirements in this specification and on the standard drawings are based on the relative density expressed as a percentage for granular soils and the percent of the max dry density (standard proctor) for cohesive soils.

Granular backfill shall be placed without voids and thoroughly compacted. Granular backfill shall be placed and compacted until the density is not less than 90% relative density. If required, the Contractor shall dry or wet the granular material to maintain a moisture content within 2% of the optimum moisture content.

NON-GRANULAR BACKFILL: (Sec. 130.04)

Unless otherwise indicated in the plans, excavated materials may be used for backfill in areas that do not require granular backfill provided the material meets the following:

1. Minimum dry weight of 110 pounds per cubic foot.
2. No silt with Ohio Classification 4-B.
3. Liquid Limit less than 65.
4. If the Liquid limit is between 40 and 65, the minimum plasticity index allowable shall be calculated from the Liquid Limit minus 30.
5. Granular materials shall be smaller than 6" in all directions and may consist of rock, shale, sandstone and sand in which at least 65% of the materials will be retained on a #200 sieve.
6. No material larger than 2" in the top foot of embankment
7. Grade to accommodate topsoil and seeding or landscaping restoration.
8. Compacted to 85% relative density.

MEASUREMENT AND PAYMENT: (Sec. 130.05)

Backfill shall be considered incidental to the bid item that required the backfill. The cost of all materials and work described by this section shall be included in the item that required the backfill. No separate payment. The standard details shall not be the sole basis of determining the quantity of bedding and backfill materials required. The Contractor must consider their construction means and methods to account for the actual excavation and backfill quantities associated with the installation of pay items.

ADJUSTING, CONNECTING TO, ABANDONING AND REMOVING MANHOLES

ITEM 230

WORK INCLUDED: (Sec. 230.01)

The Contractor shall, under this Item, furnish all Labor, Materials and Equipment, excavation, bedding, backfill, dewatering, bulk-heading and services needed to adjust existing manhole castings, connect to existing manholes, remove manholes and to abandon manholes which are necessary for the proper completion of the work as shown on the Drawings and specified herein.

RELATED ITEMS: (Sec. 230.02)

Structure Excavation and Backfill	Item 100
Backfill Materials	Item 130
Manholes	Item 500

DESCRIPTION: (Sec. 230.03)

In general, the work shall consist of connecting pipe and/or casings to existing manholes as shown on the Drawings, the installation of all pipes, fittings and specials required for the connection of sewers to existing manholes, rebuilding/adjusting manhole risers, manhole removal or manhole abandonment, clean-up, installing and removing bulkheads as shown or as needed, and all appurtenant work.

GENERAL: (Sec. 230.04)

Item 230A – Manhole Casting Adjusted
This item involves the removal and adjustment of existing manhole casting elevations. Manufactured riser rings or sewer brick/mortar may be used for adjustments as approved by the County. All adjustments shall include the removal of unsound riser rings/bricks to a maximum depth of 12". The County shall be notified of failing manhole sections that extend more than 12" below grade. The exterior of all adjustments shall be coated with ½ inch thick coating of a heavy bodied, bituminous foundation sealant. The sealant shall extend from the casting to a line 3" below the casting or 3" below the recently installed riser materials, whichever is lower. With the approval of the County, existing castings may be reused.

Item 230B – Connection to Existing Manhole
Unless approved by the County Sanitary Engineer, manhole penetrations into existing manholes shall be cored and sealed with premanufactured boots/collars. Manhole penetrations shall be thoroughly sealed to the casing and/or the barrel of the pipe and all connections neatly made without projections or voids and shall be watertight. If directed, the bottom of the manholes shall be re-channeled and benched to a depth and width equal to the diameter of the pipe. Channels shall be smooth, curved where possible, and shall provide a clear, full width flow line. Channels shall be formed concrete with or without of pipe sections.

Item 230C – Manhole Abandoned
When called for on the Drawings, manholes shall be abandoned by sealing all pipe penetrations a minimum of 12'' into the pipe with brick and mortar or concrete. The upper portion of the manhole shall be removed to a minimum depth of 6' and the remaining structure shall be backfilled with ODOT 304 compacted in 12" lifts or low strength mortar.

Item 230D – Manhole Removed
Manholes to be removed shall be removed in their entirety and the remaining pipes plugged and abandoned or reconnected as directed by the Drawings. Castings in good condition shall be delivered to the County Sanitary Engineer's yard. Damaged castings and the removed manhole shall become the property of the Contractor for proper, legal disposal.

REMOVAL OF WATER: (Sec. 230.05)

The Contractor shall remove water from all excavations while the construction of structures, pipe lines, conduits or foundations is in progress. Dams, sumps, bulkheads, underdrains, pumping equipment, well points and temporary conduits of sufficient capacity shall be provided and kept in operation as required for this purpose. The Contractor shall provide for the disposal of all water removed from the excavations in such a manner as to prevent injury to the public; impairment of the public health; damage to public or private property; or any portion of the work completed or in progress; or the surface of the streets; and preclude any inconvenience to the public.

No pipe line, conduit or structure shall be laid or built in water, and water shall not be allowed to flow over or rise upon any concrete, until the work has been inspected and has set for at least twenty-four (24) hours. No water will be permitted to enter or flow thru a pipe line or conduit during installation without written permission of the Sanitary Engineer.

MAINTAINING FLOW: (Sec. 230.06)

The flow of water or sewage in existing sewers, drains, gutters of water courses encountered during construction shall be adequately maintained by the Contractor at his expense. Unless there is a separate pay item established for maintaining flow, the contractor shall maintain flow (provide temporary by-pass pumping) under Item 230.

EXCAVATION AND BACKFILL: (Sec. 230.07)

Excavation and backfill shall be consistent with the requirements of Item 100 – Structure Excavation and Backfill and is considered incidental to Item 230 - Repair and Reconstruction of Manholes and /or Inverts.

MEASUREMENT AND PAYMENT: (Sec. 230.08)

The Each price stipulated in the proposal for Adjusting, Connecting to, Abandoning or Removing Manholes shall include all labor, materials and equipment necessary to complete the work as shown on the Drawings and specified in Section 230.01 through 230.07. Pay Items under this Item include:

Item 230A Manhole Casting Adjusted (Ea)
Item 230B Connecting to Existing Manhole (Ea)
Item 230C Manhole Abandoned (Ea)
Item 230D Manhole Removed (Ea)

MANHOLES

ITEM 500

WORK INCLUDED: (Sec. 500.01)

The Contractor shall, furnish install and construct new standard manholes, shallow manholes, and drop attachments of the diameter indicated, where shown or directed, and as shown or specified. Work shall be complete for each manhole in place and ready for service including earth excavation, shoring, dewatering, backfill, precast sections, concrete, adjusting rings, frame and cover, steps, reinforcing steel, drops and testing. This Item shall not include the manholes or portions of manholes mounted on structures.

RELATED ITEMS: (Sec. 500.02)

Structural Excavation and Backfill	Item 100
Subgrade Repair, As Directed	Item 105
Rock Excavation	Item 110
Foundation Cushion	Item 120
Backfill Materials	Item 130

MATERIALS: (Sec. 500.03)

Manholes shall be constructed of precast reinforced concrete sections with precast monolithic concrete bases.

Manhole frames and covers shall be of the size and style shown on the Drawings. All covers on sanitary manholes on sewers shall have the Mahoning County Sanitary Engineer label per the details. Rim and covers shall be machined to prevent rocking of the covers. Manhole lids shall be watertight if subject to flooding or inundation; otherwise manhole lids shall be vented.

Steps shall be installed wherever shown on the Drawings. They shall be of cast iron, aluminum alloy or steel reinforced polypropylene plastic. Aluminum steps shall be 6061-T6 alloy and conform to ASTM B221.

All castings shall conform to ASTM Specifications A48, Class 35B Iron for gray iron and ASTM A536, Grade 80-55-06 for ductile iron.

All pipes entering or leaving precast concrete manholes shall be connected into the manhole using flexible rubber gaskets meeting ASTM Spec. C923. All joints shall be watertight. Inside joints shall be smooth.

Precast manhole sections shall meet the requirements of ASTM C-478.

Joints between adjacent manhole sections shall meet the requirements of ASTM C-443. Manhole joints and grade rings shall be sealed externally and between grade rings with a layer of mastic compound such as Fabertite, Kent Seal, Conseal or equal.

GENERAL: (Sec. 500.04)

See Item 100 – Structure Excavation and Backfill for excavation, shoring, dewatering and backfill requirements.

All manholes shall be set on compacted 6" foundation cushion that extends a minimum of 12" beyond the manhole base.

The bottom of manholes shall be channeled to a depth equal to the pipes radius and of a width equal to the diameter of the pipe Channels shall be smooth, curved where required, and shall provide clear flow line. Channels shall be of formed concrete or of pipe sections. Manholes shall be narrowed at the top to fit the cast iron frame and cover as shown on the Drawings. Manhole steps and toe pockets shall be set with uniform spacing not over twelve (12) inches center to center.

If pre-approved by the Sanitary Engineer, the Contractor may install a poured-in-place monolithic concrete base and precast manhole risers. Manhole bottom sections shall be thoroughly joined to the cast in place base and all connections neatly made without projections or voids, and shall be watertight. Care shall be taken to firmly place the bottom section, and to insure it is true and plumb.

Openings for pipes eighteen (18) inches and smaller entering above the top of the outlet pipe (as for drops) may be cut in the field. Pipes over eighteen (18) inches in diameter entering the manhole above the top of the outlet pipe shall be connected to the manhole by a tee connection precast with the barrel of the manhole.

Cone sections shall be of precast reinforced concrete of the same quality Materials specified for the manhole sections. Cones shall have a taper as shown on the Drawings and shall terminate approximately twelve (12) to fifteen (15) inches below finish grade.

Precast concrete rings shall be used to adjust the manhole frame and cover to the proper elevation.

Manhole steps shall be cast in place or grouted in place; they must be watertight. If grouted in place a non-shrink grout shall be used.

Methods of handling, unloading, cutting, and joining the manholes shall be approved by the Engineer. All manhole lift holes shall be sealed water tight with approved concrete plugs or a non-shrink grout or an expanding Portland Cement mixture such as Octoplug, Quikrete, Parsons Quick Plug or equal.

SHALLOW MANHOLES: (Sec. 500.05)

Shallow manholes shall be as shown on the Drawings and shall be similar in detail to standard manholes, except that, in order to obtain headroom, reinforced concrete slabs instead of cone sections shall form the top for manholes with less than 5' from the outside crown of the pipe to the proposed bottom of the coned section.

DEEP MANHOLES: (Sec. 500.06)

Manholes deeper than 28 feet require a stand-off platform and shall be designed by an engineer for County approval.

DROP ATTACHMENTS: (Sec. 500.07)

Drop attachments shall be external and shall be constructed of pipe encased in concrete and be of the size shown on the Drawings. The tee at the upper end of the drop pipe shall have the same diameter as the incoming pipe unless shown otherwise. The tee, the drop pipe, and the 90 degree ell, and the encasing concrete are considered a part of the drop attachment. The concrete encasement must bear on solid soil. All pipe comprising the drop connection and pipe within ten (10) feet of the drop connection must be restrained.

REMOVAL OF WATER: (Sec. 500.08)

No pipe line, conduit or structure shall be laid or built in water, and water shall not be allowed to flow over or rise upon any concrete until the work has been inspected and has set for at least twenty-four (24) hours. No water will be permitted to enter or flow through a pipe line or conduit during installation without written permission of the Sanitary Engineer.

Surface flow of water or flow in existing sewers, drains, gutters or water courses encountered during construction shall be adequately maintained by the Contractor at his expense. See Item 100 – Structure Excavation and Backfill for additional requirements.

VACUUM TESTING OF MANHOLES: (Sec. 500.09)

Each manhole shall be tested immediately after assembly and prior to backfilling. If the Contractor chooses to backfill prior to testing, he will be required to make any repairs that are necessary if the vacuum test fails at his expense.

All lift holes shall be plugged with an approved non-shrink grout.

No grout will be placed in the horizontal joints before testing.

All pipes entering the manhole shall be plugged, taking care to securely brace the plugs from being drawn into the manhole.

The test head shall be placed at the inside of the top of the cone section and the seal inflated in accordance with the manufacturer's recommendation.

A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9 inches. The manhole shall pass if the time is greater than the test times provided in the body of ASTM C-1244 (latest edition).

If the manhole fails the initial test, necessary repairs shall be made with a non-shrink grout while the vacuum is still being drawn. Retesting shall proceed until a satisfactory test is obtained.

In lieu of a vacuum test the Contractor may choose to perform an infiltration/exfiltration test on each manhole which shall conform to the testing requirements of Item 2000 – Testing of Pipelines and Sewers.

MEASUREMENT: (Sec. 500.10)

The number of manholes will be the number of manholes (of each type) installed, complete and accepted, including earth excavation, installation, foundation cushion, backfill, dewatering, shoring, waterproofing, frame and cover, invert channelizing, drops, stubs, pipes, plugs, steps, testing and all appurtenances complete in place. Drops shall be measured as shown in the details.

PAYMENT: (Sec. 500.11)

Payment will be made for each manhole or drop and shall include all labor, materials and equipment to complete the work as shown on the Drawings and as specified in this Section.

Item 500 – ___' Diameter Manhole (Each)
Item 500 – ___' Diameter Shallow Manhole (Each)
Item 500 – ___' Diameter Deep Manhole (Each)
Item 500 – 8"-12" Diameter Drop, ___' Tall (LF)
Item 500 – 15"- 18" Diameter Drop, ___' Tall (LF)

MAINTENANCE OF FLOW
(BY-PASS PUMPING)

ITEM 900

WORK INCLUDED: (Sec. 900.01)

The Contractor shall, under this Item, furnish all labor, materials, pumps, piping, tools and equipment necessary to maintain the continuous flow of sewage in the Sanitary Sewer System during the life of the Contract. Prior to construction, the Contractor shall provide a by-pass plan that includes the number and size of the pumps, the system design flow, the means of back-up power and the proposed maintenance/monitoring activity schedule.

RELATED ITEMS: (Sec. 900.02)

Manholes	Item 500
Gravity Sewers	Item 1000
Submersible Type Pump Stations	Item 1800
Grinder Pump Stations	Item 1820
Forcemains	Item 1845

GENERAL: (Sec. 900.03)

This Item covers the diversion of sewage flow around the work area in a manner that prevents system back-ups and maintains compliance with all EPA regulations.

Nothing shall be done by the Contractor which will in anyway reduce the flow of sewage in the sewer system or violate any water quality standards.

PERFORMANCE: (Sec. 900.04)

If, in the opinion of the Engineer proper controls for the maintenance of flow are not being provided by the Contractor, the Engineer may immediately take the necessary steps to provide corrective measures. The cost of such services will be deducted from any money which may be due or become due the Contractor.

The Contractor's system must be capable of passing wet weather flows and must include a back-up pump and backup power supply.

PAYMENT: (Sec. 900.05)

The lump sum price stipulated in the proposal for Maintenance of Flow shall include all labor, materials, pumps, piping, excavation, tools and equipment to complete the work shown on the drawings and described in the Specifications.

Item 900 – Maintenance of Flow (Lump)

GRAVITY SEWERS

ITEM 1000

WORK INCLUDED: (Sec. 1000.01)

The Contractor shall furnish all labor, materials, excavation, bedding, backfill and equipment and install and test all sewer pipe and service laterals which are necessary for the proper completion of the work as shown on the Drawings and specified herein.

If a bidder requires subsurface information in addition to the information provided by the County in order to provide a responsible bid, the Contractor shall coordinate with the County regarding site access. The elevations of the ground levels shown on the Drawings are believed to be reasonably accurate but are not purported to be absolutely accurate. The Contractor shall satisfy themselves as to the existing elevations and the work involved.

Prior to excavation, the Contractor is responsible for the development of a Dewatering, Excavation and Support Plan that is to be provided to the County. The Dewatering, Excavation and Support Plan briefly describe the OSHA compliant trench support and anticipated dewatering efforts that will be employed (pump locations, discharge points etc.). Based on the Contractor's proposed trench support and dewatering methods, the Plan shall address the need for settlement monitoring, preconstruction structure surveys and vibration monitoring. The geotechnical report (if available), the nature of the soils and the installation/removal of shoring shall be considered during the preparation of the plan. Dewatering, excavation support and monitoring of adjacent property is considered incidental to the excavation activities required to install sewers. If indicated on the Drawings or proposal documents, the County may require Vibration Control and Monitoring, As Directed or Preconstruction Structure Survey, As Directed (Lump) regardless of the Contractor's means and methods.

The Contractor shall make reasonable efforts to not "over-dewater" and impact wells or foundations located adjacent to the project site. Dewatered water wells shall be addressed under separate pay items.

RELATED ITEMS: (Sec. 1000.02)

Subgrade Repair, As Directed	Item 105
Rock Excavation	Item 110
Backfill Materials	Item 130
Maintenance of Flow	Item 900
PVC Sanitary Pipe	Item 1400
Concrete Sewer Pipe	Item 1500
Ductile Iron Sewer Pipe	Item 1600
Testing of Pipe Lines and Sewers	Item 2000
Tracer Wire	Item 2100

MATERIALS: (Sec. 1000.03)

All pipe and fittings furnished under this Item and the related Items shall be as designated in the Drawings and proposal and comply with the latest specifications for the respective pipe material. Materials acceptable to the County are identified in the table below.

Item No.	Material	Specification	Sizes	Max Depth (1)	Joint	Bedding (2)	Deflection Test	Leakage Test	Video Inspection	Approved Lateral Material
1400	PVC - Single Wall	ASTM D-3034 (SDR 35)	4"-15"	15'	ASTM D-3212	ASTM D-2321, CL I or II, Angular #67or #57 to 90% R.D.	Y	Y	Y	Y
		ASTM D-3034 (SDR 26)	4"-15"	22'						Y
1400	PVC - Large diameter, single wall	ASTM F-679	18"-36"	15'	ASTM D-3212	ASTM D-2321, CL I or II, Angular #67 or #57 to 90% R.D.	Y	Y	Y	N
1500	Reinforced concrete	ASTM C-76, CL III	24"-60"	30' < 36" 20' > 24"	ASTM C 443	ASTM D-2321, CL I or II, Angular #67, #57 or ODOT 304 to 90% R.D.	N	Y	Y	N
1600	Ductile Iron, PC200 (min.)	ASTM A-746	6"-24"	20'	ASTM C 111	AWWA C-600, Angular coarse sand to 90% R.D.	N	Y	Y	Y

(1) Max depth is the maximum depth that the County will consider the pipe installed in medium stiff soils (N>7) that are located in non-sand soils and installed per the specifications. Deeper installations, installations in soft soil and installations in sand are possible with site specific engineering considerations prior to approval.
(2) Except for larger concrete pipe, all pipe bedding (and pipe embedment) shall extend 12" above the pipe. The pipe embedment for concrete pipes larger than 18" may be reduced to 6" above the springline (rather than 12" above the top of the pipe).

DEWATERING, EXCAVATION AND SUPPORT PLAN: (Sec. 1000.04)

The Contractor shall prepare a Dewatering, Excavation and Support Plan. The Plan shall discuss the proposed means of excavation support, support removal, the potential impacts to adjacent structures and property and the need for settlement monitoring and vibration monitoring. The need to perform pre-construction structural surveys shall also be discussed. If an excavation is deeper than 20' (or as required by OSHA regulations), the Contractor shall hire a licensed engineer experienced in excavation support design to design excavation support system(s). The plan shall be provided to the County for a general review of the proposed work. The County will not approve excavation support and monitoring plans.

The work of dewatering trenches and excavations and the control of all surface and ground water whether by temporary ditches, grading, pumping, bailing, well pointing or otherwise is the responsibility of the Contractor. The Contractor shall protect the site and soils from inclement weather. Dewatering and control of water are considered incidental to excavation and grading; no separate payment. Conditions created by the failure to control water shall not be eligible for extra compensation. In general, excavations shall be dewatered to a level two feet (2') below the bottom of the excavation. No pipe shall be laid in water.

When the dewatering discharge contains silt, the Contractor shall discharge the water removed from the excavations to a siltation basin prior to discharge to the receiving stream or pipe. The Contractor must comply with all local and county requirements regarding discharges and run-off associated with construction activity.

All support plans shall address settlement of adjacent pavement, utilities and buildings. At a minimum, existing structures whose footings fall within a 1.5 H:1V zone of influence line of an excavation shall be monitored for movement. Elevations of control points shall be obtained at least 3 times (once per 24 hours) prior to any excavation or shoring activities to establish baseline

data. No fewer than two control points shall be placed and monitored for each building. Control points shall be distinct, solid points such as survey nails in concrete, screws extending from lag shields in block walls or other points not subject to interpretation. Control points shall be checked at the beginning and end of each work day and subsequent to any activity or occurrence which may have caused or indicated ground movement outside of the limits of the excavation support. The plan shall also address the removal of trench support and any special precautions to be taken if removal of the trench support is deemed possible. The need for vibration control and monitoring shall be discussed in the Excavation Support Plan. The above requirements are minimum requirements and may be expanded as required by the Contractor or the excavation support design engineer based on specific site conditions or the selected means and methods. The excavation support plan shall be provided to the County for a general review of the proposed work. The County will not approve excavation support or monitoring plans.

VIBRATION CONTROL AND MONITORING: (Sec. 1000.05)

If specified in the contract documents or deemed appropriate by the Contractor's excavation support and monitoring plan, the Contractor shall provide vibration control and monitoring per ODOT item 208.15, except the specialist's experience does not need to be specific to rock blasting. The Contractor's specialist shall provide the range of acceptable particle velocities.

PRECONSTRUCTION STRUCTURE SURVEY: (Sec. 1000.06)

If required by the contract documents or the Contractor's vibration specialist, the Contractor shall conduct a pre-construction survey of the selected buildings, structures and utilities. Inspection shall consist of contacting potentially affected structure owners to schedule inspections, photographs and/or videos of structures (interior and exterior) to note existing conditions including a narrative of structural defects or the lack thereof. The property owner should be afforded the opportunity to accompany the inspection and provide comments regarding pre-construction conditions. The property owner shall be provided a copy of the final summary document and supporting documentation upon request. Copies of said inspection documentation shall be provided to the County.

TRENCH EXCAVATION: (Sec. 1000.07)

The Contractor shall excavate trenches to a width sufficient to accommodate the pipe laying or work and any necessary sheeting and bracing, but in no instance shall the width at the top of the pipe exceed the minimum required to perform the work and repair any compromised pavement support. Pipe trenches shall be excavated to allow pipe bedding to be installed beneath the pipe. Bedding material per the specifications and details shall be compacted in place to bring the bottom of the trench to the proper elevation and provide recesses for pipe bells and fittings.

The Contractor is required to keep the sides of the trench adequately supported by use of suitable trench boxes, sheet piling, shoring, braces or other means to fully protect all workmen, adjacent structures, existing utilities and property. The County will not provide instructions to the Contractor relative to the need for, the type of or the installation means of such protection. The determination of the need for, the design of, and the installation of such protection shall be the sole responsibility of the Contractor. In the event any sheeting or bracing is ordered left in place by the Engineer, the same will be paid for at the price bid for Item 700.
The length of trench to be opened or the area of the surface to be disturbed at any one time will be limited by the Engineer (typically 50' without backfill or plating) with consideration to both expeditious construction and to the convenience and safety of the travelling public. Unless

otherwise ordered, the excavation of the trench shall be fully completed at least twenty (20) feet in advance of the construction of any part of the pipeline or conduit.

In no case shall more than one hundred (100) feet of trench be opened in advance of the completed work unless written permission of the Sanitary Engineer is obtained. When directed, in built up districts, and in streets where traffic conditions render it necessary, the Contractor will not be permitted to store excavated materials along the line of work, but shall remove such excavated materials from the first fifty (50) feet of the trench, and then using the successive excavation, when suitable, for immediate backfill, the last fifty (50) feet of the trench being backfilled with suitable materials furnished by the Contractor for this purpose.

When construction of the pipe is temporarily halted, the Contractor shall, when so directed, refill such trench or part thereof and temporarily repave over the same, if within a pavement, at his own cost and expense, and he shall not again open such trench or part thereof until he is ready to proceed with the construction of the work.

All materials excavated may be temporarily deposited along the excavation and beyond the reach of slides. Excavation spoils not required or suitable for backfill or grading shall be hauled away and disposed of as directed by the plans at the Contractor's expense. If the plans do not direct the location for the deposition of surplus excavation spoils, the Contractor shall remove and dispose of the materials at a legal off-site location.

All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Fire hydrants, valve pits, manhole covers, valve boxes, curb stop boxes, inlets, fire and police call boxes, or other utility controls shall be unobstructed and shall be fully accessible until the work is completed. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural water courses shall not be obstructed.

Rock requiring blasting or special equipment to excavate is included under the Item 110 - Rock Excavation.

If directed by the Sanitary Engineer, unsuitable, soft or spongy material encountered at the bottom of an excavation or discovered as a result of proof-rolling shall be removed and the void backfilled with compacted approved granular material. The cost of the removal and replacement of unsuitable subgrades shall be paid for under Item 105 – Subgrade Repair, As Directed. Payment for Subgrade Repair, As Directed shall be based on the cubic yards of materials removed and replaced.

BEDDING: (Sec. 1000.08)

No pipe shall be laid in water or on frozen trench bottom, or when in the opinion of the Sanitary Engineer the trench conditions or the weather are unsuitable for such work.

All sanitary sewer pipe 30" in diameter and smaller shall be installed with a minimum of 6" of bedding beneath the pipe. The bedding beneath the pipe shall be increased to a minimum of 12" for pipes larger than 30" in diameter. The bedding material shall be carried to 12" above the pipe to create a continuous, compacted pipe embedment. For concrete pipe larger than 18" in diameter, the pipe embedment only needs to extend to 6" above the springline of the pipe.

Bell holes shall be provided for all pipes. All bedding shall be hand sliced with a shovel along the pipe barrel to ensure the haunch area below the springline is well compacted and supportive of the pipe. Compaction shall occur immediately following hand slicing. Care shall be taken to prevent compaction equipment from impacting the pipe or compacting material into the pipe joint gasket.

Care shall be taken to keep rocks larger than 1" from entering the pipe embedment.

Clay dams (5' LONG x TRENCH WIDTH x FINISHED GRADE -3') shall be installed on each sewer branch entering or exiting a manhole and at each service lateral (at the R/W). Clay shall be compacted to 95% of maximum dry density. Clay may be approved on-site material. Bedding and backfill with granular material shall be suspended in locations of clay dams. Locate clay dams 10' from pavement if possible.

See the pipe material specifications for pipe specific bedding requirements. In all cases, the bedding and its installation shall meet or exceed the manufacturer's recommendations. If the requirements of the Sanitary Engineer do not meet the manufacturer's requirements, contact the Sanitary Engineer for direction.

INSTALLATION: (Sec. 1000.09)

Methods of handling, unloading, cutting and joining the pipe shall follow the approved practice as specified by the pipe manufacturer. Pipe and fittings shall be carefully examined by the Contractor and the Sanitary Engineer for defects just before laying. No pipe or fitting shall be used which is known to be defective. Pipe and fittings shall be thoroughly cleaned before being laid.

Pipe delivered for the installation shall be strung so as to minimize the entrance of foreign material. At the end of the day and at such other times that work is not in progress, all openings in the pipeline shall be closed by watertight plugs. Joints of all pipe in the trench shall be completed before work is stopped. If water accumulates in the trench, the plugs shall remain in place until the trench is dewatered.

Methods for determining grade shall be approved by the Sanitary Engineer.

The Contractor may use a laser beam for establishing line and grade. The method used shall be as recommended by the manufacturer of the laser equipment and must be satisfactory to the Sanitary Engineer. The laser beam shall not be of a greater power than 2.5 milliwatts. The continual visual check shall be provided by the laser equipment. The Contractor will provide reference points for line and grade in 50 foot intervals to make possible the efficient use of the laser beam equipment.

The Contractor shall not deviate from the approved line or grade without the written consent of the Sanitary Engineer.

Pipe larger than 18" shall be "homed" by using a winch or come-along and held in place with this equipment until the succeeding length of pipe has been properly bedded and is in position to be jointed.

No pipe shall be covered or backfilled until it has been examined and approved by the Sanitary Engineer's office.

SERVICE LATERALS: (Sec. 1000.10)

Service laterals shall be installed/reconnected in accordance with the requirements outlined in this Item, project specific requirements and the County's standard details. Service laterals include mainline Y branches, double Y branches, service stacks, lateral piping, fittings, marker stakes, and shall be 6 inches in diameter unless specifically shown or called for as a different size.

The County shall approve the installation of a lateral stack. Lateral stacks must be a minimum of 3' high to be paid for as a stack.

Unless indicated otherwise in the Drawings, each service lateral to an unserved lot shall be installed with a minimum slope of 2% and terminate at the Right of Way at the elevation shown in the Drawings. At the termination point, the lateral shall be no more than 2" above the elevation indicated or more than 12" below the elevation indicated. Direct connection of laterals to manholes shall not be permitted unless authorized.

Reconnection of existing service sewer shall consist of locating the existing service sewers, maintaining flow as required, disconnection of the existing service sewer from the existing trunk or street sewer, removal of existing service sewer as is necessary, securely plugging the discontinued service sewer, providing and installing adapters if connecting different types of pipe, and making a proper connection to the new service sewer while maintaining a minimum slope of 2%.

The location service laterals shall be installed as shown on the plans. If conflicts are discovered, coordinate with the Sanitary Engineer prior to proceeding.

Only one building shall be permitted to be connected to each building lateral unless approval is obtained for additional connections. Lateral connections to the main public sanitary sewer, up to and including 18 inch in size, shall be made through use of manufactured "core and seal" style fittings. Neatly cored holes with core bore seals and special fittings as recommended by the Manufacturer are approvable. If a core and seal style connection is not practical, the Sanitary Engineer may approve a cut-in wye or a tapping saddle connection. Lateral connections shall be installed utilizing a laser or grade bar devices.

In all cases the open ends of wye branches, service stacks and pipes shall be securely closed with carefully fitted stoppers which will not move during field testing. Open ends shall be sealed to prevent the entrance of water, earth or other substance into the sewer. Approved plastic stoppers may be used if they fit properly into the bell. All stubs shall be plugged unless connected to branch sewers or existing lateral connection.

Where curbs are available, the locations of the end of each service lateral shall be marked by a two (2) inch cross cut into the top of the curb on the side of the street to be served by the service sewer. Where there is no curb, the end of the lateral shall be staked with a 2"x2" x 24" long stake pounded 12" into the ground and labelled ("LAT").

The Contractor shall assist the County with generating "red-line" as-builts indicating the location and elevation of the laterals and describing the relative position of the mainline sewer and the laterals to other utilities.

BACKFILLING TRENCHES: (Sec. 1000.11)

After the compacted granular pipe embedment is placed over the sewer, the remainder of the trench shall be backfilled with care being taken not to induce any unequal loads on the pipe. The backfill shall be brought to the original ground elevation (while allowing for topsoil or pavement base) and the area restored to its original condition and normal ground contours. Excess excavation must be hauled from the site and not spread over immediate areas.

In locations where the trench has been excavated within the 1:1 zone of influence of pavement or 1.5H:1V zone of influence of a structure footing, the Contractor shall backfill with granular backfill material. Unless otherwise indicated in the plans, granular trench backfill and compaction shall comply with Item 130 – Backfill Material. In paved areas the Contractor shall top dress the excavated area with an approved aggregate or gravel and shall maintain said trench open to traffic and shall keep such areas devoid of potholes, ruts and any other features which contribute to hazardous and dangerous driving conditions. The gravel or aggregate used for maintaining streets, drives or parking areas will be considered for use in providing the required base material for permanent pavement. Note that backfill requirements will be suspended for areas of clay dams. Clay dams stop 3' below finished grade. Install granular fill above clay dams.

All compaction requirements in this specification and on the standard drawings are based on the relative density expressed as a percentage for granular soils and the percent of the max dry density (standard proctor) for cohesive soils.

Based on the field conditions the Sanitary Engineer **may** approve trench backfill consisting of suitable on-site material within the above areas. **If approved**, backfill consisting of site excavated material shall be compacted to 98% of the maximum dry density when placed within the zone of influence of structures, pavement, drives or walks.

Backfill consisting of suitable excavated materials may be used in landscaped areas outside of the Right of Way and shall be compacted to 92% of max dry density.

Excavated materials used for backfill as approved by the Sanitary Engineer or in landscaped areas outside the R/W shall meet the following:

1. Minimum dry weight of 105 pounds per cubic foot.
2. No silt with Ohio Classification 4-B.
3. Liquid Limit less than 65.
4. If the Liquid limit is between 40 and 65, the minimum plasticity index allowable shall be calculated from the Liquid Limit minus 30.
5. Granular materials shall be smaller than 6" in all directions and may consist of rock, shale, sandstone and sand in which at least 65% of the materials will be retained on a #200 sieve.

Voids beneath foundations or utilities resulting from unauthorized excavation or over-excavation shall be refilled with compacted granular material, low strength mortar or concrete as directed by the Sanitary Engineer, at no cost to the Owner.

All excavation, material, backfilling and other work resulting from slides, cave-ins, inappropriate dewatering, excavation, support failure, settlement, swellings or upheavals shall be at the Contractor's cost and expense.

Clay dams (5' LONG x TRENCH WIDTH x FINISHED GRADE -3') shall be installed on each sewer branch entering or exiting a manhole and at each service lateral (at the R/W). Clay shall be compacted to 95% of maximum dry density. Clay may be approved on-site material.

The maximum backfill lift shall be 8" for hoe-mounted tampers and 4" for walk behind compaction equipment.

FIELD TESTING: (Sec. 1000.12)

After the complete line, or a portion thereof, has been laid and backfilled, it shall be subjected to leakage testing in accordance with the Item 2000 - Testing of Pipe Lines and Sewers as approved by the Sanitary Engineer.

In Addition to leakage testing, the Contractor shall furnish all labor, materials and equipment and perform a deflection test (flexible pipe only) and a video inspection of all sewers in accordance with the Item 2000 - Testing of Pipe Lines and Sewers as approved by the Sanitary Engineer. Any section of pipe not passing the testing requirements or video inspection shall be corrected and re-tested at the Contractor's expense until the section meets the requirements.

CONCRETE CRADLE OR ENCASEMENT: (Sec. 1000.13)

Concrete used to encase or support the pipe at locations called for on the Drawings or required to properly support the pipe shall be paid for under the Concrete Item. Concrete used for the encasement of the vertical drop pipes, tees and ells associated with drop manholes, and for encasement of service stacks shall be included with the respective Item.

Wherever concrete bedding is used due to exceeding the measurements limits of the trench, no payment will be made for the concrete used. Concrete shall be as specified in the Item for Concrete. Care shall be taken to prevent flotation and point loading of the pipe. All concrete shall be placed on undisturbed earth or well compacted backfill.

ABANDONING EXISTING SEWERS: (Sec. 1000.14)

Where existing sewer lines are encountered during construction and are shown on the Drawings or determined by the Sanitary Engineer to be abandoned, all broken pipe shall be removed to a sound joint to permit proper placement of bedding and new pipe. A masonry plug shall be constructed of brick and mortar to completely seal the abandoned sewer from the infiltration of soil and water. The cost of abandoning existing sewers, including removal of broken and cracked pipe and installing plugs, shall be included in the unit price bid for installing new pipe.

CLEAN-UP: (Sec. 1000.15)

The Contractor shall clean-up adjacent surfaces immediately following backfilling, including removal of all surplus excavation, pipe, broken concrete, stones, and all miscellaneous debris. Rough grading providing surface drainage shall be included. Areas subject to erosion shall be immediately stabilized. Walks and pavement shall be swept to reduce sediment run-off and airborne dust issues.

MEASUREMENT: (Sec. 1000.16)

Mainline sewers shall be measured in the field. Payment will be based on approved pipe measured along the surfaces with deductions for manholes.

Service laterals shall be paid for based on the number of each type of lateral completely installed and tested as indicated on the Drawings. Laterals with stacks will be paid for under the appropriate stack pay item and the Service Lateral Stubbed to Property pay item. No stacks less than 3' high. Reconnecting sanitary laterals shall include a wye if necessary, couplings and up to 10' of service lateral piping.

PAYMENT: (Sec. 1000.17)

Payment for mainline sewers installed, tested and approved shall be based on the linear feet of field measured quantities. Payment for service laterals shall include the mainline wye or tee, fittings, connection to existing laterals and stacks as required by the drawings and details. Payment for all gravity sewers and laterals includes earth excavation, dewatering, shoring, materials, testing, bedding, backfill, tracer wire or tape and associated appurtenances and connection to structures as required by the Drawings and standard drawings.

No payment will be made for repairing house service sewers, or any public or privately owned utility line when broken because of carelessness on the part of the contractor, or when cut for the Contractor's convenience.

Unless called for on the plans and addressed by a separate pay item, excavation of trenches for gravity sewer installation shall be considered earth excavation. Unexpected rock excavation will be paid for based on the unit price for rock excavation in the Contractor's bid. If there was no bid item for rock excavation, rock excavation shall be paid for on a time and material basis.

Tunneled or cased piping shall be furnished, placed and paid for under separate Items. Sheeting and timbering or steel sheet piling ordered left in place and subgrade repair will be paid for under separate Items.

Item 1000 ___" (material) Sanitary Sewer (LF)
Item 1000 - Vibration Control and Monitoring, As Directed (Lump)
Item 1000 – Preconstruction Structure Survey, As Directed (Lump)
Item 1000 – __" Service Lateral Stubbed to Property (Each)
Item 1000 – __" Service Stack, 3'-5' High (Each)
Item 1000 – __" Service Stack, 5'-8' High (Each)
Item 1000 – __" Service Stack 8' – 12' High (Each)
Item 1000 – __" Service Lateral Reconnected (Each)

PVC SANITARY PIPE

ITEM 1400

WORK INCLUDED: (Sec. 1400.01)

The Contractor shall, under Item1000, shall furnish and install PVC sewer pipe and fittings as shown on the Drawings and specified under Item 1400. In general, the work shall consist of all materials and labor to provide dewatering, trenching, trench support, pipe, bedding, backfill, fittings and specials required for the construction of the sewers, laterals, risers, rebuilding or connection to existing sewers, house connections, clean-up, testing and all appurtenant work required for a complete installation and as shown by the Contract documents. Surface removal and restoration are covered under separate items.

RELATED ITEMS: (Sec. 1400.02)

Subgrade Repair, As Directed	Item 105
Rock Excavation	Item 110
Backfill Materials	Item 130
Gravity Sewers	Item 1000
Testing of Pipe Lines and Sewers	Item 2000
Tracer Wire	Item 2100

MATERIALS: (Sec. 1400.03)

Pipe, fittings and specials shall be the best quality, with integral wall bell and spigot joints and of the sizes and dimensions shown or specified. Pipe must be of the manufacturer's standard size and length.

PVC pipe shall meet the requirements of the latest version of ASTM D 3034 (small diameter single wall, up to 15"), ASTM F 679 (large diameter single wall, up to 36"). The pipe stiffness must be appropriate for the installation depth and bedding.

Each length of pipe shall be marked with the manufacturer's name, nominal diameter and "home" mark on the spigot end to indicate that the pipe is fully seated.

JOINTS: (Sec. 1400.04)

Pipe shall have gasketed type joints, providing a water tight seal. Joints shall conform to ASTM D3212.

Sealing rings, shall conform to ASTM F477, and shall be retained in a groove in the bell.

Joints for PVC pipe six (6) inches or under may be solvent cement joints. Solvent cement joints shall be installed per ASTM D2855 and the manufacturer's recommendations. Solvent cement for PVC piping and fittings shall conform to ASTM D2564. Glued joints shall be air tested 24 hours after installation

All field cutting of pipe shall be done in a neat, trim manner using a hand or power saw. Cut end shall be beveled using a hand file to produce a smooth bevel of approximately 15 degrees.

Pipe shall be lubricated and joined in accordance with manufacturer's recommendations.

All joints shall be fully seated.

LAYING PIPE; (Sec. 1400.05)

Pipe and fittings shall be installed per ASTM designation D 3212 'Underground Installation of Flexible Thermoplastic Sewer Pipe."

Pipe shall be uniformly supported throughout its length except for the bell holes required for the proper installation of the joints. The ends or shoulder of each pipe shall abut against the adjacent pipe in such manner that there will be no unevenness along the inverts. Bedding shall be ASTM D 2321 Class I or Class II. The bedding material shall be used for pipe embedment and extend 12" above the top of the pipe. The haunch area beneath the pipe shall be shovel sliced when the bedding/embedment material is one fourth of the way up the outside barrel of the pipe. Shovel slicing shall be immediately followed by compaction. Care shall be taken to not impact the pipe with compaction equipment. PVC pipe shall not be assembled using a backhoe or power equipment. Backfill shall start above the pipe embedment.

All bedding shall be placed on undisturbed earth or well compacted backfill. The material used for PVC pipe bedding shall be gravel or crushed limestone. The material used for bedding and pipe embedment shall be free from dirt and may be #57 or #67 angular aggregate (according to AASHTO M43) compacted to 90% relative density.

MEASUREMENT: (Sec. 1400.06)

See Item – 1000 – Gravity Sewers

PAYMENT: (Sec. 1400.07)

See Item – 1000 – Gravity Sewers

TESTING OF PIPE LINES AND SEWERS

ITEM 2000

WORK INCLUDED: (Sec. 2000.01)

The Contractor shall furnish the material, equipment, water, air, electricity and services required to perform the tests as described herein or as shown on the Construction Drawings.

The type of testing shall be approved by the Engineer.

The Engineer and a representative of MCSE shall witness the tests and accept the tests if appropriate. This approval, however, does not relieve the Contractor of his responsibility for a tight and satisfactory installation if leaks are found or subsequently develop.

The Contractor shall make a complete record of the tests to be attested by the Engineer.

Gauges, fittings, gaskets or delicate instruments installed in the lines shall be protected against damage or excess pressure during the test.

Any portion of the lines which do not meet the required tests, shall be repaired or replaced and retested by the same method used in the original test until a successful test is achieved, at the Contractor's expense.

Testing of portions of the installed pipe line or sewer may be waived by the Engineer if in their judgment, the testing is not essential.

Service lines shall be tested in accordance with the procedures, and meet the requirements, specified in the following applicable sections for the type of test being performed.

The Contractor shall verify the gaskets, fittings and seals associated with the section of pipeline to be tested (and pipelines that are connected to, but not necessarily the subject of testing) are able to withstand the required test pressures.

RELATED ITEMS: (Sec. 2000.02)

Gravity Sewers	Item 1000
PVC Sewer Pipe	Item 1400
Concrete Sewer Pipe	Item 1500
Ductile Iron Sewer Pipe	Item 1600
Water Line	Item 1700
Force Mains	Item 1845

TESTS REQUIRED: (Sec. 2000.03)

Tests shall be performed for the various piping as follows:

Section 2000.04 - Testing of Gravity Sanitary Sewers.

Section 2000.05 - Testing of Water Lines, Force Mains and Process Piping.

Section 2000.06 - Testing of Air, fuel gas and Plant Gas Lines.

Section 2000.07 - Testing of Plumbing Systems.

TESTING OF GRAVITY SANITARY SEWERS: (Sec. 2000.04)

Initial infiltration/exfiltration test: At every change in size, class, material and/or every 1200 feet or three (3) successive manhole sections, one (1) manhole section, as selected by the Engineer, shall be subjected to an initial infiltration/exfiltration test.

Final infiltration/exfiltration test: In addition to the above initial test, prior to acceptance of the works by the Engineer, a final infiltration/exfiltration test shall be conducted on all pipe and appurtenances. On PVC or ductile iron gravity lines only, a low pressure air test may be performed in lieu of an infiltration or exfiltration test as approved by the Engineer. No air tests for concrete pipe.

Ground Water Pressure: Before initiating an infiltration, exfiltration or low pressure air test, the natural ground water pressure shall be determined at the low end of the section to be tested. A capped nipple (1/2" min.) shall be provided in the manhole, at the top of the lowest pipe entering the manhole for this purpose. The cap shall be removed and an air jet used to blow the mud and debris out of the nipple and provide a pore space for the ground water to enter. A transparent plastic tube shall be attached to the nipple and extended vertically in the manhole. The water level in the tube shall be measured in feet from the invert of the pipe being tested. This measurement divided by 2.3 will give the pounds per square inch of external pressure on the pipe due to the natural ground water. After the ground water pressure has been determined and recorded on the test report, the plastic tube shall be removed and the cap replaced. Neither well points nor pumps which may have an effect on the ground water measurement shall be operating at the time of the test.

Type of Test: If the natural ground water in the plastic tube is observed to be at a level 2 feet above the top of the pipe at the high point of the section being tested, including service sewers, an infiltration test shall be performed.

If the level in the tube is less than 2 feet above the top of the pipe at the high point of the section being tested, an exfiltration test shall be performed.

Infiltration Test: The testing of a gravity sanitary sewer system shall be conducted as the line is being installed. No more than four (4) manhole to manhole reaches not to exceed 1200 lineal feet of pipe, whichever is less, shall be installed before testing is performed. The Contractor shall conduct a test for lengths less than four (4) reaches if requested. This test shall be performed after the branch and service sewer installed under this Contract have been completed and the ends securely plugged.

The permissible leakage for sewers tested by infiltration shall not exceed 100 gal/day/inch of pipe diameter/mile of pipe.

A ninety (90) degree sharp crested V notched weir shall be furnished and installed by the Contractor at the lower end of the Section of the line to be tested. The weir shall be installed properly, securely, with edges sealed watertight. The Engineer shall approve the installation.

After the Contractor and Engineer are in agreement that a maximum flow is being maintained through the weir, a reading of the height of the flow above the crest of the weir shall be taken by means of a hook gauge. The point of measurement shall be upstream from the weir a distance of 18" or 3 times the height of flow over the weir, whichever is greater. The area downstream of the weir shall be clear and allow

free-fall of the measured water. A minimum of 12" of free-fall is required below the invert of the v-notch weir.

The infiltration flow indicated by the height of the flow above the crest of a 90 degree (sharp-crested) weir is as follows:

Flow level above invert of weir	Gal per day
0.04 ft	516
0.08 ft	2,925
0.12 ft	8,060
0.16 ft	16,546
0.20 ft	28,900
0.25 ft	50,486

The allowable infiltration rate is determined as follows:
1 mile = 5280 feet
I - Allowable infiltration (gal)
L - Length of pipe in feet
D - Diameter of pipe in inches

$$I \text{ (gal per day)} = 100 \times \frac{LD}{5280}$$

If the measured flow exceeds the allowable flow the Contractor shall make the necessary repairs and retest until the infiltration rate is less than the allowable rate.

If the ground water level is above any of the service sewers, the LD of the service sewers shall be added to the LD of the mains sewers.

As an alternative to the weir method, the contractor may use a plug with a 2" pipe attached thereto in the lower end of the section being tested. The pipe shall discharge into a container of known volume and the flow measured accordingly and compared with the allowable infiltration rate.

Exfiltration Test: The testing of a gravity sanitary sewer system by the exfiltration method shall be conducted for each reach of pipe between manholes after the service sewers attached thereto have been installed as dictated in the "Type of Test" section above. **Excessive pressures in deep sewers may be an issue when testing shallow laterals and a deep mainline sewer at the same time. The Contractor shall verify the pressure rating of the gaskets prior to applying static water head or air pressure.**

The permissible leakage for sewers tested as described in this section shall not exceed 100 gal/day/inch of pipe diameter/mile of pipe.

The ends of the service sewers shall be securely plugged and the sewer main plugged at the manhole at the low end of the section being tested. This plug shall have a 2" tap for the installation of a 2" nipple with gage valve (with extended handle) attached. The hose for filling the line shall be connected to this valve.

Upstream manhole leakage: Any opening in the upstream manhole to a level of 4 feet above the top of the sewer to be tested shall be plugged including the end of the sewer to be tested. The manhole shall then be filled with water to a level of 3 feet above the top of the sewer or 3 feet above ground water level at the upper manhole to be tested, whichever elevation is greater. Allow the water to stand for 1 hour giving the manhole material time to reach its maximum absorption. Refill the manhole to the original 3 foot level and after 2 hours retention, check the loss of volume in the manhole which shall represent the leakage from the manhole.

Remove the plug in the sewer to be tested at the upper manhole and fill the sewer and upper manhole (by means of the 2" connection at the low end of the sewer) to the original 3 feet level in the upstream manhole or 3 feet above known ground water level at that point. Allow water to stand for 3 hours to give the sewers time for absorption. Refill the sewers until the level in the upstream manhole again reaches the original 3 feet level.

After 2 hours, check the drop in the water level in the upper manhole and calculate the loss in volume. From this measurement subtract the leakage loss in the manhole as determined previously. The net loss represents the loss in the sewer main and service sewers for 2 hours.

The exfiltration rate as measured shall be converted to a 24 hour basis and compared with the allowable exfiltration loss as by substituting the exfiltration rate (E) for the infiltration rate (I) in the formula on the previous page.

Low Pressure Air Test: After completing the backfill of a reach of sewer main with its connected service sewers, the Contractor may satisfy leak testing by conducting a low pressure air test using suitable equipment, preferably pneumatic plugs and a single control panel with approved gauges. Refer to the Uni-Bell PVC Pipe Association, Recommended Practice for Low Pressure Air Testing of Installed Sewer Pipe (UNI-B-6-98).

Before proceeding with the test, the pneumatic plugs shall be seal tested by inserting one in each end of a length of pipe and inflating the bladders to 25 psig. The sealed pipe shall then be pressurized to 9 psig. The plugs shall hold against this pressure without bracing and without movement of the plugs. However plug bracing or restraint is required to prevent plug expulsion.

If the pneumatic plugs check out satisfactorily, the main sewer and service sewers shall be cleaned and a plug inserted in each end of the main sewer at a manhole. The ends of the service sewers at the property line shall be closed and restrained with pneumatic plugs or other suitable means. Plugs shall be braced to insure against blowing out.

A pressure relief valve at the compressor shall be set at 10 pounds to protect the sewers from excessive pressure. A second pressure relief valve shall be incorporated into the system for additional protection. Pressure gauges shall be accurate to within +/- 0.05psi and have minimum divisions of 0.1 psi.

Low pressure air shall be introduced into the sealed sewer at the high end until the pressure registers 4 psig more than the ground water pressure, but no more than 9 psi. This pressure shall be held in the sewer for at least 2 minutes to allow the air pressure to stabilize. After the stabilization period, the pressure in the sewers shall be set between 3.5 psig and 4.0 psig more than the ground water pressure and the air supply shut off.

The portion of the sewer being tested shall be termed acceptable if the time required for the pressure to drop 1 pound is greater than the time shown in the tables below.

If the tables do not cover the sizes or lengths of pipe to be tested, the Engineer shall furnish the allowable time.

Note that there is only a table for PVC pipe. The PVC table can be used for Ductile Iron pipe. **Concrete pipe shall not be air tested.**

PVC PIPE AIR TEST PER ASTM F-1417
MINIMUM HOLDING TIME IN MINUTES:SECONDS
REQUIRED FOR PRESSURE TO DROP FROM 3-1/2 TO 2-1/2 P.S.I.G.

L	PIPE DIAMETER												
	4"	6"	8"	10"	12"	15"	18"	21"	24"	27"	30"	33"	36"
100	3:46	5:40	7:34	9:26	11:20	14:10	17:00	19:50	22:47	28:51	35:37	43:05	51:17
150	3:46	5:40	7:34	9:26	11:20	14:10	19:13	26:10	34:11	43:16	53:25	64:38	76:55
200	3:46	5:40	7:34	9:26	11:24	17:48	25:38	34:54	45:34	57:41	71:13	86:10	102:34
250	3:46	5:40	7:34	9:53	14:15	22:15	32:03	43:37	56:58	72:07	89:02	107:43	128:12
300	3:46	5:40	7:36	11:52	17:05	26:42	38:27	52:21	68:22	86:32	106:50	129:16	153:50
350	3:46	5:40	8:52	13:51	19:56	31:09	44:52	61:00	79:46	100:57	124:38	150:43	179:29
400	3:46	5:42	10:08	15:49	22:47	35:36	51:16	69:48	91:10	115:22	142:26	172:21	205:07
450	3:46	6:24	11:24	17:48	25:38	40:04	57:41	78:31	102:33	129:48	160:15	193:53	230:46

The pressure shown is for groundwater elevation below sewer invert; for each foot of groundwater above sewer invert, add 0.43 psi.

It is the option of the Engineer to schedule all testing and to require retesting.

If the installation fails to meet the test requirements, the Contractor shall determine the source of leakage and make all necessary repairs at their own expense.

No need to add time for laterals for PVC air pressure test.

If there has been no leakage (zero pressure drop) after 60 minutes, the test section is acceptable and the test for that section is complete.

Deflection Test: Deflection testing shall be performed on all flexible pipe in accordance with the Recommended Standards for Wastewater Facilities (G.L.U.M.R.B.), current edition. The test shall be conducted after the final backfill has been in place at least thirty (30) days to permit stabilization of the gravity pipe system.

No pipe shall exceed a deflection of five percent (5%). If deflection exceeds five percent (5%), replacement or correction shall be performed at the Contractor's expense.

The rigid ball or mandrel used for the deflection test shall have a diameter not less than ninety five percent (95%) of the base inside diameter or average inside diameter of the pipe depending on which is specified in the applicable current ASTM Specification, including the appendix, to which the pipe is manufactured. The test shall be performed without mechanical pulling devices.

Lines and Grades: The Contractor shall verify the line and grade as the line is being installed. No more than two (2) manhole reaches, not to exceed 800 lineal feet of pipe, shall be installed before verifying line and grade. The Engineer shall witness and approve the line and grade.

Video Inspection Upon completion of the sewer but prior to its acceptance by the Engineer, the Contractor shall provide the Engineer with a video of the interior of the completed sewer. The video shall be in color and shall clearly identify, both by audio and video, the section of sewer being inspected, including the time, date, and station in feet. The locations of service laterals, leaks, obstructions or deformed pipe shall be identified in the written log of each inspection run. The inspection logs shall be provided as a hard copy and a pdf. Audio and video shall be recorded on a standard 12cm digital video disk (DVD) or flashdrive having a minimum playback time of 120 minutes, color, with audio.

Engineer Inspection: The Engineer reserves the right to check the installation for alignment, grade and tightness by means of photography, television or other appropriate methods. Any portion of the sewer not conforming to the specifications for these requirements shall be repaired at the Contractor's expense.

TESTING OF WATER LINES, FORCE MAINS AND PROCESS PIPING: (Sec. 2000.05)

Description: A hydrostatic pressure test and a leakage test shall be applied to all force mains and water piping in accordance with AWWA Standard C-600 except as modified herein. Waterlines shall be tested with potable water and disinfected per AWWA C651. Process piping shall be tested in accordance with American Society of Mechanical Engineers ASME B31, latest edition.

Pressure Test: The Contractor shall furnish all required apparatus necessary to perform the tests. The Contractor is to verify that test pressures do not exceed the piping system allowable pressures (valves, gaskets, plug restraint etc.). After forcemains have been installed and partially backfilled (if applicable) all newly installed pipe, or any valved sections of it, unless otherwise specified, shall be subjected to a hydrostatic pressure test equal to 50 psi greater than the pump shut-off head. Watermains shall be tested to 150 psi unless otherwise directed by the plans. The duration of each pressure test shall be at least one hundred twenty (120) minutes. Pressure testing of concrete cylinder pipe shall be per the manufacturer's recommendations.

Each valved section of pipe shall be slowly filled with water to the specified test pressure, measured at the point of lowest elevation, by means of a pump connected to the pipe in a satisfactory manner.

Before applying the full test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at the point of the highest elevation, and afterward tightly plugged, or corporation cocks may be used.

All exposed pipes, glands, fittings, valves, hydrants, joints, etc., shall be carefully examined during the pressure test. All cracked or defective pipe, glands, fittings, valves, or hydrants discovered during this pressure test shall be removed and replaced by the Contractor with sound material and the test shall be repeated at the Contractor's expense until the installation is satisfactory to the Engineer.

For waterlines, the amount of water required to maintain the working pressure shall be measured at 20 minute intervals during the test. Leakage is defined as the quantity of water that must be supplied into the newly installed pipe line, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

Forcemains shall exhibit no leakage for the test period.
No water line piping installation using mechanical, push-on, bell and spigot or flanged joints shall be accepted if the leakage is greater than L as determined by the formula:

$$L = \frac{SD(P^{0.5})}{148{,}000}$$

L= the allowable leakage in gallons per hour
S= length of the line being tested, feet.
D= Diameter of pipe in inches
P= the average test pressure in pounds per square inch gauge

TESTING OF AIR, FUEL GAS AND PLANT GAS LINES: (Sec. 2000.06)

Description: The testing of air, fuel gas and plant gas lines shall be accomplished in accordance with American Society of Mechanical Engineers ASME B31, latest edition.

Any leaks that are indicated during the tests shall be corrected and the lines retested until a passing test is obtained.

Air Lines: After all piping and valves have been installed the Contractor shall test the system in accordance with American Society of Mechanical Engineers ASME B31.3, current edition, for air lines.

Plant Gas Lines: Lines in this service shall be tested as specified for air lines.

Fuel Gas Lines: Lines shall be inspected and tested in accordance with the utility owner requirements. If the utility owner is undetermined, the lines shall be tested in accordance with the National Fuel Gas Code ANSI/NFPA Z223.1/54, current edition.

TESTING OF PLUMBING SYSTEMS: (Sec. 2000.07)

Description: Pipe lines internal to building structures shall be considered plumbing systems and as such shall be tested in accordance with the National Plumbing Code, current edition. The testing of drainage and vent lines shall be performed with water or air. The final test shall be with smoke.

The tests shall comply with the methods approved by the reviewing Building Department and any local ordinances. A representative of the local administrative authority shall approve the tests and installation.

Hydrostatic Test: All vent and drainage lines shall be subjected to a hydrostatic test utilizing water under a minimum of 10 feet of head. The water shall be kept in the section or system being tested for 15 minutes before the inspection is started. The system shall show no visible leaks or drop in head for 15 minutes once the test has commenced.

A building sewer shall be tested by plugging the end at the connection to the main sewer and pressurizing with water with not less than a 10 foot head. Any leaks observed or indicated by a loss of head shall be repaired and the line retested.

Air Test: In lieu of the hydrostatic test, an air test may be performed. Air shall be injected into the system until a pressure of 5 psig is reached. This pressure shall be held without introduction of additional air for a period of at least 15 minutes and shall show no drop in pressure.

Smoke Test: A final test shall be made of the completed vent and drainage system. All traps shall be filled with water and a thick pungent smoke introduced into the system. When the smoke appears at roof stack openings, the stacks shall be closed and a pressure equivalent to a 1 inch water column shall be built-up and maintained for the duration of the inspection.

Water Piping: Hot and cold water lines shall be subjected to a stand-up pressure test not less than the working pressure under which the lines are to be used. The lines shall show no leakage with pressure maintained for 15 minutes. The water used for tests shall be obtained from a potable source.

Sterilization: If sterilization/disinfection of the potable water system is required by the local administrative authority it shall be the Contractor's responsibility to comply with such requirements. Payment for sterilization of plumbing systems shall be included in the Plumbing Item.

Certificate of Approval: Upon the satisfactory completion and final tests of the plumbing system a certificate of approval shall be issued by the Administrative Authority to the plumber to be delivered to the Engineer.

PAYMENT: (Sec. 2000.08)

Payment to the Contractor for testing as specified herein shall be included in the unit prices bid for the piping requiring testing. The testing of plumbing systems shall be included in the bid prices for the plumbing items which require testing.

TRACER WIRE

ITEM 2100

GENERAL: (Sec. 2100.01)

The work specified in this section consists of furnishing and installing a complete and tested tracer wire system with installation of non-metallic or non-conductive pipe. This work shall include all services, equipment, materials, and labor for the complete and proper installation, testing, complete restoration of underground utilities and site amenities.

Tracer wire is required for all buried, nonconductive pressurized and directionally bored utilities. The tracer wire shall be installed sufficiently near the utility to enable electronic locating of the utility. Where applicable, this wire shall be connected to any existing tracer wire at the main in a manner that ensures continuity of the tracer system. The connection shall be a manufactured splice system designed for underground installation.

Install electrically continuous trace wire with access points as described herein to be used for locating non-metallic pipe or conduits with an electronic pipe locator after installation. The wire shall be installed in such a manner as to be able to properly trace all pipelines and services without loss or deterioration of signal and without the transmitted signal migrating off the tracer wire.

RELATED ITEMS: (Sec. 2100.02)

Force Mains	Item 1450
Water Line	Item 1700
Horizontal Directional Bore	Item 1950

MATERIALS: (Sec. 2100.03)

Materials are defined as copper cladded conductors and appurtenances that become the installed product. Incidental materials that may or may not be used to install the product, depending on field requirements, are not paid for separately and shall be included in the cost of the installed product.

Waterline (Sec. 2100.031)

Tracer wire provided for detection of buried nonconductive water mains, hydrant branches and service lines other than directional bored shall be direct burial No. 12 AWG solid (0.0808” diameter), copper clad steel core tracer wire, 250 pound tensile break load with 30 mil high molecular-high density polyethylene jacket complying with ASTM D1248, rated for 30 volts. Color shall be “blue” for domestic (potable) water lines.

Forcemain (Sec. 2100.032)

Tracer wire provided for detection of buried force main other than directional bored shall be direct burial No. 12 AWG solid (0.0808” diameter), copper clad steel core tracer wire, 250 pound tensile break load

with 30 mil high molecular-high density polyethylene jacket complying with ASTM D1248, rated for 30 volts. Color shall be "green" for sewer lines.

Directional Bored (Sec. 2100.033)

Tracer wires provided for detection of directional bored water mains shall be 10 gauge minimum with blue high density polyethylene (HDPE) insulation in accordance with the physical and electrical properties of ASTM D1248. See Item 1950 – Horizontal Directional Bore for additional requirements.

Tracer wires provided for detection of directional bored force main pipe shall be 10 gauge minimum with green high density polyethylene (HDPE) insulation in accordance with the physical and electrical properties of ASTM D1248. See Item 1950 – Horizontal Directional Bore for additional requirements.

TRACER SYSTEM: (Sec. 2100.04)

Tracer wire shall be #10 or #12 conductor, as noted in Sections 2100.031 thru 2100.033, with a high molecular weight polyethylene (HMWPE) insulation having a minimum insulation thickness of 0.030 inches and suitable for direct burial applications.

Ground rod shall be a 3/8-inch diameter, 60-inch long steel rod uniformly coated with metallically bonded electrolytic copper.

Ground rod clamp shall be constructed of a high-strength, corrosion resistant copper alloy.

An inline resin splice kit with split bolt rated for 5kV conductor cables and lower, for use with single conductor and unshielded cable splices in direct bury and submersible applications, shall be provided. Branch connections for laterals, turnouts, services and appurtenances shall securely connect one or two wires to the main trace wire without cutting the main trace wire, effectively moisture seal the connection and be manufacturer approved for direct burial and submersible applications.

Tracer wire test stations as specified in Section 2100.05 shall be provided.

TEST STATION: (Sec. 2100.05)

Test stations shall be of the flush-to-grade type, complete with insulated terminal block having four (4) terminals. Cover shall be lockable, cast-iron, and have "WATER TEST", "SANITARY TEST" or "STORM TEST" cast in the cover. The test station shall be a 4-inch diameter, 18-inch long plastic shaft with a flared end to prevent removal.

INSTALLATION: (Sec. 2100.06)

Tracer wire shall be installed on all nonconductive water mains, hydrant laterals, water services (except where such water service pipe is of copper material) and storm and sanitary force mains. The wire shall be installed in such a manner as to be able to properly trace all water mains, hydrant laterals, water services and storm and sanitary force mains without loss or deterioration of signal and without the transmitted signal migrating off the tracer wire.

Trace wire shall be installed in the same trench and inside bored holes and casing with nonconductive pipe during pipe installation. In no case shall the tracer wire be wrapped around the pipe. It shall be

secured to the pipe as required to insure that the wire remains adjacent to the pipe. The trace wire shall be securely bonded together at all wire joints with an approved watertight connector to provide electrical continuity, and it shall be accessible at all new water valve boxes, water meter boxes, fire hydrants, sanitary and storm sewer cleanouts, air release valves and other appurtenances as applicable to the utility line being installed. For lines with more than five (5') feet of cover, the wire shall be installed directly over the pipe at a depth of five (5') feet.

Where access points for trace wire exceeds 500-feet, install test stations such that maximum access point spacing is 500 feet.

At the point of connection between cast or ductile iron water mains or force mains, with any nonconductive water main or force main, the tracer wire shall be properly connected to the iron pipe with a cad weld or approved equivalent. Tracer wire welds shall be completely sealed with the use of an approved mastic type sealer specifically manufactured for underground use. Mastic shall be applied in a thick coat a minimum of two (2") inches thick and shall be protected from contamination by the backfill material with the use of a polyethylene membrane.

Tracer wire shall be laid flat and securely affixed to the pipe at the midpoint of each pipe length (10-foot maximum intervals) per the tracer wire manufacturer's recommendations. The wire shall be protected from damage during the execution of the work. No breaks or cuts in the tracer wire or tracer wire insulation shall be permitted. At water service saddles or tapping sleeves, the tracer wire shall not be placed between the saddle or sleeve and the water main.

Except for approved spliced-in connections, tracer wire shall be continuous and without splices from service saddle to building wall, valve chamber to valve chamber, valve chamber to fire hydrant or fire hydrant to fire hydrant, etc.

At existing iron or copper water service connections where any portion of the water service is replaced with a non-ductile iron or non-copper material, a water service tracer wire shall be spliced into the water main tracer wire and then connected to the remaining iron water service by means of a cad weld, or the remaining copper water service using a ground clamp sized appropriately for the copper pipe.

At water service connections where there is no tracer wire on the existing water main and the water service connection is neither iron nor copper pipe, tracer wire shall be cad welded to the water main tee or tapping valve and placed along the water service to a point where the water service enters either inside the building or water meter chamber or valve box. The tracer wire inside the water meter chamber shall be brought up and attached under the access cover. The tracer wire brought into the building shall be left with a minimum of 1-foot of slack.

At all water main end caps, a minimum of 6-feet of tracer wire shall be extended beyond the end of the pipe, coiled and secured for future connections. The end of the tracer wire shall be spliced to the wire of a six pound zinc anode and is to be buried at the same elevations as the water main.

For directional drilling, augering or boring installations, two #10 tracer wires shall be installed with the pipe and connected to the tracer wire at both ends, or cad welded to the existing iron pipe at both ends. Reference Item 1950 – Horizontal Directional Bore Section 1950.055 for additional details.

Spliced connections between the main line tracer wire and branch connection tracer wire shall only be permitted at water main tees, crosses or at iron or copper water services where a portion of the branch connection water main or water service is replaced with a non iron or non copper material. The branch

connection tracer wire shall be a single tracer wire properly spliced to the main line tracer wire. Where the existing branch connection is neither iron nor copper, the new branch connection tracer wire shall be properly spliced to the existing tracer wire on the branch connection.

Bring double run of wire (two wires) to the surface of each test station location and terminate at internal terminal connections. At all repair locations where there is existing tracer wire, the tracer wire shall be properly reconnected and spliced as outlined above.

Install ground rods adjacent to connections to existing pipe and at locations shown on plans or as directed by the Engineer.

CONDUCTIVITY TEST: (Sec. 2100.07)

After the installation of backfill, the Contractor shall demonstrate the integrity of the underground tracer wire by applying a conductivity signal and confirming the signal on all nonconductive utilities and services. Conductivity test(s) shall be witnessed by the Mahoning County Sanitary Engineer.

The intent of this test is to confirm that the tracer wire has been installed on all nonconductive utilities and services as specified. Specifically, the test shall demonstrate the integrity and continuity of the tracer wire on all nonconductive utilities and services.

A continuity signal shall be applied to the tracer wire and the signal confirmed over the entire length of all tracer wire installed. The signal shall be detectable for a distance of at least 1000 feet from either side of the signal connection point. At no time shall there be a break in the continuity of the tracer wire.

The conductivity test shall demonstrate that the tracer wire on all services is connected to the main tracer wire and that the service tracer wire is intact for the length of the service.

The Contractor shall demonstrate that the tracer wire in chambers can be accessed from finished grade and that the signal is detectable on the nonconductive utility outside the chamber.

Acceptable means of undertaking the conductivity test include using traditional locating techniques and/or determining if a low voltage electrical current travels from the connection point to test points.

If the tracer wire will not pass current, locate the break in circuit and test until the tracer wire works in accordance with its intended use.

BASIS OF PAYMENT: (Sec. 2100.08)

There is no separate payment for the supply and installation of tracer wire on any construction or installation of non-ductile iron water main, hydrant laterals, non-copper water services and force mains by the Contractor. The Contractor shall consider the supply and installation of the tracer wire and appurtenances incidental to all construction of non-ductile water main, hydrant laterals, non-copper water services and force mains and any construction/installation of other related utility structures as specified in the contract.

SECTION – CIPP – FELT LINER
CURED-IN-PLACE-PIPE FOR SEWER LINE REHABILITATION

Description

A. Furnish all labor, materials, tools, equipment, and services for cured-in-place sewer line rehabilitation, in accordance with provisions of Contract Documents.

B. Completely coordinate work with other trades.

C. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

Intent

A. It is the intent of this specification to provide for the reconstruction of pipelines and conduits by the installation of a resin impregnated flexible tube which is inserted into the original conduit. The method of rehabilitation shall be Cured-in-Place-Pipe (CIPP) as described herein for the line (or lines) listed. This method includes cleaning and video-inspection of the designated line, identification of existing taps, removing of protruding taps by remote methods, performing point repairs, installation of resin-impregnated tube into existing pipe, followed by heat or ambient temperature curing as specified by the resin manufacturer, reinstatement of branch connections, testing and sampling, restoration of property, and cleanup. Before final acceptance, a post-rehabilitation video-inspection must be conducted and approved by the Owner and/or Engineer.

B. Rehabilitation must be completed full-length from manhole to manhole, resulting in a sound, tight-fitting watertight CIPP with a smooth interior.

C. The distances stated in the contract documents are an estimate of the lengths to be lined. The Contractor shall verify the lengths prior to construction. If lengths are found to be different than those shown, notify the Owner and/or Engineer.

Reference Standards

A. The listed standards are made a part hereof by such reference and shall be the latest edition and revision thereof:

1. ASTM C581 - Standard Practice for Determining Chemical Resistance of thermosetting resins used in glass fiber reinforced structures, intended for liquid service.
2. ASTM D543 - Test Method for resistance of plastics to chemical reagents.
3. ASTM D790 - Test Method(s) for flexural properties of unreinforced and reinforced plastics and electrical insulating materials.

4. ASTM D3681 - Test method for chemical resistance of reinforced thermosetting resin pipe in a deflected condition.
5. ASTM D5813 - Cured-in-Place, thermosetting resin sewer pipe.
6. ASTM F1216 - Standard practice for rehabilitation of existing pipelines and conduits by the inversion and curing of a resin-impregnated tube.
7. ASTM F1743 - Rehabilitation of existing pipelines and conduits by pulled-in-place installation of cured-in-place thermosetting resin pipe (CIPP).
8. ASTM D3567 - Standard practice for determining dimensions of reinforced thermosetting resin pipe (RTRP) and fittings.

B. In case of conflict between this specification and these referenced documents, the most stringent shall govern.

Environmental

A. It shall be the contractor's responsibility to comply with all applicable federal, state, and local regulations for this installation.

B. Containment of sewage and site cleanliness is the responsibility of the Contractor. Any fines levied by State and Federal agencies in the event of a spill or unapproved discharge due to Contractor's negligence shall be paid by the Contractor.

C. Spill cleanup as well as site cleanup shall be conducted by and paid for by the Contractor. All cleanups will be completed prior to final acceptance of the project.

Submittals

The Contractor shall submit to Owner the information below prior to or at time indicated. Failure to do so may be grounds for rejection of bid or will prevent progression of the work to the next step.

Submittal Item	Time of Submittal
1. CIPP System Data and Design Calculations Signed and sealed by a registered professional engineer	With Bid Documents
2. Manufacturer Resin Data Test Results	With Bid Documents
3. Resin Enhancer manufacturers Data	With Bid Documents
4. Bond Enhancer manufacturers Data	With Bid Documents
5. Certification of Applicability of Resin	With Bid Documents
6. Experience Record of Contractor	With Bid Documents
7. List of Sub-Contractors with Experience	With Bid Documents
8. Quality Control and Quality Assurance Programs	With Bid Documents
9. Location of Additional Access Points	At Pre-Construction Conference
10. Diversion of Pumping Plan (including Emergency Plans) Signed and sealed by a registered professional engineer	At Pre-Construction Conference
11. *Pre-Installation Video Inspection Tape	Before Wet-Out of Tube

12. Installation and resin Curing Schedule	Before Wet-Out of Tube
13. Curing Temperature/Time Log Sheets	After Completion of each section
14. Copies of Quality Control Tests	After Completion of each section
15. Tap Cut Sheets	After Completion of each section
16. CIPP Repair Methods (if required)	Before Repairs are Made
17. Point Repair/Sag Repair Methods (if required)	Before Repairs are Made
18. *Post-rehabilitation Video Inspection tape	Before final of Project
19. Daily Logs, Weekly Time Sheets	Weekly

*If pre and post Inspections are combined onto one video tape, submit copy after completion of each section lined.

Bid Information

A. Contractor shall list the information requested in this section and submit it with the bid.

B. Failure to submit required information with the bid may render the bid non-responsive and will be grounds for rejection of the bid.

Products

Resins

A. The resin system shall be a corrosion resistant polyester or vinylester system that, when properly cured within the tube composite, meets the requirements of ASTM F 1216 or ASTM F1743 as applicable, the physical properties herein, and those which are to be utilized in the design of the CIPP for this project. The resin used in this rehabilitation project shall produce a properly cured tube which will be resistant to abrasion caused by solids, grit, sand, and/or such items associated with domestic sewage.

B. The cured tube shall be resistant to corrosion due to acids and gases such as sulfuric acid, carbonic acid, hydrogen sulfide, methane, carbon monoxide and/or any such corrosive substances associated with domestic sewage.

C. Bidder shall submit, on 8-1/2" x 11” format paper, an infrared spectrography chemical fingerprint of the resin proposed for use with the bid document. This is part of the resin data test results.

D. Acceptable Resin Types:
1. Polyester
2. Vinylester
3. Epoxy

E. Bond Enhancers
1. Suitable bond enhancer shall be utilized with resin enhancer to increase bond between resins and other materials.
2. Bond enhancer used shall be in accordance with manufacturer's recommendations.

Resin Enhancers
1. Resin enhancers are permitted and may be used by the Contractor

2. Submit, with bid documents, certification from enhancer manufacturer that the material is suitable for use in aqueous environments.

G. Other Additives

Additives required for viscosity control, fire retardance, physical or chemical resistance, or pot life extension may be used provided they do not interfere with visual inspection of the finished installed product.

Carrier Tube

A. The tube shall consist of one or more layers of absorbent non-woven felt fabric and meet the requirements of applicable ASTM standards. The tube shall be constructed to withstand pressures to which it will be subjected, have sufficient strength to bridge missing pipe, stretch to fit irregular pipe sections, and shall fit smoothly around bends. The dry felt fabric shall have a minimum thickness of 6mm.

B. For work performed under this specification, the carrier tube materials may be non-woven polyester felt or non-woven fiberglass filament reinforced polyester felt.

C. The wetout tubes shall have a uniform thickness that, when compressed at installation pressures, will meet or exceed the Design thickness.

D. The tube shall be manufactured to a size that, when installed, will tightly fit the internal circumference and length of the original pipe. Allowance should be made for any circumferential stretching during inversion/insertion. Overlapped layers of felt that cause lumps in the final product shall not be utilized.

E. An inner liner or outer liner film used for resin control, which will remain a permanent part of the system, may be used, provided the liner film is made an integral part of the carrier tube by bonding or fusing to the carrier tube.

F. The tube shall be homogeneous across the entire wall thickness containing 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.

G. The wall color of the interior pipe surface of CIPP after installation shall be a light reflective color so that a clear detail examination with closed circuit television inspection equipment may be made.

H. Seams in the tube shall be stronger than the unseamed felt. Where the length requires joining, the joint shall not be perpendicular to the long axis but spirally formed.

Structural Requirements

A. The CIPP shall be designed as per ASTM F 1216. The CIPP design shall assume no bonding to the original pipe wall.

B. The layers of the cured CIPP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or the probe or knife blade moves freely between the layers. If separation of the layers occur during testing of field samples, new samples will be cut from the work. Any reoccurrence may cause rejection of the work.

C. The cured pipe material (CIPP) shall conform to the structural properties as listed below:

		Minimum Physical Properties With Resin per ASTM F 1216	400,000 psi Properties
	Test Method		
Modulus of Elasticity	ASTM D790 Short term	250,000 psi	400,000 psi
Flexural Stress	ASTM D790	4,500 psi	4,500 psi

D. The required structural CIPP wall thickness shall be based as a minimum, on the physical properties listed above in accordance with the design equations in the appendix of ASTM F1216, and the following design parameters:

1. Pipe Condition	Fully deteriorated
2. Soil Condition	Saturated
3. Design Thickness	10' and smaller diameter - calculated thickness rounded to next higher multiple of 1.5 millimeters
4. Ovality of Pipe	2% of circumference
5. Soil load	120lbs.ft^3
6. Live Load	AASHTO H-20
7. Soil Modulus	500 psi
8. Retention Factor for Long-Term Flexural Modulus to be used in Design	50% of initial (ASTM D-790)
9. Maximum Deflection	5%
10. Design Safety Factor	2.0
11. Resin Migration Allowance	5%

E. CIPP thickness for the work specified shall be calculated by the Contractor using the design parameters listed above, information on the attached site drawings, and as required to meet field conditions. Completed, installed CIPP must be equal to or thicker than the thickness calculated by these factors. Design parameters shall not be devalued in the event of an under-thickness CIPP. In no case shall the completed CIPP thickness be less than the calculated thickness or DR 35 whichever is greater.

System Requirements

The resin/tube system proposed shall be a type that has been used on a minimum of five projects which has passed field testing for initial modulus of elasticity, long term modulus of elasticity, initial flexural strength, thickness and chemical resistance.

EXECUTION

Preparation

A. The Contractor shall carry out his operations in strict accordance with all applicable OSHA standards. Particular attention is drawn to those safety requirements involving work on an elevated platform, entry into a confined space, trench safety, the use of steam and all other operations carried out by the contractor.

B. The Contractor shall prepare and submit an installation plan detailing the order of installation, dimensions of segments, and pertinent information to each segment of the pipe to be lined.

C. The Owner will assist in locating and designating all manhole access points and provide rights of access to these points.

D. Traffic control and safety are the responsibility of the Contractor. 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 a mutually agreed time period and notify police, fire, and ambulance departments.

E. The Owner shall provide access to water from fire hydrants for cleaning, inversion and other work items requiring water. The Contractor will comply with all requirements for fire hydrant use. Water for the project will be metered and paid for by the Contractor.

F. The Contractor shall give 24 hour notice to the Engineer prior to cleaning, wetout, and installation for each section of line.

G. The physical condition or structural integrity and flow rates/characteristics of the pipelines is unknown. The contractor shall be prepared to take appropriate action in a prompt manner.

H. The Contractor shall remove all internal debris out of the sewer line that will interfere with the installation of CIPP. The material removed must be disposed of by the Contractor in accordance with all applicable federal, state and local laws. Any hazardous waste material encountered during the project will be considered a changed condition.

I. The Contractor shall provide for the flow of sewage around the section or sections of pipe designated for repair. The pump and bypass lines shall be of adequate capacity and size to handle the entire flow. The Contractor shall be responsible for all installation, operation, and maintenance of the system. Manpower, fuel, and necessary utilities required by the systems shall be provided by the Contractor.

Ready-use, stand-by pumping shall be achieved by backing up pump size for size (100% back-up capacity) in case of emergency situations, equipment malfunction, or higher than anticipated flow. A detail of the bypass plan shall be d submitted to the Engineer.

J. Inspection of pipelines shall be performed by experienced personnel trained in locating breaks, obstacles and service connections by close circuit television. The interior of the pipeline shall be carefully inspected to determine the location of any conditions which may prevent proper installation of CIPP into the pipelines, and it shall be noted so that these conditions can be corrected. A video tape and suitable log shall be kept for later reference by the Owner.

K. Line Obstructions - It shall be the responsibility of the Contractor to clear the line of obstructions such as solids, roots, and other materials that will prevent the insertion/inversion of CIPP. If pre-installation inspection reveals an obstruction such as a dropped joint or a collapse that will prevent the inversion process, and it cannot be removed by conventional sewer cleaning equipment, then the Contractor shall make a point repair excavation to uncover and remove or repair the obstruction. Cleaning and point repairs must be approved by the Owner and/or Engineer before the lining operation begins. If a line is returned to service temporarily before lining, recleaning of the line is required.

L. Public Notification. –
   1. The Contractor shall make every effort to maintain service usage throughout the duration of the project. In the event that service will be interrupted, the maximum amount of time of no service shall be 12 hours for any property served by the sewer. A public notification program shall be implemented, and shall as a minimum, require the Contractor to be responsible for contacting each home or business connected to the sanitary sewer and informing them of the work to be conducted, and when the sewer will be off-line.
   2. A person employed by the contractor (contact) shall be appointed to handle complaints or questions from customers regarding the work. The contact shall be equipped with a cellular phone and be on call 24 hours per day. The Owner will refer all customer calls concerning the work to the contact, who shall have the authority to rectify problems promptly and completely.
   3. Written notice shall be delivered to each home or business describing the work, schedule, how it affects them, and the local telephone number of the contact. This notification shall be done at the beginning of the project.
   4. Personal contact and attempted written notice shall be given to each customer the day prior to the beginning of work being conducted on the section relative to the customer affected.
   5. Personal contact shall be made with any home or business which cannot be reconnected within the time stated in the written notice.

M. The Contractor shall be responsible for confirming the locations of all branch service connections prior to insertion/inversion and curing the CIPP.

Installation

A. CIPP installation shall be in accordance with applicable ASTM requirements with additional requirements as listed herein.

B. Installation of the wetted out carrier tube may be by inversion or insertion as preferred by the Contractor. All equipment, labor, and materials required to complete the work must be ready on-site before installation begins.

C. The Contractor shall designate a location where the fiber tube will be impregnated ('wet out') with resin to thoroughly saturate the fiber tube prior to its dispatch for installation. The Contractor shall inform the Engineer in advance to allow inspection of the materials and the wet out procedure.

D. Unless the Contractor uses the "over-the-hole" wet out method, the resin impregnated tube shall be transported and kept in a refrigerated truck until it is installed in an existing line by using an application of water, air, or cable and winch properly placing the tube between the upstream and downstream manholes.

E. A catalyst system or additive(s) compatible with the resin and tube may be used for viscosity control as provided by the manufacturer. The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the loss of resin through cracks and irregularities in the original pipe wall. A vacuum impregnation process shall be used. 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 installer uses an alternate method of resin impregnation, the method must produce the same results. Any alternate impregnation method must be proven prior to installation.

F. At all locations where the CIPP liner is to be inverted into the host pipe, a preliner tube shall be used to control resin loss, liner thickness, and prevent blocked or plugged service and lateral lines. Installation of the preliner tube shall be witnessed by the Owner and/or Engineer. Failure to install the required preliner tube or installation of preliner tube over only part of the segment shall result in the completed CIPP for that segment being rejected. During thickness testing, the preliner tube shall be removed from the thickness test core sample along with any inner liner film used.

G. When using the inversion method, the tube end shall initially be turned inside out and attached to a platform ring, standpipe, or as approved. The addition of water or air pressure will be adjusted to sufficient height/pressure to cause the impregnated tube to invert from manhole to manhole, and hold the tube tight against the existing pipe wall so as to produce dimples at service connections and flared ends at manholes.

H. When using the insertion method, the tube is winched into position according to manufacturer's recommendations. The addition of water, air, or steam pressure will be adjusted to sufficient height/pressure to cause the calibration hose to invert from manhole to manhole and hold the tube tight against the existing pipe wall.

I. After installation of the CIPP is completed, the Contractor shall use a suitable heat source and recirculation system capable of delivering the required amount of heat uniformly throughout the section for a complete cure of the resin. The curing temperature and schedule shall be as recommended by the resin/catalyst system manufacturer. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing heat supply. Another such gauge shall

be placed inside the tube at the invert level at the remote end to determine the temperature at that location during the cure cycle. Initial cure may be considered completed when the exposed portions of the CIPP appear to be hard and the remote sensing device(s) reflect that the cure temperatures, as recommended by the resin/catalyst system manufacturer, have been achieved. Temperatures from each remote sensing device shall be recorded by a strip-chart recorder on a continuous tape. The strip-charts shall be submitted to the Engineer upon completion of each section. Curing temperatures and schedule shall comply with submitted data and shall include an adequate "cool down" as recommended by the resin manufacturer.

J. The Contractor shall cool the hardened pipe to a temperature below 100 degrees Fahrenheit, in accordance with the resin manufacturer's recommendation, before relieving the water column or pressure. Cool water may be added to the water column while draining hot water from a small hole at the opposite end of the cured-in-place-pipe, so that a constant water column height is maintained until cool-down is completed. Care shall be taken in the release of the water column so that a vacuum will not develop that could damage the newly installed pipe. Fluids released into the sewer line shall not exceed 110 degrees Fahrenheit.

K. The finished new cured-in-place-pipe shall be continuous over the entire length of each section lined, and be free from visual defects such as foreign inclusions, dry spots, pinholes and delamination.

L. The CIPP shall make a tight seal at the manhole opening with no annular gaps. Under all circumstances the liner shall be sealed to the manhole and host pipe with quick-set epoxy mortor. This procedure shall be completed before proceeding to the next manhole section.

Service Connections

A. After the pressure has been relieved and the CIPP has been cured, the Contractor shall reinstate the existing active service connections. A minimum relaxation period as recommended by the Manufacturer will be required of Contractor prior to the connection of service laterals. Prior to installing the CIPP pipe, the Contractor shall verify that service connections are active by introducing dye into the service lines at cleanouts, vent stacks or other access points as approved by the Owner and recording by closed circuit television inspection the location in the main line where the dye appears. All addresses will be noted on log sheets for future reference. The closed circuit television camera shall be equipped with a swivel head and shall pivot to provide a view into each service line both before and after reinstatement. Reconnection of inactive services will be determined by the Owner and/or Engineer.

B. Service connections shall be reinstated by one of two methods. Where service connection can be shown as utilizing a saddle container or inline tee, an interior connection shall be performed as described below. Where service connections are found to be protruding, they shall be trimmed by a remote method inside the pipe and an interior connection shall be performed as described below. If the connection is found to be defective (i.e, end of service connection is broken away, irregular such that the full circumference of the service line would not contact with the pipe, or excessive root infiltration as determined by the Owner and/or Engineer) a reinstatement of the service connection by excavation and reconnection shall be performed as described below.

C. Interior service connections shall be performed without excavation. Service connections shall be reinstated by means of a swivel head television camera and a cutting device that re-establishes them to not less than 95 percent of capacity. Service connections shall be cut in with neat and smooth circumferential lines to prevent snagging of debris and/or solids. Cutting devices that use high pressure water shall not be used since they may cause damage to the lateral. The service shall be brushed smooth upon completion. The Contractor shall certify that he has a minimum of two complete working cutters plus spare key components on the site before each inversion/insertion. Contractor shall provide a physical demonstration, in the presence of the Owner's representative, to show the assurance of a water tight seal of all service connections.

D. Excavation and reconnecting service connection using an approved saddle that is compatible to the CIPP. The Contractor shall remove the appropriate amount of carrier pipe to allow the saddle to be directly connected to the outside wall of the cured-in-place-pipe. An epoxy, meeting the manufacturer's recommendations, shall be applied to the saddle to assure a water tight seal between the saddle and pipe. The saddle shall be secured with stainless steel bands. After the epoxy has set and prior to backfilling, the Contractor shall seal any open annular space between the existing sewer and new CIPP pipe with a non-shrink grout. The lateral line shall be replaced from the saddle to the property line. Connections of the new lateral line to the existing lateral shall be made using elastomeric boots, full-encirclement clamps, or by other methods as approved by the Owner's representative. The Contractor shall then completely encase the saddle in concrete. The lateral line shall be embedded in sand as specified. Care shall be used not to damage the pipe. If damage occurs as a result of the Contractor's operations, the Contractor shall assume all cost associated with the repair of the pipe. Prior to any backfilling, the Owner and/or Engineer shall inspect each tap and lateral line connection. Any taps and/or lateral lines backfilled prior to inspection shall be excavated by the contractor for an inspection at no additional cost to the Owner.

Repair of Previously Installed Lines

At locations where access to a previously lined pipe is required, the liner shall be neatly cut and set aside. To repair the existing liner, the removed liner piece shall be bonded in place using a high viscosity epoxy followed by covering the joint with resin-saturated 6mm felt strips. When cured, cover the repaired area with concrete to a minimum thickness of four inches. The repair joint must be approved prior to covering with concrete.

Testing and Inspection

A. The CIPP shall meet the chemical resistance requirements of ASTM F 1216 or ASTM F 1743 as applicable. CIPP samples for testing shall be of tube and resin system similar to that proposed for actual construction. It is required that CIPP samples with and without plastic coating meet these chemical testing requirements.

B. Overall, the hydraulic profile shall be maintained as large as possible. The CIPP shall have a minimum of the full flow capacity of the original pipe before

rehabilitation. Calculated capacities may be derived using a commonly accepted roughness coefficient for the existing pipe material taking into consideration its age and condition. The roughness coefficient of the CIPP shall be verified by third party test data.

C. CIPP Field Samples -

1. The Contractor shall submit test results from previous field installations in the USA of the same resin system and tube materials as proposed for the actual installation. These test results must verify that the CIPP physical properties specified in the material requirements of this specification have been achieved in previous field applications. Testing samples from the CIPP for this project shall be prepared and physical properties tested in accordance with ASTM F l216 or ASTM F l743 as applicable.
2. The modulus of elasticity, flexural strength, and thickness must meet or exceed the value used in the design as set forth herein. The resin used must match the originally submitted infrared spectrography chemical fingerprint of the proposed resin.
3. One test from the first section of line segment will be required for structural requirements. After results are obtained from the initial test, if passing, two additional sections will be tested as randomly selected by the Engineer. If not passing, the Contractor will test the next line segment in the same manner. Two 6"xl6"cured plates shall be taken from the end of each segment of line. Both plates shall be delivered to the Engineer unless the segment is to be tested. If the segment is to be tested, one plate shall be tested by the contractor, the other shall be delivered to the Engineer. Testing shall be performed by an independent laboratory approved by the Engineer. If any test fails, an additional segment will be tested by the Contractor at a location selected by the Engineer.
4. Two tests from each section of each line segment will be required for thickness requirements. Two cores of two-inch diameter shall be taken from the top of the pipe by the Contractor. The core thickness will be measured in the presence of the Owner and/or Engineer. The thickness measurement shall deduct any inner liner film thickness. Three thickness measurements shall be taken from each sample. The resulting six measurements will be averaged. The average thickness shall be equal to or greater than the required thickness for the particular section stated in the bid form. No undersize allowance is permitted.
5. One resin sample from each liner section shall be taken by the contractor and prepared in an acceptable sampling container and delivered to the Engineer. The sample shall be a minimum of 4 ounces of liquid resin properly prepared for testing.
6. Values for (1) the initial modulus of elasticity (ASTM D-790), (2) initial flexural strength (ASTM D-790) and (3) thickness calculated in the structural requirements which are under the values calculated are not acceptable. An under thickness CIPP may be brought into compliance at no additional cost to the Owner by (1) removal and replacement of the undersized CIPP, (2) addition of a second thin CIPP (after acceptable preparation of the undersized CIPP interior), or (3) by another method approved and accepted in writing by the Owner.
7. Resin used which does not match that which has been originally proposed will be grounds for requiring removal and replacement of the liner.

D. Leakage testing of the CIPP shall be accomplished during cure while under a positive head. CIPP products in which the pipe wall is cured while not in direct contact with the pressurizing fluid (e.g. a removable bladder) must be tested by an alternative method approved by the Owner.

E. Reports shall be submitted on 8-1/2" x 11" paper. Larger drawings shall be folded to this format. Submittals shall be stamped by Contractor to indicate Contractor, date of submittal, Owner's project title and number, applicable section of specifications to be referenced, and signature of preparer.

F. Inspection of pipelines shall be performed by experienced trained personnel by closed circuit television. The interior of the pipeline shall be carefully inspected in accordance with ASTM F1216 or ASTM F1743 as applicable. Video tapes shall be submitted in a plastic protective box, labeled to indicate Owner's project number and name, date of video inspection, section of line, Contractor's name, and whether pre-installation or final inspection video tape (or both).

MEASUREMENT:

The length of CIPP liner pipe shall be the total number of lineal feet of each size actually furnished and placed, measured along the axis of the pipe after the pipe has been connected in place. The inside diameter of manholes shall be deducted. No deductions shall be made for the length of fittings or specials left in the sewer line.

PAYMENT:

The unit price stipulated in the proposal for each category covered by this Item shall include all labor, materials and equipment to complete the work as shown on the Drawings and specified in this section.

No payment will be made for repairing house service sewers, or any public or privately owned utility when broken because of carelessness on the part of the Contractor, or when cut for the Contractor's convenience.

The CIPP installed under this Item shall be paid for as specified under the reference Item for the CIPP pipe.

SECTION 011100 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 LOCATION OF THE PROJECT

A. The project is located at 5555 Market St, Youngstown, OH 44512.

1.2 PROJECT DESCRIPTION

A. The bid documents consist of two parts, Part A being the relocation of existing Mahoning County sanitary sewer on the site, and Part B being the stormwater infrastructure improvements, stream channel design and related site improvements.

In summary, the project consists of improvements to existing stormwater infrastructure by daylighting an existing twin 60" CMP storm sewer flowing from south to north, through the Forest Lawn property. The existing conveyance path once managed by buried infrastructure is proposed to be developed into a naturalized stream channel with instream design features and site features to promote public access and engagement to the Park. The scope of work includes removal of existing storm piping, underground detention system, earthwork and grading of the site, design and implementation of stream channel design features, relocation of an existing Mahoning County sanitary sewer line that runs through the site, installation of trails, seating areas, plaza, landscaping, fencing and furnishings.

This project is a stream and floodplain restoration project. The Owner intends to select a qualified contractor with demonstrated experience in accordance with the descriptions below. The Contractor and/or subcontractors must be qualified in restoration construction activities as well as sewer construction. The Contractor shall insert project summary sheets in the bid documents (See BF.4 - Experience Record) to document restoration specific work experience.

In particular the Owner desires a contractor (and/or subcontractor(s)) who has experience in stream restoration and floodplain restoration. This includes;

Work in waterways in accordance with USACE, NRCS, ODNR, County and any other applicable jurisdictional requirements and permitting.

Sensitivity and use of sustainable construction methods which promote ecology and limit erosion both during and after construction.

Installation of grade control structures (i.e. cross-vane structures), various types of riffles, pools, log sills, root wads, coir (coconut fibre) matting, planting mixes, plantings, live stakes, and boulders in accordance with specific placement, spacing, material, and embedment details.

Prompt establishment of erosion protection and vegetation.

Natural stream restoration including particular vegetation and woody material and with special attention to bank grading and floodplain grading meeting closely the intent of the provided cross-sections and grading plan.

Sourcing of select bed material, wood/log, plantings, planting mixes, live stakes, soil, boulder, rock/boulder material, and other materials as required by the plans and specifications.

Woody debris, log sills, and natural bank stabilization techniques including direction of construction, coir rolls/ matting, and live stakes and materials listed above and in the plans.

This project includes the relocation of a County sanitary sewer. The Owner intends to select a qualified contractor with demonstrated experience in construction of sanitary sewer systems.

It is expected that the bidder will submit Bid Form "BF.4 - Experience Record" numerous project examples of work completed in the last 5 years which make clear to the Owner that the bidder has considerable experience with the methods and materials necessary to successfully complete this project, both Part A and Part B.

1.3 SPECIFICATIONS

A. In general, these Specifications describe the work to be performed by the various trades, other than work specifically excluded. It shall be the responsibility of the Contractor and Subcontractors to perform all work incidental to their trade, whether or not specific mention is made of each item, unless such incidentals are included under another Item.

B. It is advised that the Contractor and all Subcontractors familiarize themselves with the contents of the complete Specifications, particularly for the trades preceding, following, related or adjacent to their work.

END OF SECTION 011100

SECTION 011419 – USE OF SITE

PART 1 - GENERAL

1.1 GENERAL

A. The Contractor will be allowed the use of as much of the site designated for the improvements as is necessary for his operation.

1.2 USE OF STREETS

A. During the progress of the work, the Contractor shall make ample provisions for both vehicle and pedestrian traffic on any public street and shall indemnify and save harmless the Owner from any expense whatsoever due to their operations over said streets. The Contractor shall also provide free access to all the fire hydrants, water, and gas valves located along the line of his work. Gutters and waterways must be kept open or other provisions made for the removal of storm water. Street intersections may be blocked only one-half at a time, and the Contractor shall lay and maintain temporary driveways, bridges and crossings, such as in the opinion of the Engineer are necessary to reasonably accommodate the public.

B. In the event of the Contractor's failure to comply with these provisions, the Owner may cause the same to be done, and may deduct the cost of such work from any monies due the Contractor under this Agreement, but the performance of such work by the Owner at its instance shall serve in no way to release the Contractor from his general or particular liability for the safety of the public or the work.

C. The Contractor shall repair at no cost to the Owner, all existing roads, parking areas, grassed areas that are damaged due to the execution of his work. The Contractor shall remove daily all mud, soil and debris that may be tracked onto existing streets, drives, or walks by his equipment or that of subcontractors or suppliers.

1.3 CLOSING STREETS TO TRAFFIC

The Contractor may with the approval of the Engineer, close streets, or parts of streets, to vehicular traffic. The streets are to remain closed as long as the construction work or the condition of the finished work requires or as determined by the Engineer. The Engineer shall be the judge of how many streets or parts of streets it is necessary for the Contractor to close at any time, and may refuse to permit the closing of additional streets to traffic until the majority of the work on the closed streets is completed and they are opened to traffic.

1.4 RIGHTS-OF-WAY

A. Whenever it is required to perform work within the limits of public or private property or in rights-of-way, such work shall be done in conformity with all agreements between the Owner and the owners of such. Care shall be taken to avoid injury to the premises

entered, which premises shall be left in a neat and orderly condition by the removal of rubbish and the grading of surplus materials, and the restoration of said public or private property to the same general conditions as pertained at the time of entry for work to be performed under this contract.

B. The Contractor shall not (except after consent from the proper parties) enter or occupy with men, tools or equipment, any land outside the rights-of-way or property of the Owner.

C. When the Contractor performs construction within 10 ft. of a right-of-way or easement line, he shall place tall stakes properly identified at points of change in width or direction of the right-of-way or easement line and at points along the line so that at least two stakes can be seen distinctly from any point on the line.

1.5 EASEMENTS

A. Where the work is to be constructed upon easements, such easements will be secured by the Owner without cost to the Contractor. The Contractor shall not enter upon or occupy any private property outside of the limits of the easements furnished.

B. Care shall be taken to avoid injury to the premises entered, which premises shall be left in a neat and orderly condition by the removal of rubbish and the grading of surplus materials, and the restoration of said public or private property to the same general conditions as pertained at the time of entry for work to be performed under this contract.

1.6 PROTECTING EXISTING BUILDINGS, STRUCTURES AND ROADWAYS

A. The Contractor shall, at his own expense, shore up and protect any buildings, roadways, utilities or other public or private structures which may be encountered or endangered in the prosecution of the work, and that may not be otherwise provided for, and he shall repair and make good any damages caused to any such property by reason of his operations. All existing fences removed due to the prosecution of the work shall be replaced by the Contractor. No extra payment will be made for said work or material, but the cost of this work must be included in the price stipulated for the work to be done under this contract.

1.7 SITE FACILITIES

A. The Contractor shall furnish and place sufficient quantities of portable toilet facilities at locations convenient for use by the Contractor's personnel, Subcontractors, the Engineer, and the Owner.

1.8 RESTORATION

A. The contractor shall restore all areas per the plans and specifications and if not specified, at least to the condition existing prior to the start of work.

END OF SECTION 011419

SECTION 011423 - ADDITIONAL WORK, OVERTIME

PART 1 - GENERAL

1.1 NIGHT, SUNDAY AND HOLIDAY WORK

A. No work will be permitted at night, Sunday or legal holidays except as noted on the plans or in the case of emergency and then only upon written authorization of the Engineer. Where no emergency exists, but the Contractor feels it advantageous to work at night, Sunday or legal holidays, the Contractor shall notify the Engineer at least two (2) days in advance, requesting written permission. Any work performed during the absence of the Engineer will be done at the Contractor's risk and responsibility and may be subject to rejection upon later inspection.

END OF SECTION 011423

SECTION 012513 – PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 MATERIALS AND EQUIPMENT

A. In the specifications and on the Engineer's drawings, are specified and shown certain pieces of equipment and materials deemed most suitable for the service anticipated. This is not done to eliminate other equipment and materials equally as good and efficient. The Contractor shall prepare his bid on the particular materials and equipment specified. Following the award of the contract, should the Contractor desire to use other equipment and materials, he shall submit to the Owner a written request for such change and state the advantage to the Owner and the savings or additional cost involved by the proposed substitution. The determination as to whether or not such change will be permitted rests with the Owner and the Engineer.

B. Each major item of equipment shall be inspected by a manufacturer's representative during installation and upon completion of the work. The Contractor shall supply the Engineer with a certificate of such inspection.

END OF SECTION 012513

SECTION 013119 - PROJECT MEETINGS

PART 1 - GENERAL

1.1 PRECONSTRUCTION MEETING

A. Prior to the Contractor beginning any work on the project, the Owner will schedule and hold a preconstruction meeting to discuss all aspects of the contract work.

B. The Contractor shall be present and be prepared to comment in detail on all aspects of his work.

C. The Contractor shall bring to the preconstruction meeting a proposed construction progress schedule, erosion control plan, quality control program, concrete mix designs, asphalt mix designs (JMF), etc. Approval of each by the Engineer is required prior to the start of any work.

D. Included in the construction progress schedule shall be an implementation sequence of the proposed erosion control efforts required by the contract.

1.2 PROGRESS MEETINGS

A. Monthly progress meetings will be held at a location to be determined by the Owner on a regularly scheduled day mutually convenient to the Owner, Contractor, and Engineer.

B. The Contractor shall provide an updated construction progress schedule and be prepared to comment in detail on all aspects of his work.

END OF SECTION 013119

SECTION 013216 – CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 PROGRESS SCHEDULE

A. Immediately after signing the Contract, the General Construction Contractor shall prepare a graphic progress schedule, indicating the work to be executed during each month and the rate of expected progress to secure completion on the agreed-upon completion date. The progress schedule shall be approved by the Engineer and Owner prior to starting work on the site. Copies of such graphic progress charts, upon which has been indicated the actual progress, shall be furnished to the Engineer with each requisition for payment.

This progress schedule must follow these general time frames (may vary with project):

1. Chip seal, paving fabric and/or the leveling course must start within 7 calendar days from the date of milling.

2. Casting adjustments and/or curb replacements must start within 7 calendar days from the completion of the chip seal, intermediate course and/or fabric.

3. Surface course asphalt concrete must begin installation within 7 calendar days from the completion of the casting adjustments and/or curb replacement.

4. Traffic paint, temporary or permanent must be installed within a time period as deemed adequate and desirable for each location.

B. Should the rate of progress fall materially behind the scheduled rate of progress, and unless the delay is authorized by the Engineer, each offending Contractor shall furnish additional labor, work overtime, or take other necessary means required for completion of the work on the scheduled date. No additional compensation beyond the set Contract price shall be paid for action taken or overtime expense incurred in maintaining scheduled progress.

END OF SECTION 013216

SECTION 013223 – SURVEY AND LAYOUT DATA

PART 1 - GENERAL

1.1 STAKING

A. The Contractor shall hire a surveyor licensed in the state the work is to be installed to provide all reference points not already established and staking. The Contractor shall protect and preserve the established staking and reference points as long as required for installation of the work and field verifications by any party. The Contractor's surveyor shall replace and accurately relocate all staking and reference points so lost, destroyed or moved.

1.2 LAYOUT OF WORK

A. The Contractor shall lay out his work and be responsible for correct locations, elevations and dimensions of all work executed by him under this Contract. The Contractor must exercise proper precautions to verify the figures shown on the Drawings before laying out the work and will be held responsible for any error resulting from his failure to exercise such precaution. The Contractor shall insure the new construction aligns with any existing work.

END OF SECTION 013223

SECTION 013236 – VIDEO MONITORING AND DOCUMENTATION

PART 1 - GENERAL

1.1 SCOPE

A. Provide all labor, materials, equipment, and services, and perform all operations necessary to furnish to the Owner a complete color audio-video record on a USB Flash Drive of the surface features within the proposed construction zone of influence. This record shall include, but not be limited to, all audio-video USB Flash Drives, storage cases, video logs, and indexes. The purpose of this coverage shall be to accurately document the pre-construction condition of these surface features.

1.2 QUALIFICATIONS

A. The color audio-video documentation shall be done by a responsible commercial firm known to be skilled and regularly engaged in the business of pre-construction color audio-video documentation. The firm shall furnish such information as the Owner deems necessary to determine the ability of that firm to perform the work in accordance with the Contract specifications.

1.3 PRODUCTS

A. The color audio-video recording delivered to the Owner shall be on a high-quality USB Flash Drive.

END OF SECTION 013236

SECTION 013319.01 - FIELD TEST REPORTING
- AGGREGATE, SOILS, CONCRETE AND ASPHALT

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall be responsible for the quality of all materials incorporated into the project work and shall be responsible for all costs of testing and certification of same. The Contractor shall provide the City Engineer a list of three (3) local qualified firms for the City to select from to be the Contractor's testing firm.

B. The Contractor shall provide the engineer with a Quality Control Plan in which his testing methods/procedures are defined. Said Plan shall meet with the approval of the Engineer and include identification of laboratories, types of testing, and the tentative amount and scheduling of each.

All certification of tests and/or gradations for material to be utilized in the work and all quality control testing shall be performed by an independent laboratory (not affiliated with, owned by, or managed by the Contractor). The laboratory shall be accredited by the AASHTO Materials Reference Laboratory for the type of testing performed.

C. The Owner may perform field Quality Assurance testing; however, such testing shall not relieve the Contractor from the responsibility of Quality Control testing or from supplying certificates from manufacturers or suppliers to demonstrate compliance with the specifications. It is intended that the testing by the Contractor and the Owner be complimentary toward a quality project; however, the Contractor may not assume the Owner will test or that any tests will be done in lieu of the Contractor's own Quality Control testing. In the same sense, the Contractor may not rely on Owner Quality Assurance testing as a basis of acceptance or approval of his work nor may any Owner-performed testing be reflected in his submitted plan.

1.2 TEST CRITERIA

A. The following tests at a minimum shall be included with the Contractor's Quality Control Plan in accordance with the specifications:

1. Aggregates
   a. For each material and/or different source, the laboratory shall perform soundness, gradation, and other tests for all parameters specified. Aggregates incorporated into concrete or asphalt mixes shall also be tested for moisture content daily.

2. Compaction Tests
   a. Compaction tests or field density tests shall be taken on all embankment, trench backfill, subgrade, and subbase materials.
   b. Minimum testing shall be as follows:
      Embankment testing shall be at least one (1) test/5,000 SF of each lift; Trench backfill testing shall be at least one (1) test/50 LF of each lift; Subgrade and/or subbase testing shall be at least one (1) test/200 LF of pavement or 5,000 SF of slabs; subject to greater frequency due to soil conditions or Engineer's direction.
   c. Proctors or relative density tests shall be performed as often as necessary for the differing soils or granular materials utilized. Proctors shall be run with a minimum of 5 points. Test reports shall show the wet (bulk) weight, dry weight, wet (bulk) density, dry density, moisture content weight and moisture content percentage. Both the dry curve and the wet curve shall be plotted.

3. Concrete Mix Design
   a. For each type of concrete, the laboratory shall perform the necessary mix design providing all test data as required by the specifications.

4. Concrete Field and Laboratory Tests
   a. The laboratory shall cast concrete cylinders and test beams:
      1. One set of four cylinders per 50 CY with a minimum of two sets per day. The cylinders shall be broken: one at 7 days, two at 28 days, one at 56 days, unless otherwise directed by the Engineer.
      2. One beam per 50 CY with a minimum of two beams per day.
   b. Temperature and unit weight shall be run on fresh concrete at intervals sufficient for the type of structure being placed and a minimum of once per day. Bulk weight, bucket weight, (tare), net weight, bucket factor (bucket volume) and unit weight shall be recorded on the fresh concrete report. Show all batch weights for yield calculations. Slump and air content tests shall be taken a minimum of one test per 20 CY and at least once per day.
   c. All field and laboratory testing shall be performed by technicians certified by the American Concrete Institute (ACI) for the type of testing performed.
   d. Initial cure of all cylinders shall be in a temperature controlled cure box or temperature controlled water tank with a hi-low thermometer. Hi-low temperature readings shall be recorded on the fresh concrete report.

5. Asphalt Mix Design
   a. For each type of asphalt mix, submit job mix formula (JMF) prepared by an ODOT pre-qualified laboratory from tests performed on the aggregates proposed for use.
   b. Sample and test for gradation and bitumen content per ODOT 441.

1.3 LABORATORY REPORTS

A. Reports of laboratory and field tests will be distributed to the Engineer, Owner, and Suppliers within 24 hours of completion.

END OF SECTION 013319.01

SECTION 013323 - SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

PART 1 - GENERAL

1.1 GENERAL

A. The Contractor shall submit detailed drawings, acceptable catalog data, specifications and material certifications for all equipment and materials specified or required for the proper completion of the work.

B. The intent of these items is to demonstrate compliance with the design concept of the work and to provide the detailed information necessary for the fabrication, assembly and installation of the work specified. It is not intended that every detail of all parts of manufactured equipment be submitted, however sufficient detail will be required to ascertain compliance with the specifications and establish the quality of the equipment proposed.

Shop Drawings shall be sufficiently clear and complete to enable the Engineer/Architect and Owner to determine that items proposed to be furnished conform to the specifications and that items delivered to the site are actually those that have been reviewed.

C. It is emphasized that the Engineer/Architect's review of Contractor's submitted data is for general conformance to the contract drawings and specifications but subject to the detailed requirements of drawings and specifications. Although the Engineer/Architect may review submitted data in detail, such review is an effort to discover errors and omissions in Contractor's drawings. The Engineer/Architect's review shall in no way relieve the Contractor of his obligation to properly coordinate the work and to Engineer/Architect the details of the work in such manner that the purposes and intent of the contract will be achieved. Such review by the Engineer/Architect shall not be construed as placing on him or on the Owner any responsibility for the accuracy and for proper fit, functioning or performance of any phase of the work included in the contract.

D. Shop Drawings shall be submitted in proper sequence and with due regard to the time required for checking, transmittal and review so as to cause no delay in the work. The Contractor's failure to transmit appropriate submittals to the Engineer/Architect sufficiently in advance of the work shall not be grounds for time extension.

E. The Contractor shall submit Shop Drawings for all fabricated work and for all manufactured items required to be furnished in the Contract in accordance with the General Provisions and as specified herein. Shop Drawings shall be submitted in sufficient time to allow at least twenty-one (21) calendar days after receipt of the Shop Drawings from the Contractor for checking and processing by the Engineer/Architect.

List of Submittals: The list below is a general representative list of submittals to be provided by the contractor for Owner and Engineer review but is not considered to be all inclusive. The Contractor shall provide all pertinent material shop drawings for review.

SWPPP Plan:

Implementation from contractor, to include lay down areas, temporary pumping measures, erosion control matting, inlet protection, silt fence/ filter sock. Plan Shall be reviewed and stamped by contractor's PE prior to CT review. Review shall include cut sheets of BMPs to be used in said SWPPP.

In Stream Submittals:

Coir Matting Materials
Stone Gradations for Various Structural Features (Rip Raps, Imbricated Rock Wall)
Plantings for Live Stakes
Seed Mixes
Bed Mixture Material
Geotextile Fabric
Materials for Stone Seating Wall Area

Site Related Submittals:

Grass Pavers (Turnaround)
Precast/Cast in Place Headwall Structures
Stone Seat Wall Material
Reinforced Concrete Pipe
Sanitary Sewer Piping
Storm Sewer Piping
Storm Structures, Steps, and Castings
Manhole Structures
Collapsible Bollards and Hardware
Regular Bollards
Fencing Cut Sheets
Flagpole Cut Sheets
Bench Cut Sheets
Stamped Concrete Color, Mix
Standard Concrete
Asphalt Mixes
Arbor Structure, and Foundation Details
Brick Pavers
Spray Lining Cut Sheets & thickness calculations
CIPP Lining Cut Sheets & thickness calculations

F. It is the responsibility of each Prime Contractor to furnish to all other Prime Contractors and especially the General Construction Contractor reviewed Shop Drawings for guidance in interfacing the various trades; i.e., sleeves, inserts, anchor bolts, terminations, and space requirements.

G. No work shall be performed requiring Shop Drawings until same have been reviewed by Engineer/Architect.

H. Accepted and reviewed Shop Drawings shall not be construed as approval of changes from Contract plan and specification requirements.

I. The Engineer/Architect will review the first and second Shop Drawing item submittals at no cost to the Contractor. Review of the third submittal and any subsequent submittal will be at the Contractor's expense. Payment will be deducted from the Contract amount at a rate of 2.8 times direct labor cost plus expenses.

1.2 SUBMITTAL PROCEDURE

A. All required submissions shall be made to the Engineer/Architect by the Prime Contractor(s) only. Any data prepared by subcontractors and suppliers and all correspondence originating with subcontractors, suppliers, etc., shall be submitted through the Contractor.

B. Contractor shall review and approve all Shop Drawings prior to submission. Contractor's approval shall constitute a representation to Owner and Engineer/Architect that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each Shop Drawing or sample with the requirements of the work and the Contract Documents.

C. Submittal Preparation: Mark each submittal with a permanent label or page for identification. Provide the following information on the label for proper processing and recording of action taken:

1. Location
2. Project Name
3. Contract
4. Name and Address of Engineer/Architect
5. Name and Address of Contractor
6. Name and Address of Subcontractor
7. Name and Address of Supplier
8. Name of Manufacturer
9. Number and Title of appropriate Specification Section
10. Drawing Number and Detail References, as appropriate.
11. Submittal Sequence or Log Reference Number.

    a. Provide a space on the label for the Contractor's review and approval markings and a space for the Engineer/Architect's "Action Stamp".

D. Each Shop Drawing, sample and product data submitted by the Contractor shall have affixed to it the following Certification Statement including the Contractor's Company name and signed by the Contractor:

Certification Statement: By this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements.

Signature Date

Company

E. Shop Drawings shall be submitted in not less than six (6) copies to the Engineer/Architect at the address specified at the Preconstruction Conference. Single mylar or sepia reproducible copies of simple Shop Drawings may be submitted with prior approval of the Engineer/Architect.

F. At the time of each submission, Contractor shall in writing identify any deviations that the Shop Drawings or samples may have from the requirements of the Contract Documents.

G. Drawings shall be clean, legible and shall show necessary working dimensions, arrangement, material finish, erection data, and like information needed to define what is to be furnished and to establish its suitability for the intended use. Specifications may be required for equipment or materials to establish any characteristics of performance where such are pertinent. Suitable catalog data sheets showing all options and marked with complete model numbers may, in certain instances, be sufficient to define the articles which it is proposed to furnish.

H. For product which require submittal of samples, furnish samples so as not to delay fabrication, allowing the Engineer reasonable time for the consideration of the samples submitted. Properly label samples, indicating the material or product represented, its place of origin, the names of the vendor and Contractor and the name of the project for which it is intended. Ship samples prepaid. Accompany samples with pertinent data required to judge the quality and acceptability of the sample, such as certified test records and, where required for proper evaluation, certified chemical analyses.

1.3 REVIEW PROCEDURE

A. Engineer/Architect will review with reasonable promptness all properly submitted Shop Drawings. Such review shall be only for conformance with the design concept of the Project and for compliance with the information given in the plans and specifications and shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.

B. The review of a separate item as such will not constitute the review of the assembly in which the item functions. The Contractor shall submit entire systems as a package.

C. All Shop Drawings submitted for review shall be stamped with the Engineer/Architect's action and associated comments.

D. Except for submittals for record, information or similar purposes, where action and return is required or requested, the Engineer/Architect will review each submittal, mark to indicate action taken, and return accordingly. Compliance with specified characteristics is the Contractor's responsibility.

Action Stamp: The Engineer/Architect will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate the action taken:

1. If Shop Drawings are found to be in general compliance, such review will be indicated by marking the first statement.
2. If only minor notes in reasonable number are needed, the Engineer/Architect will make same on all copies and mark the second statement. Shop Drawings so marked need not be resubmitted.
3. If the submitted Shop Drawings are incomplete or inadequate, the Engineer/Architect will mark the third statement, request such additional information as required, and explain the reasons for revision. The Contractor shall be responsible for revisions, and/or providing needed information, without undue delay, until such Shop Drawings are acceptable. Shop Drawings marked with No. 3 shall be completed resubmitted.
4. If the submitted Shop Drawings are not in compliance with the Contract Documents, the Engineer/Architect will mark the fourth statement. The Contractor will be responsible to submit a new offering conforming to specific products specified herein and/or as directed per review citations.

E. No submittal requiring a Change Order for either value or substitution or both, will be returned until the Change Order is approved or otherwise directed by the Owner.

APPLICATION FOR USE OF SUBSTITUTE ITEM

TO: _____

PROJECT: _____

SPECIFIED ITEM:

_____	_____	_____
Page	Paragraph	Description

A. The undersigned requests consideration of the following as a substitute item in accordance with Article 6.05 of the General Conditions.

_____

B. Change in Contract Price (indicate + or -) $ _____

C. Attached data includes product description, specifications, drawings, photographs, references, past problems and remedies, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified. For consideration of the attached data as SHOP DRAWINGS, submittal shall be in accordance with requirements of Section 013323.

D. Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The undersigned certifies that the following paragraphs, unless modified by attachments are correct:

1. The proposed substitute does not affect dimensions shown on Drawings.

2. The undersigned will pay for changes to the building design, including engineering design, detailing, and construction costs caused by the requested substitution.

3. The proposed substitution will have no adverse affect on other contractors, the construction schedule, or specified warranty requirements. (If proposed substitution affects construction schedule, indicate below using + or -)

_____ CONSECUTIVE CALENDAR DAYS

4. Maintenance and service parts will be locally available for the proposed substitution.

The undersigned further states that the function, appearance, and quality of the proposed substitution are equivalent or superior to the specified item, and agrees to reimburse the OWNER for the charges of the ENGINEER for evaluating this proposed substitute item.

E. Signature: _____

Firm: _____

Address: _____

_____

Telephone: _____ Date: _____

Attachments: _____

_____

_____

_____

For use by ENGINEER:

_____Accepted as evidenced by affixed SHOP DRAWING REVIEW stamp.
_____Accepted as evidenced by included CHANGE ORDER.
_____Not accepted as submitted. See Remarks.
_____Acceptance requires completion of submittal as required for SHOP DRAWINGS.
_____Not accepted. Do not resubmit.

By: _____ Date: _____

Remarks: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

APPLICATION FOR USE OF "OR-EQUAL" ITEM

TO: _____

PROJECT: _____

SPECIFIED ITEM:

_____	_____	_____
Page	Paragraph	Description

A. The undersigned requests consideration of the following as an "or-equal" item in accordance with Article 6.05 of the General Conditions.

_____

B. Change in Contract Price (indicate + or -) $ _____

C. Attached data includes product description, specifications, drawings, photographs, references, past problems and remedies, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified. For consideration of the attached data as SHOP DRAWINGS, submittal shall be in accordance with requirements of Section 013323.

D. Signature:

_____

Firm:

_____

Address:

_____

_____

Telephone: _____ Date: _____

Attachments: _____

_____

_____

_____

For use by ENGINEER:

_____Accepted as evidenced by affixed SHOP DRAWING REVIEW stamp.
_____Accepted as evidenced by included CHANGE ORDER.
_____Not accepted as submitted. See Remarks.
_____Acceptance requires completion of submittal as required for SHOP DRAWINGS.
_____Not accepted. Do not resubmit.

By: _____ Date: _____

Remarks: _____

END OF SECTION 013323

SECTION 013326 – PRODUCT TESTING AND CERTIFYING

PART 1 - GENERAL

1.1 QUALITY OF MATERIALS

A. Where the specifications call for mill or shop tests, the Contractor shall furnish duplicate copies of attested manufacturer's certificates showing details of quality or performance sufficient to demonstrate conformity to contract requirements. Mill, shop or witness tests shall be subject to view by the Engineer's representative, but the Engineer's representation shall not relieve the Contractor from the necessity of furnishing certificates specified. The Engineer shall be notified by the Contractor in writing, sufficiently in advance of the time of making tests, so that proper arrangements may be made. Waiving of witness of tests by the Engineer may be in writing only by the Engineer. All costs for travel, lodging, food and transportation that are necessary for the Engineer's representative and the Owner's representative to attend witness tests shall be included in the Contractor's bid for those item(s) specifically designated as being subject to witness testing.

B. Unless otherwise specified, all materials, equipment and articles shall be erected, installed, applied, or connected, used, cleaned and conditioned in accordance with the printed instructions and directions of the manufacturer.

C. The installation shall be so made that its several component parts will function together as a workable system. It shall be complete with all accessories necessary for its operation and shall be left with all equipment properly adjusted and in working order.

D. The work shall be executed in conformity with the best practice and so as to contribute to efficiency of operation, minimum maintenance, accessibility and sightliness. It shall also be executed so that the installation will conform and accommodate itself to the building structure, its equipment and usage.

E. Whenever in the contract documents a particular brand, make of material, device or equipment is shown or specified, such brand, make of material, device or equipment is to be regarded merely as a standard and such trade name shall be followed by "or equal".

1.2 QUALITY ASSURANCE

A. The equipment and materials to be furnished under this Contract shall be the products of well established and reliable firms which have had ample experience for at least five (5) years in the manufacture of equipment or materials similar in design and of equal quality to that specified. If required, the manufacturer shall submit a list of installations of similar equipment which have been in successful operation for at least five (5) years.

1.3 EXPERIENCE CLAUSE REQUIREMENT AND PERFORMANCE BONDS FOR MANUFACTURER

A. For every piece of equipment furnished under this Contract, the manufacturer will be required to have a minimum of five (5) years of experience in providing this specific type of equipment. In lieu of this experience requirement, the manufacturer will be required to provide performance bond(s) for the faithful performance of the equipment and guarantee payment in a sum of not less than one hundred and fifty percent (150%) of the total equipment price for the completed work for that item. In the absence of verifiable experience, the manufacturer will be required to provide the performance bond(s) for the same number of years that the manufacturer was found lacking in experience from the specified five (5) year period. The performance bond(s) shall be from an approved surety company, to the satisfaction of the Owner's Law Director.

B. Agents of bonding companies which write bonds for the performance and payment of the contract shall furnish power of attorney bearing the seal of the company, evidencing such agent's authority to execute the particular type of bond to be furnished, and evidencing also the right of the surety company to do business in the State of Ohio. Copy of this proof shall be attached to each copy of the contract.

C. The bond shall be purchased through a surety company with a local agent upon whom service of process can be made.

D. In event of failure of surety or co-surety, the manufacturer shall immediately furnish a new bond, as required herein. The manufacturer's bond will not be released until all provisions of the contract have been fulfilled.

E. The surety used for the bid bond and performance bond shall be listed in the latest U.S. Treasury Circular 570 and the Penal Sums shall be within the maximum specified for such company in said Circular 570.

END OF SECTION 013326

SECTION 013326.01 - QUALITY CONTROL PLAN

PART 1 - GENERAL

1.1 QUALITY CONTROL

A. The Contractor shall be responsible for the quality of all materials incorporated into the project work and shall be responsible for all costs of testing and certification of same. The Contractor shall provide the City Engineer a list of three (3) local qualified firms for the City to select from to be the Contractor's testing firm.

B. The Contractor shall provide the Engineer with a Quality Control Plan in which his testing methods/procedures are defined. Said Plan shall meet with the approval of the Engineer and include identification of laboratories, types of testing, and the tentative amount and scheduling of each.

All certifications of tests and/or gradations for materials to be utilized in the work and all quality control testing shall be performed by an independent laboratory (not affiliated with, owned by, or managed by the Contractor). The laboratory shall be accredited by the AASHTO Materials Reference Laboratory for the type of testing performed.

C. The Owner may perform field Quality Assurance testing; however, such testing shall not relieve the Contractor from the responsibility of Quality Control testing or from supplying certificates from manufacturers or suppliers to demonstrate compliance with the specifications. It is intended that the testing by the Contractor and the Owner be complimentary toward a quality project; however, the Contractor may not assume the Owner will test or that any tests will be done in lieu of the Contractor's own Quality Control testing. In the same sense, the Contractor may not rely on Owner Quality Assurance testing as a basis of acceptance or approval of his work nor may any Owner performed testing be reflected in his submitted plan.

1.2 TEST CRITERIA

A. The following tests at a minimum shall be included with the Contractor's Quality Control Plan in accordance with the specifications:

1. Aggregates

a. For each material and/or different source, the laboratory shall perform soundness, gradation, and other tests for all parameters specified. Aggregates incorporated into concrete or asphalt mixes shall also be tested for moisture content daily.

2. Compaction Tests

a. Compaction tests or field density tests shall be taken on all embankment, trench backfill, subgrade, and subbase materials.

b. Minimum testing shall be as follows:
Embankment testing shall be at least one (1) test/5000 S.F. of each lift;
Trench backfill testing shall be at least one (1) test/50 L.F. of each lift;
Subgrade and/or subbase testing shall be at least one (1) test/200 L.F. of pavement or /5000 S.F. of slabs; subject to greater frequency due to soil conditions or Engineer's direction.

c. Proctors or relative density tests shall be performed as often as necessary for the differing soils or granular materials utilized. Proctors shall be run with a minimum of 5 points. Test reports shall show the wet (bulk) weight, dry weight, wet (bulk) density, dry density, moisture content weight and moisture content percentage. Both the dry curve and the wet curve shall be plotted. The source materials shall be tested for gradation, Atterberg limits, shore-hydrometer and moisture content.

3. Concrete Mix Design

a. For each type of concrete, the laboratory shall perform the necessary mix design providing all test data as required by the specifications.

4. Concrete Field and Laboratory Tests

a. The laboratory shall cast concrete cylinders and test beams:
   1) One set of four cylinders per 50 C.Y. with a minimum of two sets per day. The cylinders shall be broken: one at 7 days, two at 28 days, one at 56 days, unless otherwise directed by the Engineer.
   2) One beam per 50 C.Y. with a minimum of two beams per day.

b. Temperature and unit weight shall be run on fresh concrete at intervals sufficient for the type of structure being placed and a minimum of once per day. Bulk weight, bucket weight, (tare), net weight, bucket factor (bucket volume) and unit weight shall be recorded on the fresh concrete report. Show all batch weights for yield calculations. Slump and air content tests shall be taken a minimum of one test per 20 C.Y. and at least once per day.

c. All field and laboratory testing shall be performed by technicians certified by the American Concrete Institute (ACI) for the type of testing performed.

d. Initial cure of all cylinders shall be in a temperature controlled cure box or temperature controlled water tank with a hi-low thermometer. Hi-low temperature readings shall be recorded on the fresh concrete report.

5. Asphalt Mix Design

a. For each type of asphalt mix, submit job mix formula (JMF) prepared by an ODOT pre-qualified laboratory from tests performed on the aggregates proposed for use.

b. Sample and test for gradation and bitumen content as per ODOT 441.

c. Asphalt compaction, thickness, and temperature tests shall be performed during asphalt placement per ODOT Item 448.

1.3 LABORATORY REPORTS

A. Reports of laboratory and field tests will be distributed to the Engineer, Owner, and Suppliers within 24 hours of completion.

END OF SECTION 013326.01

SECTION 013543 - ENVIRONMENTAL PROTECTION

PART 1 - GENERAL

1.1 UNNECESSARY NOISE, DUST AND ODORS

A. The Contractor's performance of this contract shall be conducted so as to eliminate all unnecessary noise, dust and odors.

1.2 SEWAGE, SURFACE AND FLOOD FLOWS

A. The Contractor shall take whatever action is necessary to provide all necessary tools, equipment and machinery to adequately handle all sewage, surface flows and flood flows which may be encountered during the performance of the work. The entire cost of and liability for handling such flows is the responsibility of the Contractor and shall be included in the price for the appropriate item.

1.3 WORK IN FREEZING WEATHER

A. Written permission from the Engineer shall be obtained before any work is performed which, in the judgment of the Engineer, may be affected by frost, cold, or snow. When work is performed under such conditions, the Contractor shall provide facilities for heating the materials and for protecting the finished work.

1.4 POLLUTION CONTROL

A. It shall be the responsibility of the Contractor to prevent or limit pollution of air and water resulting from his operations.

B. The Contractor shall perform work required to prevent soil from eroding or otherwise entering onto all paved areas and into natural watercourses, ditches, and public sewer systems. This work shall conform to all local ordinances and/or regulations, if any, and if not otherwise regulated by local ordinances or regulations shall at a minimum conform to the Ohio EPA General Storm Water NPDES Permit for Construction Activities and the Ohio Department of Natural Resources Rainwater and Land Development manual. This work may consist of but not be limited to construction and continual maintenance of silt fence, bio bag filters, sedimentation traps, stilling basins, check dams, temporary seeding, temporary mulching, erosion mats and other means to clarify waters containing suspended materials from excavations, embankments, cleared and grubbed or stripped areas, stockpiles, well points, and disposal sites and shall be commensurate with the contractor’s schedule, sequence of work, means and methods. If a SWPPP plan is not required for the project, the contractor shall at a minimum submit a plan of his proposed erosion control prevention methods for approval by the Owner and/or other regulatory authorities having jurisdiction prior to starting any construction activities which may cause erosion.

C. The Contractor shall perform work required to prevent dust attributable to his operations from entering the atmosphere. Dust on unsurfaced streets or parking areas and any remaining dust on surfaced streets shall be controlled with water and/or calcium chloride dust palliative as needed.

D. Any material removed from sanitary or storm sewers shall be disposed in accordance with all applicable regulations.

END OF SECTION 013543

SECTION 014126 - GENERAL REGULATIONS AND PERMITS

PART 1 - GENERAL

1.1 REGISTRATION

All Contractors and subcontractors shall be registered with the Building Department having jurisdiction. Contact the Building Department for additional registration information.

1.2 PERMITS

The Contractor shall apply for all permits from the Owner and/or other authorities having jurisdiction. The Owner will waive all permit and inspection fees for permits under their jurisdiction; however, the Contractor must pay all permit and inspection fees for permits issued by other authorities having jurisdiction.

1.3 ARCHAEOLOGICAL DISCOVERIES

Contractors and subcontractors are required under Ohio Revised Code (O.R.C.) Section 149.53, to notify Ohio's State Historic Preservation Office (SHPO), and to cooperate with that office in archaeological and historic surveys and mitigation efforts if such discoveries are uncovered within the project area.

Contact: Ohio's State Historic Preservation Office
Diana Welling, Resource Protection & Review Department Manager
Phone: 1-614-298-2000
Email: dwelling@ohiohistory.org

Should archaeological discoveries or other activities delay progress of the work, an adjustment in contract time will be made.

END OF SECTION 014126

SECTION 014223 - INDUSTRY STANDARDS

PART 1 - GENERAL

1.1 ABBREVIATIONS

A. Abbreviations, as used, designate the following:

AASHTO	-	American Association of State Highway and Transportation Officials
ACI	-	American Concrete Institute
AIEE	-	American Institute of Electrical Engineers
AISC	-	American Institute of Steel Construction
ANSI	-	American National Standards Institute
ASTM	-	American Society of Testing and Materials
AWWA	-	American Water Works Association
CMS	-	Construction and Material Specifications
NEMA	-	National Electrical Manufacturers Association
ODOT	-	Ohio Department of Transportation
ORC	-	Ohio Revised Code
UL	-	Underwriters Laboratories, Inc.

1.2 REFERENCE TO OTHER SPECIFICATIONS

A. Where reference is made to specifications such as ASTM, AWWA or AASHTO, the latest edition shall be used, unless otherwise noted on the plans or in the specifications.

1.3 CODES AND STANDARDS

A. All work provided for by these specifications must be installed according to the provisions of the State and local building codes, subject to inspection and acceptance by the State and local inspectors.

END OF SECTION 014223

SECTION 014323 – QUALIFICATIONS OF TRADESMEN

PART 1 - GENERAL

1.1 CHARACTER OF WORKMEN AND EQUIPMENT

A. The Contractor shall employ competent and efficient workmen for every kind of work. Any person employed on the work who shall refuse or neglect to obey directions of the Owner or his representative, or who shall be deemed incompetent or disorderly, or who shall commit trespass upon public or private property in the vicinity of the work, shall be dismissed when the Owner so orders, and shall not be re-employed unless express permission be given by the Owner. The methods, equipment and appliances used on the work and the labor employed shall be such as will produce a satisfactory quality of work, and shall be adequate to complete the contract within the specified time limit.

B. In hiring of employees for the performance of work under this Contract, or any Subcontract hereunder, no Contractor or Subcontractor, nor any person acting on behalf of such Contractor or Subcontractor, shall, by reason of race, sex, creed or color, discriminate against any citizen of the State of Ohio in the work to which the employment relates. No Contractor, Subcontractor, nor any person on his behalf shall, in any manner, discriminate against or intimidate any employee hired for the performance of work under this contract on account of race, creed, sex or color.

END OF SECTION 014323

SECTION 015100 - TEMPORARY POWER SERVICE

PART 1 - GENERAL

1.1 ELECTRICAL POWER

A. The Contractor shall furnish at his own expense all electrical power which may be required for the project. All temporary lines shall be furnished and installed by the Contractor at his own expense in a manner which meets the approval of the Engineer, and shall be removed by the Contractor at the completion of the construction.

END OF SECTION 015100

SECTION 015136 - TEMPORARY WATER AND DISTRIBUTION

PART 1 - GENERAL

1.1 WATER

A. The Contractor shall be responsible for an adequate supply of water suitable for his use for construction and drinking. At his own expense, he shall provide and maintain adequate supplies and supply lines in such locations and installed in such a manner as may be satisfactory to the Engineer.

END OF SECTION 015136

SECTION 015213 - FIRST AID

PART 1 - GENERAL

1.1 AID TO THE INJURED

The Contractor shall keep in their office and on the work site, all articles necessary for giving "First Aid to the Injured". They shall also have standing arrangements for the immediate removal and hospital treatment of any employee or other person who may be injured on the work site.

END OF SECTION 015213

SECTION 015713 - TEMPORARY EROSION CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnishing all labor, materials, tools, equipment and services for the temporary soil erosion and sediment control work as indicated.

B. Coordinating the temporary pollution and erosion control with work of all other trades.

C. Reducing to the greatest extent practicable the area and duration of exposure of readily erodible soils.

D. Protecting the soils by use of temporary vegetation or mulch or by accelerating the establishment of permanent vegetation.

E. Mechanically retarding the rate of runoff from the construction site and control disposal of runoff.

F. Traping all sediment resulting from construction in temporary or permanent debris basins.

G. Using temporary measures to keep erosion under control if construction is suspended for any appreciable length of time.

H. Providing protection against chemical, fuel, or lubricant spills, and sewage pollutants.

I. Protecting project and existing structures from surface water damage due to utility line excavations.

J. Controlling soil erosion and sedimentation by use of silt fences, dikes, ditches, slope protection, sediment pits, basins, dams, slope drains, coarse aggregate, mulches, sod, grasses, filter fabrics, and other erosion control devices or methods.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

None

1.3 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION (Not Used)

1.4 UNIT PRICES

A. Work under this section is incidental to work covered under other sections of these Specifications and shall be paid as work incidental to those items.

1.5 SUBMITTALS

A. Product Data
   1. Filter fabric

B. Shop Drawings

C. Samples

D. Quality Control Submittals
   1. Design Data
   2. Test Reports
   3. Certificates
      a. Seed
      b. Fertilizer
      c. Limestone
   4. Manufacturers Instructions

E. Contract Closeout Submittals
   1. Project Record Documents

1.6 QUALITY ASSURANCE

A. Qualifications

B Regulatory Requirements

C. Certifications

D. Field Samples

E. Mock-ups

F. Pre-Installation Conference

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping
   1. Deliver grass seed, fertilizer and limestone in original containers labeled with content analysis.

B. Acceptance at Site

C. Storage and Protection

1.8 PROJECT CONDITIONS

A. Environmental Requirements

B. Existing Conditions

C. Field Measurements

1.9 SEQUENCING AND SCHEDULING

A. All temporary control measures as shown on the Drawings, called for in these Specifications or ordered by the Engineer shall remain in effect during the life of the contract to control soil erosion, sedimentation and water pollution.

PART 2 - PRODUCTS

2.1 SEED

A. Provide fresh, clean, new crop seed complying with tolerance for purity and germination established by Official Seed Analysts of North America.

B. All areas of temporary seeding shall be seeded with grass as shown in the following table:

March 1 - August 15	Per 1000 Square Feet	Per Acre
Oats	3 lbs.	4 bu.
Perenial Ryegrass	1 lb.	40 lbs.
Tall Fescue	1 lb.	40 lbs.

August 16 - November 1*	Per 1000 Square Feet	Per Acre
Rye	3 lbs.	2 bu.
Wheat	3 lbs.	2 bu.
Perenial Ryegrass	1 lb.	40 lbs.
Tall Fescue	1 lb.	40 lbs.

* After November 1, use mulch only

2.2 ORGANIC MULCH

A. Select mulch material based on site requirements, availability of materials and availability of labor and equipment. The following are the minimum rates:

	Rates		
Mulch	Per Acre	Per 1000 ft^2	Notes
Straw (temporary only)	2 tons	90 lbs.	Free from weeds and coarse matter. Must be anchored. Spread with mulch blower or by hand.
Wood Chips (permanent or temporary)	400 $yds.^3$	9 - 10 $yds.^3$	Apply approx. 3" deep. Treat with 12 lbs. of nitrogen per ton. Do not use on firm turf areas. Apply with mulch blower, chip handler, or by hand.
Bark Chips or Shredded Bark (temporary mulch only)	70 $yds.^3$	1½ - 2 $yds.^3$	Do not use in fine turf areas. Apply about ½" thick. Apply with a mulch blower or by hand.

2.3 FERTILIZER

A. All fertilizer shall be manufactured from cured stock and organic sources. Chemical elements shall be accurately proportioned, uniformly mixed, and delivered to the site in factory-sealed containers fully labeled, bearing the name or trademark and warranty of the manufacturer. Commercial fertilizer for lawn sodding shall be dry or liquid compounds of 12-12- 12 analysis, meeting applicable requirements of State and Federal laws.

2.4 LIMESTONE

A. All limestone shall be ground agricultural grade dolomitic limestone containing at least 10 percent magnesium oxide with a minimum total neutralizing power of 90, with at least 40 percent passing a No. 100 sieve and at least 95 percent passing a No. 8 sieve.

2.5 WATER

A. All irrigation water shall be clean and free from injurious amounts of oil, acid, alkali, or other deleterious substances.

2.6 DITCH CHECKS

A. Temporary ditch checks shall consist of coarse aggregate dikes.

2.7 INLET FILTERS

A. Temporary inlet filters and silt fences shall be adequately supported as detailed on the drawings.

2.8 SLOPE DRAINS

A. Temporary slope drains shall consist of pipe, coarse aggregate, riprap, rock channel protection, mats, plastic sheets or other materials approved by the Engineer. Sediment pits may be included as part of slope drain protection.

2.9 FILTER FABRIC

A. Synthetic filter fabric shall be a pervious sheet of propylene, nylon, polyester or ethylene yarn and shall be certified by the manufacturer or supplier as conforming to the following requirements:

Physical Property	Requirements
Filtering Efficiency	75% (min.)
Tensile Strength at 20% (max.) Elongation *	Extra Strength - 50 lbs./lin. in. (min.)
	Standard Strength - 30 lbs./lin. in. (min.)
Flow Rate	0.3 gal./sq.ft./min. (min.)

*Requirements reduced by 50 percent after 6 months of installation.

B. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0° F to 120° F.

2.10 BURLAP

A. Burlap shall be 10 ounce per square yard fabric.

2.11 FILTER SUPPORTS AND REINFORCING

A. Posts for silt fences shall be either 4" diameter wood or 1.33 pounds per linear foot steel with a minimum length of 5 feet. Steel posts shall have projections for fastening wire to them.

B. Stakes for filter barriers shall be 1" x 2" wood (preferred) or equivalent metal with a minimum length of 3 feet.

C. Wire fence reinforcement for silt fences using standard strength filter cloth shall be a minimum of 42 inches in height, a minimum of 14 gauge and shall have a maximum mesh spacing of 6 inches.

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. The Contractor shall limit the surface area of erodible earth material exposed by clearing and grubbing; the surface area of erodible earth material exposed by excavation; borrow; and fill operations; and provide immediate permanent or temporary control measures to prevent contamination of adjacent streams or other areas of water impoundment. Such work will involve the construction of temporary ditch checks, filters, benches, dikes, slope drains, and use of temporary mulches, mats, seeding or other control devices or methods necessary to control erosion and sedimentation.

B. The Contractor shall incorporate all permanent erosion control features into the Work at the earliest practicable time. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages, as soon as substantial areas of exposed slopes can be made available. This will require the establishing of final grades as shown on the Drawings and application of agricultural limestone, commercial fertilizer, seeding and mulching or sodding . When directed by the Engineer, temporary fertilizer, seeding and mulching materials shall be used. In general, the Contractor shall temporarily seed all disturbed areas within seven (7) days if they are to remain dormant for more than forty- five (45) days. Permanent soil stabilization shall be applied to disturbed areas within seven (7) days after final grade is reached on any portion of the site.. Temporary control measures will be used when and as directed by the Engineer to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

C. Where erosion is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise temporary erosion control measures will be required between successive construction stages.

D. The Engineer will limit the area of excavation, borrow and embankment operations in progress commensurate with the Contractor's capability and progress in keeping the finished grading, mulching, seeding, and other such permanent control measures current in accordance with the accepted schedule. Mulching, seeding, and other such permanent control measures shall be applied after completion of a vertical eight (8) feet of embankment or cut, unless otherwise directed by the Engineer. Should seasonal limitations or embankment make such coordination unrealistic, temporary erosion control measures shall be taken immediately.

E. The Engineer may increase or decrease the allowable amount of surface area or erodible earth material to be exposed at one time by clearing and grubbing, excavation, borrow and fill operations as determined by his analysis of project conditions. Factors such as soil erodibility, slope, cut or fill height, exposed area contributing to a watercourse and weather will be considered in this determination.

F. In the event of conflict between these requirements and pollution control laws, rules, or regulations or other Federal, State or local agencies, the more restrictive laws, rules or regulations shall apply.

G. Temporary seeding areas shall be fertilized at a rate of 12-15 pounds per 1000 square feet of 10-10-10 or 12-12-12 analysis or equal.

H. When directed by the Engineer, the seed bed shall be thoroughly watered to maintain adequate moisture in the upper four (4) inches of soil, necessary to promote proper root growth.

I. When directed by the Engineer, temporary seeded areas shall be mowed when grass exceeds four (4) inches in height.

J. Temporary erosion control features shall be acceptably maintained and shall subsequently be removed or replaced when directed by the Engineer.

K. Removed materials shall become the property of the Contractor and shall be disposed of off the site at the Contractor's expense.

3.2 PERFORMANCE

A. If, in the opinion of the Engineer and Owner, proper control of soil erosion and sedimentation is not being provided by the Contractor, the Owner may take all necessary steps to provide corrective measures and the cost of such services will be deducted from any money which may be due or become due the Contractor.

B. Control work performed for protection of construction areas outside the construction site, such as borrow and waste areas, haul roads, equipment and material storage sites, and temporary plant sites shall be considered as a subsidiary obligation of the Contractor, with all necessary control costs included in the contract price.

C. In the event that temporary erosion and sediment control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled, and are ordered by the Engineer, such temporary work shall be performed by the Contractor at his expense.

3.3 SILT FENCE

A. The height of a silt fence shall not exceed 36 inches (higher fences may impound volumes of water sufficient to cause failure of the structure).

B. The filter fabric shall be purchased in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are necessary, filter cloth shall be spliced together only at a support post, with a minimum six (6) inches overlap and securely sealed.

C. Posts shall be spaced a maximum of ten (10) feet apart at the barrier location and driven securely into the ground (minimum of 12 inches). When extra strength fabric is used without the wire support fence, post spacing shall not exceed six (6) feet.

D. A trench shall be excavated approximately four (4) inches wide and four (4) inches deep along the line of posts and upslope from the barrier.

E. When standard strength filter fabric is used, a wire mesh support fence shall be fastened securely to the upslope side of the posts using heavy duty wire staples at least one (1) inch long, tie wires or hog rings. The wire shall extend into the trench a minimum of two (2) inches and shall not extend more than 36 inches above the original ground surface.

F. The standard strength filter fabric shall be stapled or wired to the fence, and eight (8) inches of the fabric shall be extended into the trench. The fabric shall not extend more than 36 inches above the original ground surface. Filter fabric shall not be stapled to existing trees.

G. When extra strength filter fabric and closer post spacing are used, the wire mesh support fence may be eliminated. In such a case, the filter fabric is stapled or wired directly to the posts with all other provisions of Subparagraph F above applying.

H. The trench shall be backfilled and soil compacted over the filter fabric.

I. Silt fences shall be removed when they have served their purpose, but not before the upslope area has been permanently stabilized.

J. Silt fences and filter barriers shall be inspected immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately.

K. Should the fabric on a silt fence or filter barrier decompose or become ineffective prior to the end of the expected usable life and the barrier is still necessary, the fabric shall be replaced promptly.

L. Sediment deposits should be removed after each storm event. They must be removed when deposits reach approximately one-half the height of the barrier.

M. Any sediment deposits remaining in place after the silt fence or filter barrier is no longer required shall be dressed to conform with the existing grade, prepared and seeded.

3.4 TEMPORARY MULCHING

A. Application
   1. Mulch materials shall be spread uniformly, by hand or machine.
      a. When spreading straw mulch by hand, divide the areas to be mulched into approx. 1000 sq. ft. sections and place approx. 90 lbs. of straw in each section to facilitate uniform distribution.

B. Mulch Anchoring
   1. Straw mulch shall be anchored immediately after spreading to prevent windblow. One of the following methods of anchoring straw shall be used:
      a. Mulch anchoring tool
         1. This is a tractor-drawn implement (mulch crimper, serrated straight disk or dull farm disk) designed to punch mulch approximately two(2) inches into the soil surface. This method provides maximum erosion control with straw. It is limited to use on slopes no steeper than 3:1, where equipment can operate safely. Machinery shall be operated on the contour.
      b. Liquid mulch binders
         1. Application of liquid mulch binders and tackifiers should be heaviest at edges of areas and at crests of ridges and banks, to prevent windblow. The remainder of the area should have binder applied uniformly. Binders may be applied after mulch is spread; however, it is recommended to be sprayed into the mulch as it is being blown onto the soil. Applying straw and binder together is the most effective method.
         2. The following type of binder may be used:
            a.) Asphalt - any type of asphalt thin enough to be blown from spray equipment is satisfactory. Recommended for use are rapid curing (RC-80, RC-250, RC-800), medium curing (MC-250, MC-800) and emulsified asphalt (SS-1, MS-2, RS-1 and RS-2). Apply asphalt at 4 gal./1000 $ft.^2$, 600 gal./acre. Do not use heavier applications as it may cause the straw to "perch" over rills.

b.) Wood Fiber - wood fiber hydroseeder slurries may be used to tack straw mulch.

c. Mulch nettings

1. Lightweight plastic, cotton or paper nets may be stapled over the mulch according to manufacturer's recommendations.

C. Chemical Mulches

1. Chemical mulches may be used alone only in the following situations:
   a. Where no other mulching material is available.
   b. In conjunction with temporary seeding during the times when mulch is not required for that practice.
2. Chemical mulches may be used to bind other mulches or with wood fiber in a hydroseeded slurry at any time. Manufacturer's recommendations for application of chemical mulches shall be followed.

D. Nets and Mats

1. Nets may be used alone on level areas, on slopes no steeper than 3:1, and in waterways.
2. When mulching is done in late fall or during June, July and August, or where soil is highly erodible, net should only be used in conjunction with an organic mulch such as straw.
3. When net and organic mulch are used together, the net should be installed over the mulch except when the mulch is wood fiber. Wood fiber may be sprayed on top of the installed net.
4. Excelsior blankets are considered protective mulches and may be used alone on erodible soils and during all times of the year.
5. Other products designed to control erosion shall conform to manufacturer's specification and should be applied in accordance with manufacturer's instructions provided those instruction are at least as stringent as this specification.
6. Staples will be made of plain iron wire, No. 8 gauge or heavier, and will be six (6) inches or more in length.
7. Prior to installation:
   a. Shape and grade as required the waterway, channel, slope or other area to be protected.
   b. Remove all rocks, clods or debris larger than two (2) inches in diameter that will prevent contact between the net and the soil surface.
   c. When open-weave nets are used, lime, fertilizer and seed may be applied either before or after laying the net. When excelsior matting is used, they must be applied before the mat is laid.
8. Laying the Net:
   a. Start laying the net from top of channel or top of slope and unroll down-grade.
   b. Allow to lay loosely on soil - do not stretch.
   c. To secure net: Upslope ends of net should be buried in a slot or trench no less than six (6) inches deep. Tamp earth firmly over net. Staple the net every twelve (12) inches across the top end.

d. Edges of net shall be stapled every three (3) feet. Where two strips of net are laid side by side, the adjacent edges shall be overlapped three (3) inches and stapled together.

e. Staples shall be placed down the center of net strips at 3-foot intervals. Do not stretch net when applying staples.

9. Joining strips
   a. Insert new roll of net in trench, as with upslope ends of net. Overlap the end of the previous roll eighteen (18) inches, turn under six (6) inches and staple across end of roll just below anchor slot and at the end of the turned-under net every twelve (12) inches.
10. At bottom of slopes
   a. Lead net out onto a level area before anchoring. Turn ends under six (6) inches and staple across end every twelve (12) inches.
11. Check slots
   a. On highly erodible soils and on slopes steeper than 4:1, erosion check slots should be made every fifteen (15) feet. Insert a fold of net into a six (6) inch trench and tamp firmly. Staple at twelve (12) inch intervals across the downstream portion of the net.
12. Rolling
   a. After installation, stapling and seeding, net should be rolled to ensure firm contact between net and soil.
13. All mulches should be inspected periodically, in particular after rainstorms, to check for rill erosion. Where erosion is observed, additional mulch should be applied. Net should be inspected after rainstorms for dislocation or failure. If washouts or breakage occur, re- install net as necessary after repairing damage to the slope. Inspections should take place up until grasses are firmly established. Where mulch is used in conjunction with ornamental plantings, inspect periodically throughout the year to determine if mulch is maintaining coverage of the soil surface; repair as needed.

3.5 TEMPORARY SEEDING

A. Site Preparation
   1. Grade as needed and feasible to permit the use of conventional equipment for seedbed preparation, seeding, mulch application and anchoring.
   2. Install the needed erosion control practices prior to seeding such as diversions, temporary waterways for diversion outlets and sediment basins.

B. Seedbed Preparation
   1. Lime (in lieu of a soil test recommendation) shall be applied on acid soil (pH 5.5 or lower) and subsoil at a rate of 100 pounds per 1000 square feet or two tons per acre of agricultural ground limestone. For best results, make a soil test.
   2. Fertilizer (in lieu of a soil test recommendation) shall be applied at a rate of 12-15 pounds per 1000 square feet or 500-600 pounds per acre of 10-10-10 or 12-12-12 analysis or equivalent.

3. Work the lime and fertilizer into the soil with a disk harrow, springtooth harrow or similar tools to as depth of two inches. On sloping areas, the final operation shall be on the contour.

C. Seeding
1. Apply the seed uniformly with a cyclone seeder, drill, cultipacker seeder or hydroseeder (slurry may include seed and fertilizer) preferably on a firm, moist seedbed. Seed wheat or rye no deeper than one (1) inch. Seed ryegrass no deeper than one-fourth (¼) inch.
2. When feasible, except where a cultipacker type seeder is used, the seedbed should be firmed following seeding operations with a cultipacker, roller or light drag. On sloping land, seeding operations should be on the contour wherever possible.

D. Mulching
1. Mulch shall be applied to protect the soil and provide a better environment for plant growth.
2. Mulch shall consist of small grain straw (preferably wheat or rye) and shall be applied at the rate of two tons per acre or 100 pounds (two to three bales) per 1000 square feet.
3. Spread the mulch uniformly by hand or mechanically so the soil surface is covered.
4. Mulch Anchoring Methods
   a. Mechanical - use a disk, crimper or similar type tool set straight to punch or anchor the mulch material into the soil.
   b. Asphalt Emulsion - apply at the rate of 160 gallons per acre into the mulch as it is being applied.
   c. Mulch Nettings - use according to the manufacturer's recommendations. Use in areas of water concentration to hold mulch in place.

E. Irrigation
1. If soil moisture is deficient, supply new seedings with adequate water for plant growth until they are firmly established. This is especially true when seedings are made late in the planting season, in abnormally dry or hot seasons, or on adverse sites.

END OF SECTION 015713

SECTION 015800 - PROJECT IDENTIFICATION

PART 1 - GENERAL

1.1 PROJECT SIGN

A. The Contractor shall be responsible for constructing, installing, maintaining and removing all project signs.

B. The Contractor shall be responsible for obtaining all permits for project signs from any local authority having jurisdiction including the payment of fees, if any.

C. The contractor shall install one project sign at a location to be determined by the Owner. The sign shall contain all of the data and graphics depicted on the attached exhibit SD-6-16 C.

D. See Bid Book Section 9, Special Requirements – EPA, Signage pages SR.EPA.45 to 48.

END OF SECTION 015800

SECTION 016600 - PRODUCT HANDLING AND PROTECTION

PART 1 - GENERAL

1.1 DELIVERY AND STORAGE OF MATERIALS

A. The Contractor shall be responsible for delivery and storage of all materials.

B. The Contractor shall coordinate with the Engineer on the arrangement for storing construction materials and equipment. Deliveries of all construction materials and equipment should be made at suitable times.

C. The Contractor shall store all materials required for the performance of this contract at sites designated by the Engineer.

D. All stockpiles shall be neat, compact, completely safe, and barricaded with warning lights if necessary.

E. Precautions shall be taken so that no shade trees, shrubs, flowers, sidewalks, driveways or other facilities will be damaged by the storage of materials. The Contractor shall be responsible for the restoration of all stockpile sites to their original condition.

F. Materials, tools and machinery shall not be piled or placed against shade trees, unless they shall be amply protected against injury therefrom. All materials, tools, machinery, etc. stored upon public thoroughfares must be provided with red lights at night time so as to warn the traffic of such obstruction.

G. Materials shall be so stored as to assure the preservation of their quality and fitness for the work. Stored materials, even though approved before storage, shall again be inspected prior to their use in the work. Stored materials shall be located so as to facilitate their prompt inspection. Approved portions of the construction site may be used for storage purposes and for the placing of the Contractor's plant and equipment, but any additional space required therefore must be provided by the Contractor at his expense. Private property shall not be used for storage purposes without written permission of the property owner or lessee, and copies of such written permission shall be furnished the Engineer. All storage sites shall be restored to their original condition by the Contractor at his expense.

END OF SECTION 016600

SECTION 016617 - MAINTENANCE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section provides general requirements for the maintenance of equipment in the field. Storage maintenance requirements are provided by Section 016600, Product Handling and Protection. Specific maintenance requirements are provided by manufacturers per individual Sections in the Project Manual.

B. Maintenance is performed to ensure delivery to the Owner of equipment in an undeteriorated and fully serviceable condition.

C. This Section also includes requirements for preventive and corrective maintenance during operation of the equipment prior to the commencement of the Warranty period.

1.2 RELATED SECTIONS

A. Section 016600, Product Handling and Protection.

1.3 DEFINITIONS

A. Storage maintenance consists of establishing and maintaining the environment required by the stored materials and performing periodic servicing.

B. Preventive maintenance consists of activities performed on a periodic basis to maintain operating or operational items or equipment.

C. Corrective maintenance consists of correcting faults or failures in an item or equipment. This may include adjustments or replacement of defective parts.

1.4 SUBMITTALS

A. The Maintenance Log shall be submitted to the Owner upon completion of the Operational Demonstration and before the start of the Warranty period.

B. No submittals are required by this Section, except as noted above. Maintenance schedules and practices shall conform to approved submittals required by individual Sections in the Project Manual.

PART 2 – PRODUCTS

2.1 COMPONENTS, ACCESSORIES AND REPAIR PARTS

A. All components, accessories and repair parts used in maintenance shall be supplied by or approved by the equipment manufacturer for use on the equipment.

2.2 SOURCE QUALITY CONTROL

A. All parts and materials used in maintenance shall meet the quality control requirements provided for the item or equipment. These are specified in individual Sections of the Project Manual.

PART 3 – EXECUTION

3.1 EXAMINATION AND VERIFICATION OF CONDITION

A. The Contractor shall prepare a Maintenance Log for all equipment.

1. This log shall include a list of required maintenance services and inspections, as provided by the manufacturer and submitted under individual Sections of the Project Manual.

2. The Maintenance Log shall include checklists for the periodic services and inspections required.

3. The Contractor shall initial and date the requisite log entries upon completion of the individual servicing or inspection.

4. The Maintenance Log shall be located in the Contractor's Field Office and shall be available for review by the Owner until it is submitted for record purposes upon completion of the Operational Demonstration and the start of the Warranty period.

3.2 PREPARATION

A. Before removing an item from storage per Section 016600, the Contractor all review the installed location. Protection and services at the installed location must meet the equipment storage requirements.

B. Before moving equipment to the installed location, the Contractor shall have available materials for temporary shelter or services required to establish the proper storage environment after the equipment is installed until it is placed in service in its final operating environment.

3.3 PERFORMANCE OF MAINTENANCE

A. The Contractor shall perform all storage and preventive maintenance and inspections required by the manufacturer at the specified intervals.

B. When notified by the Owner, the Contractor will perform corrective maintenance. This will be performed at no cost to the Owner. Corrective maintenance will be performed per manufacturer's written instructions or by direction of the approved representative of the manufacturer.

C. The Contractor shall restore equipment to its operating condition before start-up.

D. The Contractor shall re-establish storage maintenance in the event an item or equipment is removed from service.

E. When the equipment warranty becomes effective, the Owner will assume responsibility for its maintenance.

END OF SECTION 016617

SECTION 017800 - FINAL COMPLIANCE AND SUBMITTALS

PART 1 - GENERAL

1.1 The following forms and related sign-offs shall be documented in accordance with provisions of the contract. These forms shall be completed by the Contractor and approved by the Owner before final retainer is approved for release. Forms for Items A to E will be attached to the Contractor's executed copy of the contract.

A. Certificate of Substantial Completion (To be submitted at time of Substantial Completion).

B. Contractor's Certification of Completion.

C. Contractor's Affidavit of Prevailing Wage.

D. Consent of Surety Company for Final Payment.

E. Affidavit of Final Acceptance Date and Correction Period.

F. Before the OWNER will approve and accept the work and release the retainer, the CONTRACTOR will furnish the OWNER a written report indicating the resolution of any and all property damage claims filed with the CONTRACTOR by any party during the construction period. The information to be supplied shall include, but not be limited to, name of claimant, date filed with CONTRACTOR, name of insurance company and/or adjuster handling claim, how claim was resolved and if claim was not resolved for the full amount, a statement indicating the reason for such action.

G. DBE Subcontractor Participation Forms SR-EPA.7-8 (Applicable for WPCLF & WSRLA funded projects only).

H. Subcontractor List, Specification Section 011100 - 2 form (Applicable for CDBG funded projects only).

END OF SECTION 017800

SECTION 017821 - CLEANING AND PROTECTION

PART 1 - GENERAL

1.1 GENERAL

A. On or before the completion date for the work, the Contractor shall tear down and remove all temporary structures built by him, all construction plant used by him, and shall repair and replace all parts of existing embankments, fences or other structures which were removed or injured by his operations or by the employees of the Contractor. The Contractor shall thoroughly clean out all buildings, sewers, drains, pipes, manholes, inlets and miscellaneous and appurtenant structures, and shall remove all rubbish leaving the grounds in a neat and satisfactory condition.

B. As circumstances require and when ordered by the Engineer, the Contractor shall clean the road, driveway, and/or sidewalk on which construction activity under this contract has resulted in dirt or any other foreign material being deposited with an automatic self-contained mechanical sweeper with integral water spray, vacuum and on-board or supplementary containment.

C. Failure to comply with this requirement when ordered by the Engineer or his representative, may serve as cause for the Engineer to stop the work and to withhold any monies due the Contractor until such order has been complied with to the satisfaction of the Engineer.

D. As the work progresses, and as may be directed, the Contractor shall remove from the site and dispose of debris and waste material resulting from his work. Particular attention shall be given to minimizing any fire and safety hazard from form materials or from other combustibles as may be used in connection with the work, which should be removed daily.

E. The Contractor shall wash all windows and other glass surfaces, leaving all areas free from putty marks, paint, etc.

F. During and after installation, the Contractor shall furnish and maintain satisfactory protection to all equipment against injury by weather, flooding or breakage thereby permitting all work to be left in a new condition at the completion of the contract.

END OF SECTION 017821

SECTION 017839 - PROJECT RECORDS, DRAWINGS

PART 1 - GENERAL

1.1 RECORD DRAWINGS

A. The Contractor shall furnish an authentic set of marked-up drawings showing the installation insofar as the installation shall have differed from the Engineer's drawings. The drawings shall be delivered to the Engineer for making revisions to the original drawings immediately after final acceptance by the Owner.

B. The Contractor shall furnish dimensioned drawings indicating locations of all underground mechanical and electrical facilities.

1.2 SERVICE CONNECTION RECORDS

A. The Contractor shall record the location of all service and property connections, new or existing, made to utilities constructed under this contract. Such records shall be turned over to the Owner upon completion of the work. The cost of making such records shall be included in the various unit or lump sum prices stipulated for the various items of the work.

B. The location of each sewer connection as measured along the sewer from the nearest downstream manhole and its description with respect to the sewer shall be recorded. The record shall include the depth of new stubs for future connections and the depth of existing connections as measured from the surface grade. Also, the use of any vertical riser pipe shall be noted.

C. The location of each water connection as measured along the water line from the nearest fire hydrant.

END OF SECTION 017839

SECTION 024100 - DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. It is the intent of this section that the Contractor shall furnish all of the equipment, labor, and materials necessary to demolish various concrete structures and to remove, disconnect and/or transport some miscellaneous equipment from the site of the existing structure; together with all associated appurtenances as noted on the Contract Drawings, listed in the specifications herein, or as directed by the Engineer.

1.3 JOB CONDITION

A. The Contractor shall exercise all necessary precaution to protect adjacent properties and roadways from falling debris, material, and sections during the demolition process. All necessary barricades to protect pedestrians and vehicular traffic will be installed.

1.4 SUBMITTALS

A. The Contractor shall submit to the Engineer prior to the start of any proposed demolition, a written description of the method proposed to abandon, dismantle, or remove any of the structures or equipment located at the site. Under no circumstances will blasting or the use of explosives be allowed.

1.5 SCHEDULE

A. Demolition shall be scheduled and performed in strict conformance with these specifications and in a manner which will ensure no interruption of sewage pumping operations beyond that provided for and approved by the Owner and the Ohio EPA. The date and the time of commencing the separate items of demolition work shall be submitted to the Engineer for review, and no demolition work shall commence until the Engineer's approval of date and time for the specific operation is in the hands of the Contractor.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXCAVATION, DEMOLITION & REMOVAL

A. The Contractor shall be responsible for the excavation, demolition, removal, and transportation from the site of the facility.

OWNERSHIP & DISPOSAL OF MATERIALS

B. All salvaged material shall become the property of the Contractor.

C. All materials, whether they may be salvageable or not, shall be promptly removed from the construction site as demolition progresses. Material not sold for scrap value shall be transported to an approved land fill site for proper disposal.

END OF SECTION 024100

SECTION 024116 – STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. This section includes all demolition of existing structures and removal of pavement, piping, and equipment necessary to clear space for new construction and/or to rehabilitate existing construction.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

A. State and local code requirements shall control the disposal of debris resulting from the removal operation.

1.4 PROTECTION

A. Structures shall be removed in such a manner as not to damage portions of the existing structure which are to remain in place.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 PAVEMENTS, SIDEWALKS, CURBING, SIMILAR STRUCTURES

A. Removal of existing pavements, sidewalks, curbing, and similar structures shall end at an existing joint or a sawed joint. Sawed joints shall be straight, neat and free from chipped or damaged edges.

B. For removal of reinforced or nonreinforced concrete, the minimum depth of saw cut shall be 3 in.

C. For removal of reinforced concrete, the depth of saw cut shall be sufficient to cut the steel.

D. If the concrete is coated with a bituminous surface or other material, the depth shall be sufficient to cut into the concrete, not including the coating depth, as specified above.

3.2 EXCAVATION OF RIGID PAVEMENT

A. The Contractor shall excavate rigid pavement, consisting of concrete or concrete base with a wearing surface of brick or bituminous concrete, wherever such excavation is required for the purpose of this Contract.

B. Pavement shall be excavated to neat lines and, only to widths required for trenches, for pipe laying and for construction of structures. Adequate provision shall be made to prevent settlement and breakage of pavement beyond the approved limits of excavation.

C. All pavement broken or damaged beyond the limits above stated, or the approved extension thereof, shall be replaced by the Contractor at his expense.

3.3 MANHOLES, CATCH BASINS, INLETS AND SIMILAR STRUCTURES

A. Existing drainage structure designated by the Engineer to be removed shall be completely removed.

B. Catch basins, inlets, and similar structures designated to be abandoned shall be removed to an elevation of at least 3 ft. below the finished subgrade or ground surface. The remaining void shall be filled with selected backfill material compacted to 100% optimum density per ASTM D 698.

C. Manholes designated by the Engineer to be abandoned shall be adjusted to 1' below proposed ground grade and the casting welded closed or an 8" reinforced concrete slab placed over the manhole.

D. Live sewers connected to structures removed or abandoned shall be rebuilt through the area with new pipe. Sewer flow shall be maintained between removal and replacement operations. Abandoned sewers shall be sealed and made watertight with approved precast stoppers or masonry bulkheads.

E. All castings salvaged from abandoned or removed drainage structures shall remain the property of the Owner and shall be cleaned and transported by the Contractor to a site designated by the Engineer or incorporated in the work where called for on the Drawings, scheduled, or so directed.

3.4 GUARDRAIL AND FENCE

A. Where so required by the Drawings, existing guardrail and fence shall be carefully dismantled and stored for reuse or for salvage by the Owner.

B. Wood posts and other materials not considered salvageable by the Engineer shall be disposed of by the Contractor.

C. The Contractor will be required to replace, at no cost to the Owner, material lost or damaged by negligence or by the use of improper methods.

3.5 SUPERSTRUCTURES, TANKS, CHAMBERS AND SIMILAR STRUCTURES

A. Care shall be used in demolishing structural elements which are continuous with structural elements remaining in service. Concrete and masonry shall be cut with a masonry or concrete saw before removing unwanted portions.

B. Methods and equipment used in demolition work shall be chosen so the structural integrity and watertightness of both newly constructed and existing plant structures remain unimpaired by the performance of the demolition work.

C. Existing structures and equipment which are damaged in appearance and/or function by performance of demolition work shall be replaced or repaired to approved first-class condition by the Contractor at no increase in Contract Price.

D. Extreme care shall be used when removing existing concrete from around reinforcing steel which must be used for securing new concrete. If this reinforcing steel is damaged, the Contractor shall remove additional existing concrete until sufficient existing reinforcing steel is exposed to provide adequate imbedment length in the new concrete, as approved by the Engineer.

E. Abandoned pipes shall be sealed and made watertight with approved precast stoppers or masonry bulkheads.

3.6 EQUIPMENT REMOVAL

A. All equipment, valves, piping, fittings, and miscellaneous steel structures that are removed shall remain the property of the Owner and shall be stored at site selected by the Owner. The Owner reserves the right to require the Contractor to dispose of certain unwanted portions of removed equipment and materials. The Owner shall have the right to reject any or all materials removed during construction, and the Contractor shall haul away and dispose of these materials in a suitable manner at no additional cost to the Owner.

3.7 DISPOSAL OF DEBRIS

A. All debris resulting from demolition operations; i.e., broken concrete, masonry, pipe, miscellaneous metal, trees and brush, equipment, etc., shall be disposed of off-site.

B. The Contractor shall police the hauling of debris to ensure that all spillage from haul trucks is promptly and completely removed.

3.8 BACKFILLING

A. All trenches, holes, and pits resulting from the removal and abandonment of any structure or obstruction shall be backfilled and compacted in accordance with the requirements of Section 312333.

END OF SECTION 024116

SECTION 030000 - CONCRETE WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1. Section 013319 – Field Testing Requirements

1.2 SUMMARY

A. This Section specifies cast-in place concrete, including form work, reinforcing, mix design, placement procedures and finishes.

1. Extent of concrete work is shown on drawings.
2. Concrete paving and walks are specified in Division 2.
3. Precast concrete is specified in other Division-3 sections.
4. Mechanical finishes and concrete floor toppings are specified in other Division-3 sections.

1.3 SUBMITTALS

A. Product Data: Submit data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry-shake finish materials, and others as requested by Engineer.

B. Shop Drawings; Reinforcement: Submit original shop drawings prepared for fabrication, bending, and placement of concrete reinforcement. Comply with ACI Detailing Manual showing bar schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

C. Shop Drawings; Form work: Submit shop drawings prepared by a registered Professional Engineer for fabrication and erection of forms for specific finished concrete surfaces. Show form construction including jointing, special form joint or reveals, location and pattern of form tie placement, and other items which affect exposed concrete visually.

1. Engineer's review is for general architectural applications and features only. Design of form work for structural stability and efficiency is Contractor's responsibility.

D. Samples: Submit samples of materials as requested by Engineer, including names, sources, and descriptions.

E. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design tests.

1. The proposed mix design submittal(s) shall follow the procedures of Chapter 5, Sections 5.2 to 5.3 of ACI-318.
2. Reference should be made to ACI-211.5R "Guide for Submittal of Concrete Proportions" for the required submittal information. Sample forms for presenting the necessary information can be found in the addendum at the end of this section. Example Form B should follow a completed Example A in the submittal when laboratory trial batches are used to document a water-cementious materials ratio curve.
3. Additional data summarizing the past performance records should be an integral part of the submittal if the submittal is based on past performance with the proposed materials and proportions.

F. Materials Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted by Engineer. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following codes, specifications, and standards, latest revisions, except where more stringent requirements are shown or specified:

1. ACI 301 "Specifications for Structural Concrete for Buildings."
2. ACI 318 "Building Code Requirements for Reinforced Concrete."
3. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice."
4. ACI 347 "Guide to Form work for Concrete."
5. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

B. Materials and installed work may require testing and retesting at anytime during progress of work. Tests, including retesting of rejected materials for installed work, shall be done at Contractor's expense.

C. Engage a testing agency acceptable to Engineer to perform initial material evaluation and certification tests for mix designs and to design concrete mixes.

D. Mockup: Cast mockup of size indicated or as required to demonstrate typical joints, form tie spacing, and proposed surface finish, texture, and color. Maintain sample panel exposed to view for duration of project, after Engineer's acceptance of visual qualities.
1. Demolish mockup and remove from site when directed by Engineer.

E. Pre-installation Conference: Conduct conference at project site to comply with requirements of Division 1 Section "Project Meetings" and the following:

1. At least 35 days prior to submitting design mixes, conduct a meeting to review detailed requirements for preparing concrete design mixes and to determine procedures for satisfactory concrete operations. Review requirements for submittals, status of coordinating work, and availability of materials. Establish preliminary work progress schedule and procedures for materials, inspection, testing and certifications. Require representatives of each entity directly concerned with cast-in-place concrete to attend conference, including, but not limited to, the following:

a. Contractor's Superintendent
b. Agency responsible for concrete design mixes.
c. Agency responsible for field quality control.
d. Ready-mix concrete producer.
e. Concrete Subcontractor
f. Primary admixture manufactures.

1.5 PROJECT CONDITIONS

A. Protection of Footings Against Freezing: Cover completed work at footing level with sufficient temporary or permanent cover as required to protect footings and adjacent subgrade against possibility of freezing; maintain cover for time period as necessary.

B. Protect adjacent finish materials against spatter during concrete placement.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.

1. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood," Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least two (2) edges and one side for tight fit.

C. Forms for Textured Finish Concrete: Units of face design, size, arrangement, and configuration to match Engineer's control sample. Provide solid backing and form supports to ensure stability of textured form liners.

D. Forms for Cylindrical Columns and Supports: Metal, fiberglass reinforced plastic, or paper or fiber tubes. Construct paper or fiber tubes of laminated plies using water-resistant adhesive with wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist loads imposed by wet concrete without deformation.

E. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

F. Form Ties: Factory-fabricated, adjustable-length, snapoff metal or glass fiber-reinforced plastic form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units which will leave no metal closer than 1-1/2" to the exposed surface.

1. Provide ties which, when removed, will leave holes not larger than 1" diameter in concrete surface.
2. All form ties shall have a factor of safety of two (2) to determine the recommended safe working load.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Galvanized Reinforcing Bars: ASTM A 767, Class II (2.0 oz. zinc psf) hot-dip galvanized, after fabrication and bending.

C. Epoxy-Coated Reinforcing Bars: ASTM A 775.

1. Repair of damaged epoxy-coating - When required, damaged epoxy-coating shall be repaired with patching material conforming to ASTM A 775. Repair shall be done in accordance with the patching material manufacturer's recommendations.

D. Steel Wire: ASTM A 82, plain, cold-drawn steel.

E. Welded Wire Fabric: ASTM A 185, welded steel wire fabric. (Flat sheets only)

F. Welded Deformed Steel Wire Fabric: ASTM A 497.

G. Epoxy - Coated Welded Wire Fabric: ASTM A884, Class A.

H. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications.

1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

2.1 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I, II or I/II and ASTM C595M, Type IP, unless otherwise specified. (See Table I, Concrete Requirements).

1. Use one brand of cement throughout project, unless otherwise acceptable to Engineer.

B. Fly Ash: ASTM C 618, Class F.

1. Limit use of fly ash to not exceed 25% of cement content by weight.

C. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.

1. Limit use of granulated blast-furnace slag to not exceed 30% of cement content by weight.

D. Normal Weight Aggregates: ASTM C 33, and as herein specified. Provide aggregates from a single source for exposed concrete, with nominal maximum aggregate size of 1 inch.

1. For exterior exposed surfaces, do not use fine or coarse aggregates containing spalling-causing deleterious substances.
2. Local aggregates not complying with ASTM C 33 but which have shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to Engineer.
3. Combined Aggregate Gradation: Well graded from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 (0.3-mm) sieve, and less than 8 percent may be retained on sieves finer than No. 50 (0.3 mm).

E. Lightweight Aggregates: ASTM C 330.

Maximum nominal aggregate size of 1 inch.

F. Water: Drinkable and complying with ASTM C94.

G. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Air-Mix"; Euclid Chemical Co.
b. "Sika Aer"; Sika Corp.
c. "MB-VR or MB-AE"; Master Builders.

H. Water-Reducing Admixture: ASTM C 494, Type A, and containing not more than 0.1 percent chloride ions.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "WRDA"; W.R. Grace.
b. "Eucon WR-75"; Euclid Chemical Co.
c. "Pozzolith Normal"; Master Builders.

I. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C 494, Type F and containing not more than 0.1 percent chloride ions.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Sikament 300"; Sika Chemical Corp.
b. "Eucon 37"; Euclid Chemical Co.
c. "Rheobuild or Polyheed"; Master Builders.

J. Water-Reducing, Non-Chloride Accelerator Admixture: ASTM C 494, Type E, and containing not more than 0.1 percent chloride ions.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Accelguard 80"; Euclid Chemical Co.
b. "Pozzutec 20"; Master Builders.
c. "Daraset"; W.R. Grace & Co.

K. Water-Reducing, Retarding Admixture: ASTM C 494, Type D, and containing not more than 0.1 percent chloride ions.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Pozzolith"; Master Builders.
b. "Eucon Retarder 75"; Euclid Chemical Co.
c. "Plastiment"; Sika Chemical Co.

L. Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Catexol 1000CL; Axim Concrete Technologies.
b. MCI 2000 or MCI 2005; Cortec Corporation.
c. DCI or DCI-S; W.R. Grace & Co., Construction Products Div.
d. Rheocrete 222+; Master Builders, Inc.
e. FerroGard-901; Sika Corporation.

M. Prohibited Admixtures: Calcium chloride thyocyanates or admixtures containing more than 0.1 percent chloride ions are not permitted.

N. Fiber Reinforcement:

1. Synthetic fiber reinforcing shall be added to the concrete for the areas so indicated in the drawings. Only fibers designed and manufactured specifically for use in concrete shall be acceptable as secondary reinforcement, complying with ASTM C1116, not less than 3/4 inch long.
2. The fibers may be added at the batch plant. The incorporation of said fibers shall be documented on the delivery ticket from the ready mix producer. Fibers shall be added to the concrete in strict accordance with manufacturer's printed instructions. The minimum dosage rate shall be 1.5 lbs/cubic yard.
3. Nylon fibers containing 100% virgin nylon monofilaments shall be utilized to impart a "non-hairy" surface to the finished concrete.
4. Products: Subject to compliance with requirements, provide the following fibrous reinforcement or approved equal:

    a. Nycon Fiber; Nycon, Inc.
    b. Nylo-Mono; Forta Corp.
    c. Fibrasol N; Axim Concrete Technologies

2.2 RELATED MATERIALS

A. Reglets: Where resilient or elastomeric sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 26 gage galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.

B. Waterstops: Provide waterstops at construction joints and other joints as indicated and specified in Section 030000.02.

C. Granular Base: Evenly graded mixture of fine and coarse aggregates to provide, when compacted, a smooth and even surface below slabs on grade.

D. Vapor Retarder: Provide vapor retarder cover, ASTM E1745 Class C, over prepared base material where indicated below slabs on grade. Use only materials which are resistant to deterioration when tested in accordance with ASTM E 154, as follows:

1. Polyethylene sheet not less than 10 mils thick.
2. Water resistant barrier paper consisting of heavy Kraft papers laminated together with glass fiber reinforcement and over-coated with black polyethylene on each side.

    a. Product: Subject to compliance with requirements, provide Moistop Ultra 10 by Fortifiber Corporation, Stego Wrap 10-mil by Stego Industries or equal.

E. Non-Shrink Grout: CRD-C 621 and ASTM C-1107, factory pre-mixed grout.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Non-metallic

1) "Set Grout"; Master Builders.
2) "Euco-NS"; Euclid Chemical Co.
3) "Five Star Grout"; U.S. Grout Corp.

F. Non-slip Aggregate Finish: Provide fused aluminum oxide grits, or crushed emery, as abrasive aggregate for non-slip finish with emery aggregate containing not less than 50 percent aluminum oxide and not less than 25 percent ferric oxide. Use material that is factory-graded, packaged, rust-proof, and non-glazing, and is unaffected by freezing, moisture, and cleaning materials.

G. Colored Wear-Resistant Finish: Packaged, dry, combination of materials, consisting of Portland cement, graded quartz aggregate, coloring pigments, and plasticizing admixture. Use coloring pigments that are finely ground, non-fading mineral oxides, interground with cement. Color as selected by Engineer, unless otherwise indicated.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Colorcron"; Master Builders.
b. "Surflex"; Euclid Chemical Co.
c. "Lithochrome"; L.M. Scofield Co.

H. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

I. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.

1. Waterproof paper.
2. Polyethylene film.
3. Polyethylene-coated burlap.

J. Liquid Membrane-Forming Curing Compound: Liquid type membrane- forming curing compound complying with ASTM C 309, Type I, Class A. Moisture loss not more than 0.55 kg./sq. m. when applied at 200 sq ft./gal.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Masterkure"; Master Builders.
b. "Ecocure"; Euclid Chemical Co.
c. "Horn Clear Seal"; A.C. Horn, Inc.

K. Underlayment Compound: Freeflowing, self-leveling, pumpable cementitious base compound for applications from 1 inch thick to feathered edges.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Flo-Top"; Euclid Chemical Co.
b. "Underlayment 110," Master Builders, Inc.
c. "Thoro Underlayment Self-Leveling"; Thoro System Products.

L. Bonding Compound: Polyvinyl acetate or acrylic base.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Polyvinyl Acetate (Interior Only):

1) "Euco Weld"; Euclid Chemical Co.
2) "Weldcrete"; Larsen Products Corp.
3) "Everweld"; L&M Construction Chemicals, Inc.

b. Acrylic or Styrene Butadiene:

1) "Day-Chem AD Bond"; Dayton Superior Corp.
2) "Everbond"; L & M Construction Chemicals.
3) "SBR Latex"; Euclid Chemical Co.

M. Epoxy Adhesive: ASTM C 881, two component material suitable for use on dry or damp surfaces. Provide material "Type," "Grade," and "Class" to suit project requirements.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Epoxtite Binder 2390"; A.C. Horn, Inc.
b. "Sikadur 32 Hi-Mod"; Sika Chemical Corp.
c. "Euco Epoxy 452 or 620"; Euclid Chemical Co.

2.3 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301 and ACI 211. If the trial batch method is used, use an independent testing facility acceptable to Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing unless otherwise acceptable to Engineer.

1. Limit use of fly ash to not exceed 25 percent of cement content by weight.

B. Submit written reports to Engineer and Structural Engineer of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Engineer.

C. Design mixes to provide normal weight concrete with the following properties, as indicated in Table I.:

TABLE 1

CONCRETE REQUIREMENTS

Concrete Class	Cement Type	Min. 28-Day Compressive Strength PSI	*Max. Water-Cement Ratio	Min. Cement Content Sacks	Slump Min.	Inch Max.	Entrained Air %
A	I	4000	0.45	6	-	-	6±1
B	I	2000	0.74	4-1/2	2	6	5±1-1/2
C	I	4000	0.50	6.38	1	4	6±2
D	II or IP	4000	0.45	6	-	-	6±1

*Maximum Water - Cementitious Materials Ratio

1. All reinforced concrete shall be Class A, except as otherwise specified or shown on the drawings.
2. Concrete used for mud mats, fill and channeling in manholes and chambers shall be Class B unless otherwise noted on the drawings.
3. Class C concrete conforming to ODOT 499 (Class C) shall be used for all concrete pavement, curbing, driveways, and sidewalks, unless noted otherwise on the drawings.
4. Class B concrete may be used for encasing pipelines, fill, and pipe bedding.
5. Class B concrete shall be used as concrete fill in concrete tanks for shaping or sloping bottoms.

    a. The following steps shall be taken for installation of the Class B concrete:

        1) Scrub concrete slabs and/or walls with a stiff wire brush and streams of clean water as a minimum, to remove laitenance.
        2) Apply a bonding agent in accordance with the manufacturer's surface preparation and application recommendations.
        3) The Class B concrete shall then be placed and screeded to bring the surface to final grade.

6. Class D concrete shall be used for sewerage treatment plants and sewerage pump stations, as noted on the drawings.

D. Lightweight Concrete: Lightweight aggregate and concrete shall conform to ASTM C 330. Proportion mix to produce concrete with a minimum compressive strength of 3000 psi at 28 days and a calculated equilibrium unit weight of 110 pcf plus or minus 3 pcf as determined by ASTM C 567. Concrete slump at the point of placement shall be the minimum necessary for efficient mixing, placing, and finishing. Maximum slump shall be 6 inches for pumped concrete and 5 inches elsewhere. Air entrain concrete exposed to weather according to ACI 301 requirements.

E. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in work.

F. Admixtures:

1. Use high range water-reducing admixture (super plasticizer) in Classes A and D concrete unless noted otherwise.
2. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F (10 deg C).
3. Use air-entraining admixture in all concrete, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content within limits shown in Table I.
4. Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.
5. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as shown in Table I:

    a. Concrete containing HRWR admixture (super-plasticizer): Not more than 8" after addition of HRWR to site-verified 2"-3" slump concrete.

2.4 CONCRETE MIXING

A. Job-Site Mixing: Mix materials for concrete in appropriate drum type batch machine mixer. For mixers of one cu. yd., or smaller capacity, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than one cu. yd., increase minimum 1-1/2 minutes of mixing time by 15 seconds for each additional cu. yd., or fraction thereof.

1. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.

B. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified.

1. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.

    a. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.

3.2 FORMS

A. Design, erect, support, brace, and maintain form work to support vertical and lateral, static, and dynamic loads that might be applied until such loads can be supported by concrete structure. Construct form work so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain form work construction tolerances complying with ACI 347.

B. Design form work to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.

C. Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.

D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.

E. Provide temporary openings where interior area of form work is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.

F. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

G. Provisions for Other Trades: Provide openings in concrete form work to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

H. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retightening forms and bracing after concrete placement if required to eliminate mortar leaks and maintain proper alignment.

3.3 VAPOR RETARDER INSTALLATION

A. Following leveling and tamping of granular base for slabs on grade, place vapor retarder sheeting with longest dimension parallel with direction of pour.

B. Lap joints 6" and seal with manufacturer's recommended mastic or pressure-sensitive tape.

3.4 PLACING REINFORCEMENT

A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports, and as herein specified.

1. Avoiding cutting or puncturing vapor retarder during reinforcement placement and concreting operations. Repair damages before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement by form work, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in longest lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

F. Epoxy - Coated Reinforcing Steel:

1. Epoxy-coated reinforcing bars supported from form work shall rest on coated wire bar supports, or on bar supports made of dielectric material or other acceptable materials. Wire bar supports shall be coated with dielectric material for a minimum distance of 2 inches from the point of contact with the epoxy-coated reinforcing bars. Reinforcing bars used as support bars shall be epoxy-coated.

   In walls having epoxy-coated reinforcing bars, spreader bars where specified by the Engineer, shall be epoxy-coated. Proprietary combination bar clips and spreaders used in walls with epoxy-coated reinforcing bars shall be made of corrosion-resistant material.

2. Epoxy-coated reinforcing bars - Equipment for handling epoxy-coated bars shall have protected contact areas. Bundles of coated bars shall be lifted at multiple pick-up points to minimize bar-to-bar abrasion from sags in the bundles. Coated bars or bundles of coated bars shall not be dropped or dragged. Coated bars shall be stored on protective cribbing. Fading of the color of the coating shall not be cause for rejection of epoxy-coated reinforcing bars. Coating damage due to handling, shipment and placing need not be repaired in cases

where the damaged area is 0.1 square inches or smaller. Damaged areas larger than 0.1 square inches shall be repaired in accordance with the epoxy material manufacturer's recommendations. The maximum amount of damage including repaired and unrepaired areas shall not exceed 2 percent of the surface area in each linear foot of each bar.

3.5 JOINTS

A. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Engineer.

1. Provide keyways at least 1-1/2" deep in construction joints in walls, slabs, and between walls and footings; accepted bulkheads designed for this purpose may be used for slabs.
2. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, except as otherwise indicated.

B. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions.

C. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

1. Joint filler and sealant materials are specified in Section 030000.02 of these specifications.

D. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction joints in slabs-on-ground to form panels of patterns as shown. Use inserts 1/4 of slab depth, unless otherwise indicated.

1. Form contraction joints by inserting premolded plastic strips into fresh concrete until top surface of strip is flush with slab surface.
2. Follow the directions of Insert Manufacturer for finishing the slab and joints.

E. If joint pattern not shown, provide joints not exceeding 15' in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third-bays).

1. Joint sealant material is specified in Section 030000.02 of these specifications.

3.6 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto. Electrical conduit shall not be embedded in concrete.

B. Install reglets to receive top edge of foundation sheet waterproofing, and to receive thru-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.

C. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units to support screed strips using strike-off templates or compacting type screeds.

3.7 PREPARATION OF FORM SURFACES

A. Clean re-used forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition.

B. Coat contact surfaces of forms with an approved, nonresidual, low-VOC, from-coating compound before placing reinforcement.

C. Thin form-coating compounds only with thinning agent of type, amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

D. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel form work is not acceptable.

3.8 CONCRETE PLACEMENT

A. Preplacement Inspection: Before placing concrete, inspect and complete form work installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.

1. Apply temporary protective covering to lower 2' of finished walls adjacent to poured floor slabs and similar conditions, and guard against spattering during placement.

B. General: Comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete," and as herein specified.

1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.

C. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.
2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

D. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

1. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
3. Maintain reinforcing in proper position on chairs during concrete placement operations.

E. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.

1. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C), and not more than 80 deg F (27 deg C) at point of placement.

    a. The concrete shall be maintained within this temperature range for not less than seven (7) days.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials or against cold reinforcing steel.
3. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

F. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F (32 deg C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.

2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
3. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.
4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Engineers.

3.9 FINISH OF FORMED SURFACES

A. Rough Form Finish: For formed concrete surfaces not exposed-to- view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.

B. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system. This is an as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed; provide smooth rubbed finish to smooth form finish. Refer to "Concrete Surface Repairs."

C. Smooth Rubbed Finish: Provide smooth rubbed finish to scheduled concrete surfaces, which have received smooth form finish treatment.

1. Scarify or roughen entire surface by grinding or similar effective means.
2. Combined one part Portland cement to 1-1/2 parts fine sand by volume and a 50:50 mixture of acrylic or styrene butadiene-based bonding admixture and water to form the consistency of thick paint. Blend standard Portland cement and white Portland cement, amounts determined by trial patches, so that final color of dry grout will match adjacent surfaces.
3. Thoroughly wet concrete surfaces and apply grout to coat surfaces and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.
4. Repeat the above process if necessary to fill voids or bug holes and obtain a consistent match to adjacent surfaces, subject to acceptance of the Engineer.

D. Grout Cleaned Finish: Provide grout cleaned finish on scheduled concrete surfaces which have received smooth form finish treatment.

1. Scarify or roughen entire surface by grinding or similar effective means.
2. Apply Thoroseal plaster mix coating by Thoro System Products or approved equivalent with an approximate thickness of 1/8-inch to ¼-inch.
3. Follow the manufacturer's recommendations and guidelines regarding surface preparation, application methods and curing.
4. Repeat the above process if necessary to fill voids or bug holes and obtain a consistent match to adjacent surfaces, subject to acceptance of the Engineer.

E. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 MONOLITHIC SLAB FINISHES

A. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, Portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated.

1. After placing slabs, plane surface to tolerances for floor flatness F(F) 15 and floor levelness F(L) 13, measured according to ASTM E 1155. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms, or rakes.

B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated.

1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both, Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to tolerances of F(F) 18 F(L) 15. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

C. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.

1. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances of F(F), 20 and F(L) 17, measured according to ASTM E1155. Grind smooth surface defects which would telegraph through applied floor covering system.

D. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.

E. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

F. Non-slip Aggregate Finish: Apply non-slip aggregate finish to concrete stair treads, platforms, ramps, sloped walks, and elsewhere as indicated.

1. After completion of float finishing, and before starting trowel finish, uniformly spread 25 lbs. of dampened non-slip aggregate per 100 sq. ft. of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface. After broadcasting and tamping, apply trowel finishing as herein specified.
2. After curing, lightly work surface with a steel wire brush, or an abrasive stone, and water to expose non-slip aggregate.

G. Colored Wear-Resistant Finish: Provide colored wear-resistant finish to monolithic slab surface indicated.

1. Apply dry shake materials for colored wear-resistant finish at rate of not less than 100 lbs. per 100 sq. ft., unless greater amount is recommended by material manufacturer.
2. Immediately following first floating operation, uniformly distribute approximately 2/3 of required weight of dry shake material over concrete surface, and embed by means of power floating. Follow floating operation with second shake application, uniformly distributing remainder of dry shake material with overlapping applications, and embed by power floating.
3. After completion of broadcasting and floating, apply trowel finish as herein specified. Cure slab surface with curing compound recommended by dry shake hardener manufacturer. Apply curing compound immediately after final finishing.

3.11 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Protect concrete from rapid moisture loss before and during finishing operations.
1. The evaporation graph, Figure 1, of ACI 308 - Curing Concrete, shall be used to determine the evaporation rate during concrete placement. If the rate of evaporation equals or exceeds 0.2 lbs/sq.ft./hr., steps shall be taken to prevent excessive evaporation from the surface.
2. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing.

a. Initial curing may be any of the methods listed herein that maintain a satisfactory moisture content and temperature.

3. Begin final curing procedures, if they differ from initial curing, immediately following initial curing and before concrete has dried. Continue curing for at least seven (7) days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

B. Curing Methods: Perform curing of all structural concrete as herein specified.

1. Provide moisture curing by following methods.

a. Keep concrete surface continuously wet by covering with water.
b. Continuous water-fog spray.
c. Cover concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.

2. Provide moisture-cover curing as follows:

a. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

C. Provide curing and sealing compound to pavement, walks, and curbs only, as follows:

1. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours) and after surface water sheen has disappeared. Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within three (3) hours after initial application. Maintain continuity of coating and repair damage during curing period.

D. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

E. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by moist curing methods.

1. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.

3.12 SHORES AND SUPPORTS

A. Comply with ACI 347 for shoring and reshoring in multistory construction, and as herein specified.

B. Extend shoring from ground to roof for structures four (4) stories or less, unless otherwise permitted.

C. Extend shoring at least three (3) floors under floor or roof being placed for structures over four (4) stories. Shore floor directly under floor or roof being placed, so that loads from construction above will transfer directly to these shores. Space shoring in stories below this level in such a manner that no floor or member will be excessively loaded or will

induce tensile stress in concrete members where no reinforcing steel is provided. Extend shores beyond minimums to ensure proper distribution of loads throughout structure.

D. Remove shores and reshore in a planned sequence to avoid damage to partially cured concrete. Locate and provide adequate reshoring to safely support work without excessive stress or deflection.

1. Keep reshores in place a minimum of 15 days after placing upper tier, and longer if required, until concrete has attained its required 28-day strength and heavy loads due to construction operations have been removed.

3.13 REMOVAL OF FORMS

A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for five (5) days after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days or until concrete has attained at least 75 percent of design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members. Lab cured cylinders will not be considered.

C. Form facing material may be removed five (5) days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

3.14 RE-USE OF FORMS

A. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new form work.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Engineer.

3.15 MISCELLANEOUS CONCRETE ITEMS

A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment with template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

1. Grout base plates and foundations as indicated, using specified non-shrink grout. Use non-metallic grout for exposed conditions, unless otherwise indicated.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads and landings and associated items. Cast-in safety inserts and accessories as shown on drawings. Screed, tamp, and finish concrete surfaces as scheduled. Cure concrete as herein specified.

E. Reinforced Masonry: Provide concrete grout conforming to ASTM C476 for reinforced masonry lintels and bond beams where indicated on drawings and as scheduled. Maintain accurate location of reinforcing steel during concrete placement.

3.16 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Engineer.

1. Saw-cut out honeycomb, rock pockets, voids over 1/4" in any dimension, down to solid concrete but, in no case to a depth of less than 1." Make edges of cuts slightly undercut to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.
2. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

B. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Engineer. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with Portland Cement patching mortar, or precast cement cone plugs secured in place with bonding agent. When other materials are used, apply them in accordance with manufacturer's recommendations.

1. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
2. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces

sloped to drain for trueness of slope, in addition to smoothness using a template having required slope.

3. Repair finished unformed surfaces that contain defects which affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01" wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.
4. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.
5. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to Engineer.
6. Repair defective areas, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4" clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair isolated random cracks and single holes not over 1" in diameter by dry-pack method. Groove top of cracks and cut-out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry pack after bonding compound has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.
8. Perform structural repairs with prior approval of Engineer or Structural Engineer for method and procedure, using specified epoxy adhesive and mortar.
9. Repair methods not specified above may be used, subject to acceptance of Engineer.
10. Underlayment Application: Leveling of floors for subsequent finishes may be achieved by use of specified underlayment material.

3.17 THROUGH SECTION CONCRETE CRACK REPAIRS

A. Sealing through wall or slab cracks.

1. Seal cracks for a water-tight or structurally bonded repair with epoxy or chemical grouting procedures.

    a. The Contractor shall make proper repairs with epoxy injection or chemical injection with a moisture reactive hydrophilic polyurethane foam grout, as directed by the Engineer.

3.18 MUD MATS

A. Where called for on the plans or as directed by the Engineer, the Contractor shall construct concrete mud mats immediately after cleaning the excavation bottom, to preserve the bearing surface condition. Concrete for mud mats shall be not less than 3 in. thick. Bottom of excavation shall be free of water, mud and loose material prior to mud mat placement. See Section 310000.

1. Mud mat concrete shall be cast against the side walls of all excavations to completely seal the bottom.

ADDENDUM
EXAMPLE FORM A

CONCRETE SUPPLIER:_____

PROJECT:_____ CONTRACTOR:_____

MIXTURE ID:_____ SPECIFIED f'c:_____PSI

MATERIAL MIXTURE PROPORTIONS lbs-mass/cu.yd. (pcy)

1.0 Cement Type_____ Source:_____

Sp. Gr._____ _____pcy _____cu. ft.

1.1 Other Cementitious Materials:_____ Class:_____ Source:_____

Sp. Gr._____ _____pcy _____cu. ft.

2.0 Aggregate (No. 1) Type:_____ Size:_____ Source:_____

SSD Sp. Gr._____ _____pcy _____ cu. ft.

Dry Rodded Unit Wt.:_____pcf

Alternate (No. 1) Lightweight Aggregate Type:_____ Size:_____Source:_____

Sp. Gr. Factor _____ over dry pcy _____ cu. ft.

Loose Unit Wt._____pcf Estimated Wet_____pcf

2.1 Aggregate (No. 2) Type:_____ Size:_____ Source:_____

SSD Sp. Gr._____ _____pcy _____cu. ft.

Dry Rodded Unit Wt.: _____pcf (If Fine Sized - FM _____)

2.2 Aggregate (Nos. 3, 4, n) Type:_____ Size:_____ Source:_____

SSD Sp. Gr._____ _____pcy _____cu. ft.

Dry Rodded Unit Wt.: _____pcf

3.0 Water: _____gal. _____pcy _____cu. ft.

4.0 Admixtures expressed as fluid ounces/cubic yard, and estimated range

Source:_____ Name:_____ Type_____ _____oz

Source:_____ Name:_____ Type_____ _____oz

Source:_____ Name:_____ Type_____ _____oz

Total Admixture Liquid Vol. _____ cu. ft.

(*) Note: Show volume in 4.0 if not included in cubic feet of air or water.

5.0 Other Materials - fibers, color pigment or other additions

Sp. Gr._____ _____pcy _____cu. ft.

Total Mixture Mass and Volume: _____pcy _____cu. ft.

Fresh Concrete Properties

Slump _____ +/-_____ in.

Unit Weight _____ pcf

Air Content _____+/-_____%

If Trail Batch Data -

Identify Batch No. _____

Batch Date _____

Concrete Temp._____°F

Comp. Strength-Average _____°F

Coarse & Fine Aggregate Gradation

Percent Passing

Sieve Size	Aggregate No. 1	2	3	4	Combined
2 in.	____	____	____	____	_____
1-1/2 in.	____	____	____	____	_____
1 in.	____	____	____	____	_____
3/4 in.	____	____	____	____	_____
1/2 in.	____	____	____	____	_____
3/8 in.	____	____	____	____	_____
No. 4	____	____	____	____	_____
No. 8	____	____	____	____	_____
No. 16	____	____	____	____	_____
No. 30	____	____	____	____	_____

7 day avg. _____psi	No. 50	____ ____ ____ ____ _____
28 day avg. _____psi	No. 100	____ ____ ____ ____ _____
	No. 200	____ ____ ____ ____ _____

Comments:_____

_____

Signature: _____ Date:_____

Title: _____

Organization: _____

EXAMPLE FORM B

CONCRETE SUPPLIER:_____

MATERIAL	TRAIL BATCH NUMBER - proportions per cubic yard			
	1	2	3	4
1.0 Cement Source: _____				
Type ____	_____lb	_____lb	_____lb	_____lb
1.1 Other Cementitious Material Sources:_____				
Type ____	_____lb	_____lb	_____lb	_____lb
2.0 Aggregate No. 1 Size_____ Source:_____				
SSD ____	_____lb	_____lb	_____lb	_____lb
Alternate No. 1 Lightweight Aggregates Type _____ Source: _____				
Sp. Gr. Factor _____				
Oven Dry	_____lb	_____lb	_____lb	_____lb
Wet	_____lb	_____lb	_____lb	_____lb
2.1 Aggregate No. 2 Size_____ Source:_____				
SSD ____	_____lb	_____lb	_____lb	_____lb
2.2 Aggregate Nos. 3, 4, n) Size_____Source:_____				
SSD ____	_____lb	_____lb	_____lb	_____lb
3.0 Water	_____lb	_____lb	_____lb	_____lb
4.0 Admixtures Source: _____				
_____ Type _____	_____oz	_____oz	_____oz	_____oz
_____ Type _____	_____oz	_____oz	_____oz	_____oz
_____ Type _____	_____oz	_____oz	_____oz	_____oz

EXAMPLE FORM B (CONTINUED)

5.0 Other Materials

_____ Type _____ _____lb _____lb _____lb _____lb

Total Mass: _____lb _____lb _____lb _____lb

Total Mass/cy: _____pcy _____pcy _____pcy _____pcy

Relative Cubic Yard Volume:
_____cy _____cy _____cy _____cy

Water-Cementitious Material Ratio:

Fresh Concrete Properties

TRAIL BATCH NUMBER

	## -1	## -2	## -3	## -4
Slump-inches	_____	_____	_____	_____
Air-Content %	_____	_____	_____	_____
Unit Wt. pcf	_____	_____	_____	_____
Concrete Temp. °F	_____	_____	_____	_____

Compressive Strength Results (ASTM C192, C39) or Other Specified Test Requirements

7 days	_____	_____	_____	_____
	_____	_____	_____	_____
	_____	_____	_____	_____
Average (7 day)	_____	_____	_____	_____

28 days	_____	_____	_____	_____
	_____	_____	_____	_____
	_____	_____	_____	_____
Average (28 day)	_____	_____	_____	_____
Water-Cementitious Material Ratio:				
	_____	_____	_____	_____

Signature: _____ Date:_____

Title:_____

Organization: _____

END OF SECTION 030000

SECTION 030000.02 - EXPANSION AND CONSTRUCTION JOINTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to the work of this section.

1.2 DESCRIPTION OF WORK

A. This work includes furnishing and installing all joints where necessary.

B. In general, the work may include the following types of joints:

1. Types A, D, E, F, H and J Expansion Joint
2. Types B and L Waterstop Construction Joint
3. Types C and G Isolation Joints
4. Type K Construction Joint
5. Type CJ Control Joint

C. Refer to the contract drawings and specifications for locations and details of the joints to be used.

PART 2 - PRODUCTS

2.1 MATERIALS

A. The non-extruding preformed filler for joint Types A, C, D, E, F, J, L, and M shall conform to the requirements of "Standard Specifications for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction" ASTM D 1752, Type I, Sponge Rubber. Preformed filler shall be "Sponge Rubber" as manufactured by W.R. Meadows Company, Everlastic 1300 Series concrete gray sponge by Williams Products, Inc. or equal.

B. The preformed filler for joint Type H shall conform to the requirements of ASTM D 1752, Type III, self-expanding cork. Self-expanding cork shall be as manufactured by W.R. Meadows Company, or equal.

C. Preformed filler strips up to one (1) inch thickness shall be made as a single piece. Strips greater than one (1) inch thickness shall be fabricated by cementing together a minimum number of pieces. All cementing or vulcanizing shall be done at the point of manufacture.

D. The joint sealer shall be cold applied in accordance with manufacturer's recommendations.

1. Where the joint is not in contact with water, "No-Trak" as manufactured by A.C. Horn, Inc., "Gardox" by W.R. Meadows, Inc., or equal, shall be used.

2. Where the joint is in contact with water, "Sikaflex-IA" as manufactured by Sika Corporation, or equal shall be used.

E. Extruded polyvinyl chloride (PVC) waterstops for Type "C" joint shall be nine (9) inches in width, not less than three-eighths (3/8) inch in thickness; Type "L" joint shall be four (4) inches wide, not less than three-sixteenths (3/16) inch in thickness; Types "G" and "J" joint shall be six (6) inches in width, not less than three-eighths (3/8) inch in thickness and all waterstops shall be of corrugated construction. Types "C", "G", and "J" shall have a center bulb and corrugated ends. The waterstops shall be made continuous by use of factory made fittings and field jointing by heat welding in accordance with the manufacturer's recommendations. PVC waterstops shall be as manufactured by Vinylex Corporation, Greenstreak Products, or equal. Provide a test report for each lot of waterstops shipped to the job site.

F. Type "B" joints shall be as detailed on the drawings. The preformed plastic waterstops shall meet or exceed all requirements of Federal Specifications SS-S-210A, "Sealing Compound for Expansion Joints". Such preformed plastic waterstop shall be "Snyko-Flex" waterstop manufactured by Synko-Flex Products, 2100 Travis Street, Houston, Texas, or an approved equivalent.

G. Elastomeric bearing pad in joint Type "G" shall be 50 durometer Everlastic 1200 Series Neoprene as manufactured by William Products, Inc., or equal.

H. Type "K" joint shall be constructed as detailed on the drawings.

I. Type "CJ" premolded insert shall be "Speed-E-Joint" by W.R. Meadows, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Form work shall be designed to hold the preformed filler in alignment within the joint during and after concrete is poured. General description of the joints are as follows:

1. Type "A", "D", "E" and "F" expansion joints shall consist of non-extruding preformed filler only to separate the adjoining faces of concrete without the use of a waterstop. The top shall be finished by a joint sealer for slabs. Unless otherwise shown, preformed filler shall be three-fourths (3/4) inch thick and shall be of a width equal to the faces of concrete which it is separating. Where required, the preformed filler shall be attached to concrete by the use of an approved adhesive. Apply bond breaker to edge of preformed filler material only, prior to placing joint sealer. The joint sealer shall bond only to the concrete surfaces.
2. Type "B" waterstop construction joint shall consist of a standard construction joint and waterstop as detailed on the drawings.
3. Types "C" and "J" joint shall consist of preformed filler material, waterstop and joint sealer as detailed on the drawings.
4. Type "G" joint shall consist of an elastomeric bearing pad and waterstop as detailed on the drawings.

5. Type “H” joint shall consist of self-expanding cork to separate the adjoining faces of concrete without the use of a waterstop. The top shall be finished by a joint sealer.
6. Type “CJ” Control joints shall be made by inserting a removable preformed insert to create a joint which is then filled with a joint sealer, if required.
7. Type “K” joint shall consist of a standard construction joint, a saw cut, and joint sealer as detailed on the drawings.

B. PVC waterstops shall be wired to the reinforcing steel every 12” to prevent misalignment during concreting.

END OF SECTION 030000.02

SECTION 034000.04 - PRECAST CONCRETE CATCH BASINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Under this section the Contractor shall furnish and construct precast catch basins of designated types at locations shown on the Drawings and/or scheduled.

B. This section includes furnishing and installing concrete of classes called for, reinforcing steel, brick, Portland cement mortar, precast concrete inlet structures, flexible joints where specified, inlet castings, making watertight connections to new and existing sewers, and other incidental work.

1.3 QUALITY ASSURANCE

A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.4 DEFINITIONS

A. Types of catch basins included under this section shall be as designed and detailed on the Drawings.

B. The term catch basins as used herein refers to nomenclature of standard drawings for specified structures and of details shown on the Drawings.

1.5 SUBMITTALS

A. Manufacturer's Shop Drawings and Certificates:

1. Precast Catch Basins
2. Flexible Joints

B. Supplier's Certificates

1. Brick

1.6 PROTECTION

A. Adequate precautions shall be taken to prevent concrete and/or mortar from freezing. Brick, having a temperature of 40 degrees F or less shall not be set with mortar until heated for a period sufficient to insure a temperature of 50 degrees F to 80 degrees F throughout the entire mass of material.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Precast Concrete Catch Basin Sections

1. Precast concrete catch basin sections, flat slab tops, and adjusting rings shall conform to ASTM C 478.
2. Joints shall be O-ring type conforming to ASTM C 443.
3. The standard length of riser sections shall be 48 in. Lengths of 32 in. or 16 in. shall be used to meet required dimensions and as specified.
4. Openings for connecting pipes in riser sections, bottom riser sections, and integral base sections, and for access in flat slabs shall be preformed or cored by the manufacturer. Cut-out openings shall be made immediately after the pipe is removed from the casting form. All cored openings for sewer pipe connections shall have flexible joints.
5. Precast integral base sections shall be of monolithic construction. The bottom of the section shall be 6 in. thick minimum and contain 0.32 sq. in. minimum of steel reinforcing each way in top of the slab. Walls shall meet ASTM C 478.

B. Catch Basin Frames and Covers

1. Catch Basin frames and covers shall be as shown on the Drawings.

C. Flexible joints for precast catch basins pipe openings herein specified shall conform to ASTM C 923, "A-Lok" Type as manufactured by A-Lok Products, "Kor-N-Seal" Type as manufactured by National Pollution Control systems, Inc., or equal.

PART 3 - EXECUTION

3.1 LOCATION AND CONSTRUCTION

A. Location and type of catch basin installed shall be as shown on the Drawings or directed.

B. Construction shall be in conformance with details shown on the Drawings and as specified.

3.2 INSTALLATION OF INTEGRAL BASE SECTIONS

A. Concrete shall be poured to provide a minimum of 4-in. thick pad under the entire area of the catch basin. Place the catch basin on the pad before the concrete is completely set so that final leveling adjustment can be made.

B. Six inch (6") granular backfill bedding can be used in lieu of concrete at the direction of the Engineer.

3.3 INSTALLATION OF CAST-IN-PLACE BASES

A. Unless otherwise called for on the Drawings or directed, precast bottom riser sections shall be placed with cast-in-place concrete bases.

B. The base shall be of concrete 9 in. thick minimum placed on undisturbed earth.

C. The cut-out riser section shall be blocked in place above the pipe and the concrete base poured in place. Concrete shall be extended above the lower rim of the riser wall as required to provide a watertight seal around the entire circumference of the riser section.

D. On straight runs the Contractor may carry the sewer pipe through the catch basin and break out the top half after the fill concrete has set. In all cases the sewer pipe shall extend through the catch basin wall to the inside face.

3.4 PRECAST CONCRETE RISER SECTIONS

A. The shortest length of riser section to be incorporated into the catch basin shall be installed immediately below the flat slab top.

3.5 INSTALLATION OF CATCH BASIN FRAMES

A. Catch basin frames and covers shall be installed to grades shown on the Drawings or as directed.

B. Adjustment of catch basin castings shall be made using specified brick or precast adjusting rings and Portland cement mortar joints. The entire outer surface of adjusting rings and castings shall be plastered with 1 in. minimum Portland cement mortar unless otherwise detailed on the Drawings or directed.

C. The maximum depth of adjustment below any catch basin casting shall be 16 in.

END OF SECTION 034000.04

SECTION 129300 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications sections, apply to work of this section.

1.2 SUMMARY

A. Extent and location of the site furnishings are shown on the drawings.

1. Benches
2. Waste Receptacles
3. Dog Waste Station
4. Bat Boxes
5. Curved Metal Arbor
6. Solar Lights
7. Park Signs
8. Flag Pole with lights

1.3 QUALITY ASSURANCE

A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

Manufacturing Standards: Provide site furnishings as complete units produced by a single manufacturer, including any appurtenances.
ODOT Item 499 Concrete, General
ODOT Item 511 Concrete for Structures

1.4 JOB CONDITIONS

A. Delivery, storage, and handling.

1. Handle and store to prevent damage, or soiling, or breakage.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Subject to compliance with requirements, provide products of the following or Owner approved equal:

1. Bench with back

a. Manufacturer: Landscape Forms
b. Catalog No: Model Gretchen with Polysite high-density polyethylene bench seat material.
c. Color: Frame to be powder coated black and bench material bark
d. Supplier: Landscape Forms 800-430-6209

2. Stone Bench:
   a. Catalog No: 20-22" wide x 4'-5' length x 18" height stone blocks
   b. Color: Full Color Sandstone
   c. Finish: Split face front and back, sawn bottom, top and ends
   d. Supplier: Cleveland Quarries 440-963-4008 or approved local supplier.

3. Waste Receptacle:
   a. Manufacturer: Landscape Forms
   b. Catalog No.: Model Gretchen with side opening. Slats to be Polysite high density polyethylene material
   c. Color: Frame to be powder coated black and bench material bark
   d. Supplier: Landscape Forms 800-430-6209

4. Dog Waste Station:
   a. Manufacturer: DOG-ON-IT
   b. Catalog No.: Model 7408S, Complete waste station, single pull.
   c. Color: Frame to be powder coated black
   d. Supplier: 877-348-3647

5. Bat Boxes:
   a. Manufacturer: Big Bat Box
   b. Catalog No.: Triple Chamber bat box
   c. Color: Cedar
   d. Supplier: wecare@bigbatbox.com www.bigbatbox.com

6. Curved Metal Arbor:
   a. Curved arbor shall be 39' long x 8' wide and 10' eave height
   b. Materials: Steel columns, straight steel slats, curved beams
   c. Color: Ecoat/powder coated frame, color tan as approved by the Owner
   d. Manufacturer: ICON Shelter Systems
   e. Catalog No: AT10X39-10K
   f. Supplier: DWA Recreation 800-762-7936

7. Solar Light Poles
   a. Manufacturer: Firstlight Technologies
   b. Catalog No: IPL-PTM-BK-T4-NW-09 Solar LED light pole
   c. Color: lantern and post to be black
   d. Supplier**:** Firstlight Technologies 844-279-8754

8. Informational Kiosk signs, Single Sided.
   a. Model: 18"x24" ½" thick HPL, high pressure laminate panel with NPS cantilever style, 2"x3" support posts, surface mount.

b. Sign Panel A: Custom owner supplied of color plan of park. (see appendix A)
c. Sign Panel B: Custom owner supplied of funding source logos. (see appendix B)
d. Sign Panel: Native Plants – G21-2
e. Color: Posts to be brown
f. Manufacturer: Vacker Sign 877-487-3101

9. Trail Signs
   a. Model: Wildflowers – Do not Mow or Spray, part: S2-5106-AL-14, 10” x 14” 63 mil heavy duty aluminum.
   b. Model: Park closes at dusk, part K-7977, 12” x 18”, 63 mil heavy duty aluminum.
   c. Color: post to be 4”x4” recycled brown embedded post
   d. Supplier: My Safety Sign 800-952-1457

10. Main Park Sign (Monument Sign)
   a. Model: Routed bi-color ¾” thick HDPE park entrance sign, standard shape 1 with (2) logo inserts, embedded mount.
   b. Artwork to be supplied to the sign company.
   c. Post to be pressure treated lumber, stained with 2 coats exterior dark brown.
   d. Color: Brown /Tan/ Brown (Tan lettering)
   e. Supplier: VackerSign 877-487-3101

11. Flagpole with lights
   a. Flagpole Manufacturer: Morgan-Francis Flagpoles & Accessories as or approved equal.
   b. Model: 35' ground set, internal halyard, cone tapered aluminum flagpole; 38'-6" total height with a shaft of 7" x 3.5" x .156" #CI385721.
   c. Finish: clear anodization
   d. Mounting: Standard Embedded Foundation
   e. Supplier DWA Recreation, Inc. 513-788-1824
   e. Flagpole solar light manufacturer: LumeGen
   f. Catalog No: Pole mount 3 head Solar LED Flagpole Light, 1080 lumens, model FLG_ST_SF801-3
   g. Color: Black
   h. Supplier**:** United States Flag Store 877-732-2458

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install as per manufacturer specifications and Contract Documents.
   1. Installation is to include any saw-cutting of existing pavements, footers, excavating for footers, and all appurtenances required to install site furnishings as per manufacturer's specifications and Contract Documents.

   2. Locate and layout all site furnishings and obtain Architect's or Owner's acceptance prior to installation.

3. Submit product shop drawings and color choices to Owner for approval prior to ordering furnishings.

4. Furnishing Installation

   a. Waste Receptacle, Dog Waste Station, bat boxes and Signage:
      1) To be installed with concrete footer a minimum of 36" deep and 12" in diameter. Concrete is to be as per ODOT Item 499.

   b. Bench:
      1) Assemble bench and surface mount to walk with manufacturer specified anchors.

   c. Curved Metal Arbor
      1) Contractor to provide and submit final stamped engineered drawings with structure, footers and design calculations from the manufacturer to the Township for review and permit. Contractor shall be responsible for all review and permit fees.
      2) Install post footers per manufacturer's specifications.
      3) Assemble arbor complete per manufacturer's drawings and specifications.

   d. Solar Light Poles:
      1) Install concrete footer for light poles, per manufacturer's specifications, and Contract Documents.
      2) Assemble fixture and mount pole to footers with manufacturer specified anchor assembly and fasteners.

   e. Informational Kiosk Signs
      1) Owner to provide artwork for park plan and funding sign. Contractor to coordinate sign fabrication with sign supplier and provide proof for Owner approval prior to manufacturing.
      2) Install post footers per manufacturer's specifications.
      3) Assemble sign per product drawings and specifications.

   f. Park Placard Sign
      1) Install post per manufacturer's specifications.
      2) Mount sign to wood 4"x4" post with tamper proof galvanized bolts.

   g. Monument Sign
      1) Contractor to coordinate sign fabrication with sign supplier and provide proof for Owner approval prior to manufacturing.
      2) Install sign to posts with angle aluminum brackets on to 8"x8" ground contact pressure treated timbers per manufacturer's specifications and detail.
      3) Mount sign to post with per manufacturers specifications.

   h. Bat Boxes
      1) Install at 15' height on 2-3/8" min. diameter schedule 40 galvanized steel post per manufacturer's specifications in concrete footer.

2) Mount box to post with 2x4 mounting boards and galvanized U-shaped bolts per manufacturer's specifications.
3) Install with front of box facing south or southeast.

i. Stone Seat Wall
1) Stone to be approved by the owner prior to materials being delivered to the site.
2) Install stone seat wall per plan and details on compacted aggregate base.
3) Stone shall be set level and abut adjacent stones.
4) Backfill back and sides of stone blocks to prevent settling.

j. Flagpole
1) Install in location shown on plans per details.
2) Install solar flagpole lights on flagpole with provided brackets.

3.2 PROTECTION:

Protect furnishings from other construction related activity. Wrap with plastic to protect finish.

3.3 CLEAN-UP:

A. Upon completion of the work all excess materials and debris which has not previously been cleaned up shall be removed from the site or disposed of as directed by the Architect.
B. Protect work and materials from damage due to operations by other contractors, trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged work as directed.

Appendix A
Informational kiosk park entry sign. Final artwork to be supplied to sign company.

Appendix B
Informational kiosk funding sign. Final artwork to be supplied to sign company.

END SECTION

SECTION 310000 - EARTHWORK

1.1 SUMMARY

A. The Work covered by this Section shall include all excavation, trenching and related work for the construction of the designated stream channel and utilities, backfill and other incidental work.

B. The Work covered by this Section consists of:
1. making all necessary excavations for the construction of all Work;
2. preparing subgrade for foundations, slabs, walks, and pavements;
3. doing all pumping, fluming, and dewatering necessary to keep the trenches and other excavation free from water;
4. providing for uninterrupted flow of existing drains and sewers, and the disposal of water from any sources during the progress of the Work;
5. supporting and protecting all trench walls, structures, pipes, conduits, culverts, posts, poles, wires, fences, buildings and other public and private property adjacent to the Work;
6. removing and replacing existing sewers, culverts, pipelines and bulkheads where necessary;
7. removing after completion of the Work all sheeting and shoring or other soil support materials not necessary to support the sides of trenches;
8. removing and disposing all surplus excavated material;
9. doing all backfilling and grading, of compacting backfill to limits specified or ordered by the Engineer;
10. restoring all property damaged as a result of the Work involved in this Contract.

C. The Work includes transporting surplus excavated materials not needed for backfill at the location where the excavation is made, to other parts of the Work where filling is required, and disposal of all types of surplus material off the site.

D. The Work includes:
1. constructing a structure of soil or granular material in layers to a predetermined elevation and cross section;
2. supporting and protecting all structures, pipes, conduits, culverts, posts, poles, wires, fences, buildings and other public and private property adjacent to the Work;
3. placing all fill and performing rough grading;
4. compacting fill to limits specified or ordered by the Engineer;
5. restoring all property damaged as a result of the Work involved in this Contract.

1.2 RELATED DOCUMENTS AND SECTIONS

A. Section 013319 – Field Testing Requirements

B. Section 015713 - Temporary Erosion Control

C. Section 030000 - Concrete Work

1.3 DEFINITIONS

A. Backfill: Soil or granular materials used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in a trench, not including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Bedding: Layer placed over the excavated subgrade in a trench before laying pipe.

C. Borrow: Satisfactory soil imported for use as fill or backfill.

D. Excavation: Removal and disposal of material encountered above subgrade or foundation elevations.
   1. Additional Excavation: Excavation below subgrade or foundation elevations as directed by Engineer.
   2. Trench: Narrow linear excavation
   3. Unauthorized Excavation: Excavation below subgrade or foundation elevations or beyond indicated dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.
   4. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface or subsurface conditions encountered, including rock, soil materials and obstructions.

E. Embankment: A structure consisting of soil, granular material, shale, rock, or other approved material, constructed in layers to a predetermined elevation and cross-section.

F. Granular materials: Natural aggregate, such as broken or crushed rock, gravel, or sand that can be readily incorporated into an 8-inch layer, and in which at least 65% by weight of the grains or particles are retained in a No. 200 sieve.

G. Laboratory Dry Weight: The maximum laboratory dry weight shall be the weight provided by the laboratory when the sample is tested in accordance with ASTM D-698 Method A, C, or D.

H. Optimum Moisture: The water content at which the maximum density is produced in a soil by a given compaction effort (ASTM D-698).

I. Pavement Prism: Also referred to as the zone of influence. The area below a line drawn 45 degrees to the horizontal from the surface at the edge of pavement, sidewalk or curb.

J. Pipe Embedment: The material placed in a trench surrounding a pipe or conduit consisting of the foundation, bedding, haunching, and initial backfill.

K. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material one (1) cu. yd. or more in volume that when tested by an independent geotechnical testing agency, according to ASTM D 1586, exceeds a standard penetration resistance of 100 blows/2 inches.

L. Shale: Laminated material, formed by the consolidation in nature of soil, having a finely stratified structure. For the purpose of these specifications, the following bedrock types shall also be considered shale: mudstone, claystone, siltstone and hard clay.

M. Soil: All earth materials, organic or inorganic, which have resulted from natural processes such as weathering, decay, and chemical reaction.

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

O. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage course, or topsoil materials.

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

1.4 SUBMITTALS

A. Comply with all provisions of Section 013323, Shop Drawings and Submittals.

[Retain only those Submittals required for Project.]

B. Product Data: For the following:
   1. Source-locations of all materials shall be identified to the Engineer.
   2. Source quality laboratory test of all fill materials as required to show compliance with material specifications.

C. Shop Drawings: Submit information for the following items:

[The designer should determine if the character of the following work is substantial enough to require the stamp of a professional engineer.]

   1. Sheeting and bracing *(prepared and stamped by a professional engineer, registered in the State of Ohio)*.

2. Dewatering system and standby equipment *(prepared and stamped by a professional engineer, registered in the State of Ohio)*.
3. Cofferdams *(prepared and stamped by a professional engineer, registered in the State of Ohio)*.
4. Protection methods anticipated *(prepared and stamped by a professional engineer, registered in the State of Ohio)*.
5. Underpinning *(prepared and stamped by a professional engineer, registered in the State of Ohio)*.
6. Excavation procedures *(prepared and stamped by a professional engineer, registered in the State of Ohio)*.

1.5 REFERENCES

A. AASHTO M 43 Standard Specification for Size of Aggregate for Road and Bridge Construction

B. ASTM C-150 Standard Specification for Portland Cement

C. ASTM C-618 Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

D. ASTM D-698 Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb (2.49-kg) Rammer and 12-in. (305-mm) Drop

E. ASTM D-1586 Standard Method for Penetration Test and Split-Barrel Sampling of Soils

F. ASTM D-2487 Standard Test Method for Classification of Soils for Engineering Purposes

G. ASTM D-2940 Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports

H. ASTM D-4253 Standard Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table

I. ASTM D-4254 Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density

J. State of Ohio - Department of Transportation - Construction and Material Specifications, Item 304, Aggregate Base.

K. State of Ohio - Department of Transportation - Construction and Material Specifications, Material Detail 703.16, Suitable Materials for Embankment Construction.

L. State of Ohio - Department of Transportation - Construction and Material Specifications, Material Detail 703.02.A.2, Fine Aggregate for Portland Cement Concrete

1.6 QUALITY ASSURANCE

A. Qualifications

B. Regulatory Requirements

C. Certifications

D. Field Samples

E. Mock-ups

F. Pre-Construction Conference

1.7 PROJECT CONDITIONS

A. Environmental Requirements

B. Existing Conditions
   1. Existing ground elevations of the site are shown by figures and/or by contours on the Drawings. The contours and elevations of the present ground are believed to be reasonably correct, but do not purport to be absolutely so, and, together with any schedule of quantities, are presented only as an approximation. The Contractor shall satisfy himself, however, by actual examination on the site of the Work, as to the existing elevations and contours, and the amount of work required.

C. Existing Utilities
   1. Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated.
   2. Notify Engineer not less than two days in advance of proposed utility interruptions.
   3. Do not proceed with utility interruptions without Engineer's written permission.
   4. Contact utility-locator service for area where Project is located before excavating.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver products to the site, store and protect under provisions of Section 016600, Product Handling and Protection.

B. Comply with all provisions of Section 013543, Environmental Protection.

1.9 SEQUENCING AND SCHEDULING

A. Refer to 013319 for testing laboratory service scheduling.

1.10 PROHIBITION OF EXPLOSIVES

A. The use of explosives is not permitted.

1.11 FIELD MEASUREMENTS

A. The Contract Drawings may indicate locations where certain utilities, structures or facilities might possibly interfere with the installation of new improvements. The Contractor shall dig such exploratory test pits as may be necessary to determine the exact location and elevation of the indicated subsurface structure and shall make acceptable provision for their protection, support and maintenance in operation. The Engineer shall be provided advance notification when and where excavation for test pits will take place. The Contractor shall provide the Engineer a record of field locations of all listed utilities, structures or facilities a minimum of five (5) days prior to initiating construction of the project. Locations and elevations are to be provided by a Surveyor registered in the State of Ohio.

PART 2 - PRODUCTS

2.1 GRANULAR PIPE EMBEDMENT

A. Crushed gravel or crushed limestone meeting AASHTO M 43 gradation shall be used for bedding, haunching, and initial backfill as shown on the Drawings.

2.2 SPECIAL BACKFILL MATERIAL (ODOT Item 304)

A. Special backfill material shall meet the gradation requirements of ODOT Item 304 and shall consist of crushed gravel or crushed limestone in combination with natural sand or stone. The aggregate shall meet the following gradation requirements:

Sieve	Total Percent Passing
2 inch	100
1 inch	70-100
¾ inch	50-90
No. 4	30-60
No. 30	9-33
No. 200	0-15

2.3 LOW STRENGTH MORTAR BACKFILL

A. Low Strength Mortar shall comply with ODOT Item 613.

B. Submit test data that demonstrates that the proposed mix has a strength of 50 to 100 PSI at 28 days.

C. Each load shall be tested with 3 cylinders for strength test broken at 3, 7, and 28 days until the Engineer is assured that the mix will be between 50 to 100 PSI at 28 days. Thereafter, one set of strength tests shall be taken every 50 CY.

It is intended that the sand be fine enough to stay in suspension in the mixture to the extent required for proper flow. The Engineer reserves the right to reject the sand if a flowable mixture cannot be produced.

D. Mortar Mix Proportioning

1. The initial trial mixture shall be as follows:

Quantity of Dry Materials per Cubic Yard

Cement	100 lbs.
Fly Ash	250 lbs.
Sand (SSD)*	2700 lbs.
Water	500 lbs.

* saturated-surface dry

2. These quantities of materials are expected to yield approximately l cubic yard of mortar of the proper consistency. Adjustments of the proportions may be made providing the total absolute volume of the materials is maintained.

2.4 EMBANKMENTS

A. Soils suitable for use in an embankment must conform to ODOT 703.16 and are restricted as follows:

1. Maximum laboratory dry weight shall not be less than 90 pounds per cubic foot, except that soils having maximum dry weights of less than 100 pounds per cubic foot shall not be used in the top 12 inches of embankment.
2. Soil having a liquid limit in excess of 49 are considered as unsuitable for use in an embankment.
3. Silt from excavation or borrow identified as Ohio Classification A-4b shall be considered suitable for use in an embankment only when placed at least 3 feet below the surface of the subgrade.
4. No slag, recycled Portland cement concrete or recycled asphaltic concrete products are suitable for use in an embankment.
5. Do not use any suitable material that cannot be incorporated in an 8-inch lift in the top 2 feet of the embankment.
6. Do not use shale, hard shale, or siltstone in the top 2 feet of embankment.
7. Do not use materials that cannot be satisfactorily placed and compacted to a stable and durable condition.
8. Material excavated in the work that contains excessive moisture is unsuitable for embankment construction unless dried. Dry or aerate such material before incorporating in the work. The Contractor may elect to waste this material, instead of drying it.

9. Granular material Type E as specified in ODOT 703.16.C, is not allowed.
10. No petroleum contaminated soils are suitable for use in an embankment.

2.5 ACCESSORIES

A. Warning Tape
1. 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:
   a. Red: Electric.
   b. Yellow: Gas, oil, steam, and dangerous materials.
   c. Orange: Telephone and other communications.
   d. Blue: Water systems.
   e. Green: Sewer systems.

B. Detectable Warning Tape
1. Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
   a. Red: Electric.
   b. Yellow: Gas, oil, steam, and dangerous materials.
   c. Orange: Telephone and other communications.
   d. Blue: Water systems.
   e. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PROTECTION

A. Excavation; Temporary Sheeting, Shoring, and Bracing
1. All excavation shall be in accordance with the Occupation Safety and Health Administration (OSHA) regulations.
2. The Contractor shall furnish and install adequate sheeting, shoring, and bracing to maintain safe working conditions, and to protect newly built work and all adjacent neighboring structures from damage by settlement.
3. Bracing shall be arranged so as not to place a strain on portions of completed work until construction has proceeded enough to provide ample strength. Sheeting and bracing may be withdrawn and removed at the time of backfilling, but the Contractor shall be responsible for all damage to newly built work and adjacent and neighboring structures.
4. All sheeting shall be removed unless specifically authorized in writing by the Engineer to be left in place.

B. Construction Sheeting Left in Place
   1. The Contractor shall furnish, install, and leave in place construction sheeting and bracing when specified or when indicated or shown on the Drawings.
   2. Any construction sheeting and bracing which the Contractor has placed to facilitate his work may be ordered in writing by the Engineer to be left in place. The right of the Engineer to order sheeting and bracing left in place shall not be construed as creating an obligation on his part to issue such orders. Failure of the Engineer to order sheeting and bracing left in place shall not relieve the Contractor of his responsibility under this Contract.

3.2 REPLACING, MOVING AND REPAIRING OF EXISTING UTILITIES

A. The Contractor shall:
   1. replace, move, repair and maintain all utilities and all other structures encountered in the work
   2. coordinate and communicate with applicable utility companies
   3. repair all damage done to any of the said structures and appurtenances through his acts or neglect and shall keep them in repair during the life of this contract. The Contractor shall in all cases leave them in as good condition as they were previous to the commencement of the work and to the satisfaction of the Engineer.

3.3 DEWATERING

A. Drainage and Removal of Water
   1. The Contractor shall dispose of water from the Work in a suitable manner without damage to adjacent property or structures.
   2. The Contractor shall, when ordered by the Engineer, construct tight bulkheads across trench and provide pumps suitable for the removal of any water which may be encountered or which may accumulate in the trenches. Unless otherwise provided for in the Contract Documents, drainage water will not be permitted to flow through the conduit.
   3. The trench shall be kept free from sewage and storm, surface, and subsurface water to at least 2 feet below the bottom of the excavation.
   4. Where open water courses, ditches, or drain pipes are encountered during the progress of the Work, the Contractor shall provide protection and securing of the continuous flow in such courses or drains and shall repair any damage that may be done to them.

3.4 EXCAVATION CLASSIFICATION

A. All excavated materials are unclassified as defined in Article 1.3.

3.5 GENERAL EXCAVATION

A. All necessary excavation for buildings, structures, pavements, and site improvements shall be performed to accommodate the completion of all related Contract Work.

B. The Drawings show the horizontal and the lower limits of structures. The methods and equipment used by the Contractor when approaching the bottom limits of excavation shall be selected to provide a smooth surface and to prevent disturbing the soil below the bottom limits of excavation. All soil loosened during excavation shall be removed from the bottom of the excavation.

C. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 feet, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.

D. Excavation which is carried below the bottom limits of structures shall be classified as Unauthorized Excavation, unless said excavation below bottom limits of structures has been authorized by the Engineer prior to each occurrence.

E. Unauthorized Excavation shall be filled with Class B concrete to the bottom limits of structures. Under circumstances where structural integrity is not a factor, the Engineer may authorize the filling of Unauthorized Excavation with Low Strength Mortar Backfill or Special Backfill material compacted to 100% density as specified under the compaction requirements in this Section. Such work shall be at the cost of the Contractor.

3.6 TRENCH EXCAVATION

A. Excavation for trenches in which pipelines, sewers, and conduits are to be installed shall provide adequate space for workmen to space and joint pipe properly, but in every case the trench shall be kept to a minimum width. The width of trench shall not exceed the limits shown on the Drawings.

B. Excavation shall be to the depth necessary for placing of granular bedding material under the pipe as shown on the Drawings. If over-excavation occurs, the trench bottom shall be filled to grade with compacted granular bedding material.

C. Trenching operations shall not be performed beyond the distance that will be backfilled and compacted the same day.

D. In general, backfilling shall begin as soon as the conduit is in approved condition to receive it and shall be carried to completion as rapidly as possible. New trenching shall not be started when earlier trenches need backfilling or the surfaces of streets or other areas need to be restored to a safe and proper condition.

3.7 EXCAVATION OF UNSUITABLE MATERIALS

A. Unsuitable materials existing below the Contract bottom limits for excavation shall be removed as directed by the Engineer. Such excavation shall not exceed the vertical and lateral limits as prescribed by the Engineer.

B. In utility trenches, the voids left by removal of unsuitable excavated material shall be filled with AASHTO M 43 No. 1 and No. 2 aggregate conforming to the material requirements of Article 2.1 of this Section.

C. In excavations other than utility trenches, the voids left by removal of unsuitable excavated material shall be filled with material consisting or either: (1) Special Backfill Material; (2) Class B concrete; or (3) Low Strength Mortar Backfill, whichever is ordered by the Engineer.

D. Removal of unsuitable excavated material and its replacement as directed will be paid on basis of Contract Conditions relative to Changes in Work unless specific unit prices have been established for excavation of unsuitable material.

3.8 DISPOSAL OF UNSUITABLE AND SURPLUS MATERIAL

A. It shall be the responsibility of the Contractor to dispose of all surplus material that cannot be used in backfill or embankments at his expense outside the limits of the project. Unsuitable excavated material, including rock or large boulders, shall be disposed of outside the limits of the project.

B. Surplus material may be wasted adjacent to or incorporated in the regular construction only when ordered in writing by the Engineer.

3.9 BACKFILL

A. Pipelines, Sewers and Conduits

1. All pipe shall have bedding extending the width of the trench with depth in conformance with the Drawings. The bedding material shall be thoroughly compacted by tamping until no further densification is possible.
2. Pipe cover material shall be used for filling above the pipe bedding along the sides of the pipe and to a height of twelve (12) inches over the top of the pipe. The pipe cover material shall be brought up evenly on both sides of the pipe to eliminate the possibility of lateral displacement of the pipe and shall be thoroughly compacted by tamping until no further densification is possible. Care shall be taken to spade the aggregate under the pipe haunch below the spring line.
3. All trenches and excavations shall be backfilled immediately after pipe is laid therein, unless otherwise directed by the Engineer.
4. After the pipe cover has been placed and compacted around the pipe as specified above, the remainder of the trench may be backfilled by machine. The backfill material shall be deposited in eight (8) inch horizontal layers, and each layer shall be thoroughly compacted to the specified density by approved methods before a succeeding layer is placed. In no case will backfilling material from a bucket be allowed to fall directly on a pipe and in all cases the bucket must be lowered so that the shock of the falling earth will not cause damage.

B. Structures

1. Backfilling shall not commence before concrete has attained specified strength. Do not use equipment for backfilling and compaction operations against structures that will overload the structure.
2. Backfilling around and over structures shall be carefully placed and tamped with tools of suitable weight to a point one (1) foot above the top of same. Additional backfill may be required to protect the structure from damage from heavy equipment. Backfill shall be placed in uniform layers not exceeding eight (8) inches in depth. Each layer shall be placed, then carefully and uniformly compacted to the specified density so as to eliminate the possibility of displacement of the structure.
3. After the backfill has been placed and compacted around the structure to the height specified above, the remainder may be backfilled by machine. The backfill material shall be deposited in eight (8) inch horizontal layers, and each layer shall be thoroughly compacted to the specified density by approved methods before a succeeding layer is placed. In no case will backfilling material from a bucket be allowed to fall directly on a structure, and in all cases the bucket must be lowered so that the shock of the falling earth will not cause damage.

C. Where any new, proposed, or future pavement, driveway, parking lot, curb, curb and gutter, or walk is to be placed over a backfilled area, Special Backfill material shall be used for any portion of the trench falling within the pavement prism.

D. Where it is necessary to undercut or replace existing utility conduits and/or service lines, the excavation beneath such lines shall be backfilled the entire length with approved Granular Pipe Embedment Material compacted in place in eight (8) inch layers to the required density. The approved Granular Pipe Embedment Material shall extend outward from the spring line of the conduit a distance of two (2) feet on either side and thence downward at its natural slope.

3.10 EMBANKMENT

A. In making fill for embankment, the surface of the existing ground shall be cleared, grubbed, stripped of organic material, plowed, compacted according to the requirements specified in this Section, and stepped on slopes so as to enable bond or firm bearing for the new fill. The materials for these fills shall be selected of approved materials free from organic matter and placed in horizontal layers not exceeding eight (8) inches in thickness when loose, each layer being thoroughly compacted. Materials shall not be placed when fill or foundation is frozen.

B. Where fill is to be placed on side slopes steeper than one (1) vertical to six (6) horizontal, steps shall be formed into the slope before any embankment is placed. These steps shall be cut at vertical intervals at no more than two (2) feet and shall have a horizontal dimension of not less than three (3) feet.

C. As fill progress, the top shall be kept crowned or sloped for drainage. No pavement shall be placed upon embankment until it meets compaction testing requirements.

D. Fills that abut or contain concrete or masonry structures shall be placed with care to avoid undue or unbalanced loads on these structures.

E. Following the completion of embankment, all slopes shall be neatly and evenly dressed to proper elevation, grade and dimension.

3.11 SUBGRADE

A. All soil subgrade shall be prepared in accordance with this subsection.

B. Drainage
   1. The surface of the subgrade shall be maintained in a smooth condition to prevent ponding of water after rains to insure the thorough drainage of the subgrade surface at all times

C. Unsuitable Subgrade
   1. Where unsuitable subgrade or subgrade not meeting the required bearing capacity is encountered in cuts, due to no fault or neglect of the Contractor, in which satisfactory stability cannot be obtained by moisture control and compaction, the unstable material shall be excavated to the depth required by the Engineer.
   2. Suitable material required for the embankment to replace the undercut will be paid on basis of Contract Conditions relative to changes in Work.
   3. Where soft subgrade in cuts is due to the failure of the Contractor to maintain adequate surface drainage as required in this article, or is due to any other fault or neglect of the Contractor, the unstable condition shall be corrected as outlined above at no expense to the Owner.

D. Full Width New Pavement Construction
   1. After the surface of the subgrade has been shaped to approximate cross section grade, and before any pavement, base or subbase material is placed thereon, the subgrade shall be compacted. When the rolling is completed, all surface irregularities shall be corrected and the surface of the subgrade shall be shaped as necessary to conform to the grade and cross section shown on the Drawings within the tolerance set forth in this Section and shall be so maintained until the overlying course is in place.

3.12 CONSTRUCTION WITH MOISTURE AND DENSITY CONTROL

A. All backfill and embankments, except rock embankments, shall be constructed using moisture and density control. All subgrade, except rock and shale in cut sections, shall be constructed using moisture and density control.

B. Backfill, embankment and subgrade material which does not contain sufficient moisture to be compacted in accordance with the requirements of Article 3.17 of this Section shall be sprinkled with water as directed by the Engineer to bring the moisture content to within the range of optimum plus or minus three (3) percent. Water shall be thoroughly incorporated into the material by means of discs or other approved equipment.

C. Backfill, embankment and subgrade material containing excess moisture shall be dried, prior to installation, to a moisture content not greater than three (3) percentage points above optimum, except that for material within the moisture content range specified herein that displays pronounced elasticity or deformation under the action of loaded construction equipment, the moisture content shall be reduced to optimum or below if necessary to secure stability. For subgrade material, these requirements for maximum moisture shall apply at the time of compaction of the subgrade and also at the time of placing pavement or subbase. Drying of wet soil shall be expedited by the use of plows, discs, or by other approved methods when so ordered by the Engineer.

3.13 COMPACTION REQUIREMENTS

A. The bottom of excavations upon which concrete foundations or structures are to be placed shall be compacted so as to obtain 100% of maximum dry density per ASTM D-698 in the top twelve (12) inches.

B. The top twelve (12) inches of stripped original subgrade and final subgrade shall be compacted to not less than 100% of maximum dry density per ASTM D-698.
   1. Subgrade under new, proposed, or future pavement shall be compacted 18 inches beyond the edge of pavement, paved shoulders or paved medians.

C. Compaction of subgrade for sidewalks (regardless of paving material) shall be 100% of maximum dry density per ASTM D-698 in the top six (6) inches.

D. Compaction of non-paved areas shall be 90% of maximum dry density per ASTM D-698.

E. Aggregate pipe embedment and aggregate backfill around structures shall be compacted to not less than 100% of maximum dry density per ASTM D-4253 and ASTM D-4254.

F. Final backfill shall be compacted to not less than 100% of maximum dry density per ASTM D-698.

G. Fill placed within the interior of structures shall be compacted to not less than 100% of maximum dry density per ASTM D-698.

H. Embankment shall be placed and compacted in layers until the density is not less than the percentage of maximum dry density indicated in the following table determined by ASTM D-698.

EMBANKMENT SOIL COMPACTION REQUIREMENTS

Maximum Laboratory Dry Weight Pounds/Cubic Foot	Minimum Compaction Requirements Percent Laboratory Maximum
90-104.9	102
105-119.9	100
120 and more	98

I. Test Sections

1. If it is determined by the Engineer that the composition of the material is such that it cannot be tested for density using a nuclear densometer or other methods; or where, in the opinion of the Engineer, in-place compaction testing is not feasible; and if approved by the Engineer, the Contractor may construct a test section to demonstrate acceptable compactive effort in lieu of in-place compaction testing. Test sections shall be constructed at no additional cost to the Owner.
2. The test section shall be completed by repeatedly compacting the material until no further density is achieved. This value shall be the Minimum Test Section Density (MTSD). The compaction equipment used to complete the test section shall be of suitable size to compact the material and shall be the same equipment used to compact the in-place material.
3. The test section shall be constructed with moisture density control as specified in this Section.
4. The material shall be compacted to at least 98% of the MTSD.
5. Each lift of in-place fill or backfill shall be densified using a compactive effort equal to or greater than the effort applied to achieve the MTSD; i.e., if six passes were required to achieve MTSD, then each lift of material shall be compacted using six or more passes.
6. Construct a new test section when, in the opinion of the Engineer, the fill or backfill material has changed character or when the supporting material has changed character.

3.14 GRADING

A. 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 Grading
   1. Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
      a. Lawn or unpaved areas shall be graded to plus or minus *1 inch*
      b. Walks shall be graded to plus or minus *(1 inch) (insert tolerance)*.

END OF SECTION 310000

SECTION 312323.14 – COMPACTED GRANULAR BACKFILL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. The Contractor shall furnish, place and compact all the materials needed.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Aggregate shall be ODOT 304 crushed limestone. Crushed gravel or slag products are unacceptable.

B. Contractor shall submit current test reports for the lot(s) of the material to be supplied.

PART 3 - EXECUTION

3.1 PLACING AND COMPACTING

A. Compacted granular backfill shall be properly placed in layers sufficient to meet the compaction requirement of 100% of maximum laboratory dry density per ASTM D 698 throughout the entire layer and thoroughly compacted with mechanical compaction equipment with moisture adjustment as needed. Should after settlement occur, the Contractor must add and compact additional material, and he must maintain the backfill at the required finished grade or sub-grade until the project is satisfactorily completed and during the correction period.

B. Approved mechanical compaction equipment shall be used for tamping backfill. Flooding, jetting, or puddling of backfill will not be permitted.

END OF SECTION 312323.14

SECTION 312333 - UNDERGROUND CONDUIT INSTALLATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Construction Drawings and General Provisions of this Contract including the General and Supplementary Conditions, Specific Project Requirements, Proposal, and all referenced standard specifications apply to work defined in this section.

1.2 DESCRIPTION

A. This work shall consist of the construction or reconstruction of underground pipe conduits in accordance with these specifications and in reasonable close conformance to the lines and grades shown on the detailed plans or as otherwise established by the Engineer.

B. This work shall include excavating for the conduit, fittings, and appurtenances; clearing and grubbing and removal of all materials necessary for placement of the conduit except any items paid for separately; furnishing and placing bedding and backfill as required; constructing and subsequently removing all necessary cofferdams, cribs and sheeting; pumping and dewatering; making all conduit joints as required; installing all necessary conduit; joining to existing and proposed appurtenances as required; performing leakage tests as required; restoration of all disturbed facilities and surfaces. The work shall also include the maintenance of existing flow and service to facilities being modified. Procedures for such maintenance shall be as approved by the Engineer prior to any work commencing.

PART 2 - MATERIALS

2.1 CONDUIT

A. All conduit utilized shall be of one type and size specified in the proposal meeting the requirements of the detailed material specification.

B. Shop drawings, catalog cuts, and test certifications may be required by the Engineer for all conduit, fittings, and appurtenances.

C. Aggregate for the bedding and backfill shall conform to the requirements of the plan detail or as modified in writing by the Engineer. All aggregates shall conform to ODOT 703 for soundness and gradation.

D. All other materials utilized as part of this work shall meet their respective ASTM requirements.

EXECUTION

2.2 REMOVAL OF STRUCTURES AND OBSTRUCTIONS

A. Pavement, Sidewalks, and Curbing

1. Removal of existing pavements, sidewalks, curbing, and similar structures shall end at an existing joint or a sawed joint. Sawed joints shall be straight, neat, and free from chipped or damaged edges.
2. For non-reinforced concrete, the saw cut shall be completely through concrete.
3. For reinforced concrete, the saw cut shall be completely through the steel and concrete.
4. If the concrete is coated with a bituminous surface or other material, the saw cut shall be as specified above.

B. Manholes, Catch Basins, and Inlets

1. Existing drainage structures and sanitary manholes designated by the Engineer to be removed shall be completely removed.
2. Manholes designated to be abandoned shall be removed to an elevation of at least 3 ft. below the finished subgrade or ground surface. The remaining void shall be filled with backfill material in accordance with Section 312323.13 - Compacted Backfill.
3. Live sewers connected to structures removed or abandoned shall be rebuilt through the area with new conduit. Sewer flow shall be maintained between removal and replacement operations. Abandoned sewers shall be sealed and made watertight with approved precast stoppers or masonry bulkheads.

C. Fence

1. Where necessary, existing fence shall be carefully dismantled and disposed of.
2. Posts and other materials not considered salvageable by the Engineer shall be disposed of by the Contractor.
3. The Contractor will be required to replace, at no cost to the Owner, material lost or damaged by negligence or by the use of improper methods.

2.3 METHOD OF EXCAVATION

A. All excavation shall be in open cut unless otherwise permitted by the Engineer. Loosening of material by blasting will not be permitted without written authorization by the Owner specifying both the extent and location of the blasting to be done. If permission is granted the Contractor shall submit in writing his means and methods of blasting to the Owner for approval. Blasting shall not begin until the Owner issues written approval of the means and method of blasting.

B. Excavation shall be made to undisturbed finish subgrade to the depth below the bottom of the conduit or structure as shown on the Contract Drawings details.

C. Trenches shall be excavated with vertical sides from the bottom of the trench to one (1') foot above the top of the conduit from which point sides may slope to ground surface,

except that, in streets or roadways, trenches shall be excavated with near vertical sides to the top of the trench. Width of trench in the vertical section shall be excavated only as wide as necessary to accommodate a safety box and to provide free working space on each side of the conduit or structure according to the size of the conduit or structure and the character of the ground. In every case there shall be sufficient space between the conduit or structure and the sides of the trench to make it possible to thoroughly ram the bedding around the conduit or structure and to secure tight conduit joints, but in no case more than twelve inches on either side of conduit. In no case, however, shall the width of the trench at the top of the conduit exceed the dimensions as shown on the contract drawings. In no case will it be permitted to excavate conduit trenches with sides sloping to the bottom.

D. The trench bottom shall be firm and uniform for its full length. Should unstable material be encountered below plan subgrade, it shall be removed to a depth directed by the Engineer. Replacement of the additional excavation shall be with the specified bedding material or as otherwise directed by the Engineer.

E. In the case the flow line is changed not to exceed one (l) foot or it becomes necessary to remove unstable material in an amount not to exceed one (l) foot, the same shall be done at one contract bid price or amount. When the flow line is lowered more than (1 foot) or if it becomes necessary to remove more than (1 foot) of unsuitable material below the bottom of the trench, compensation will be provide therefore in a supplemental agreement for the excavation and backfill beyond (1 foot).

2.4 UNAUTHORIZED EXCAVATIONS

A. All excavations carried outside of the lines and grades given or specified, together with the disposal of such material, and all excavations and other work resulting from slides, cave-ins, swellings or upheavals shall be at the Contractor's own cost and expense. All spaces resulting from unauthorized excavations or from slides or cave-ins shall be refilled at the Contractor's expense with suitable material as specified in ODOT Item 203, "Roadway Excavation and Embankment" or Section 312323.13, "Compacted Backfill" in designated areas shown on the contract drawings or specified under this Section. Compaction requirements shall be in accordance with these specifications.

2.5 SHEETING AND SHORING

A. The Contractor shall be responsible for supporting and maintaining all excavations required even to the extent of sheeting or shoring the sides and ends of excavations with timber or other satisfactory supports. If the sheeting, braces, shores, stringers, waling timbers, or other supports are not properly placed or are insufficient, the Contractor shall provide additional or stronger supports. The requirements of sheeting or shoring or of the addition of supports shall not relieve the Contractor of his responsibility for their sufficiency. All trench protection and sheeting and shoring must conform to the regulations of both the Ohio State Industrial Commission (OSIC) and the Federal Occupational Safety and Health Act (OSHA) and will be subject to their respective inspections. All orders of OSIC and OSHA representatives must be complied with by the Contractor.

B. All sheeting and shoring shall be removed where and when required and, upon its removal, all voids filled. If any sheeting or shoring is ordered to be left in place, it shall be cut-off as

directed. In compensation for the sheeting and shoring left in place, if any, shall be by prior written change order.

2.6 REMOVAL OF WATER

A. All conduit shall be installed in a dry and stable trench. The Contractor may pump or otherwise remove any water, sewage, or other liquid that may be found or may accumulate in the trench.

B. If, in the opinion of the Contractor, dewatering pumps and equipment are required to maintain a dry and stable trench, suitably sized pumps shall be provided to meet the requirements. The manner and spacing of well points shall be at the Contractor's discretion.

C. Excess water shall not be considered reason for undercut of trench bottom.

D. The Contractor shall maintain the pumps for the duration of their need including a satisfactory discharge outlet. Power for the pumps shall be electric unless otherwise approved by the Engineer. Noise abatement may be required for any on-site generators in residential areas.

2.7 BEDDING FOR LAYING CONDUIT

A. Bedding shall conform to the requirements of the plan detail unless otherwise modified by the Engineer.

B. All granular bedding material shall be compacted to 95 percent of maximum laboratory dry density.

C. All pipe bedding shall be of the gradation(s) specified and be limestone. Slag may not be used and gravel may be used with permission of the Engineer.

2.8 LAYING CONDUIT

A. Except as otherwise permitted by the Engineer, all conduit shall be laid starting at the outlet end. Pressure conduits may be laid from either direction however the joints shall be such that the bell is upgrade or toward normal pressure.

B. Line and grade for gravity conduits shall be established by the use of sufficient means to maintain acceptable installation tolerances and allow for reasonable checking observation by the Engineer.

C. Line and grade shall be established and maintained over a length of fifty (50) feet minimum. Cut sheets establishing grade at fifty (50) foot intervals shall be provided to the Engineer prior to beginning work.

D. The Contractor shall provide sufficient equipment and workers to safely handle and lay all conduit included as part of this work. All storage of materials shall be in a manner as to avoid damage to either surface prior to placement.

E. The Contractor shall inspect each piece of conduit prior to placement in the trench and any unsatisfactory conduit shall be rejected.

F. Conduit shall not be laid in water, mud, or any otherwise unsuitable trench. The conduit shall not be pushed into or allowed to fall to the bottom of the trench. Handling of the conduit shall be in conformance to the manufacturer's recommendations.

G. The conduit shall be kept clean and any open ends of installed conduit shall be closed when work is not in progress.

H. Jointing of the conduit shall be in accordance to the requirements of the manufacturers and as required by the specification material type. Any deviation from these acceptable methods requires approval of the Engineer.

I. Testing of joints, where required, shall be done in accordance with the Specification for Testing. Should any section fail to meet test requirements, the Contractor shall make suitable corrections, at their cost, until the requirements are met.

2.9 FINAL BACKFILL

A. Final backfill shall be installed from the top of the Pipe Embedment to the final grade. Final backfill of all conduit trenches shall conform to the requirements of the plans and details, Section 312323.13 "Compacted Backfill", and Section 312323.14 "Compacted Granular Backfill". All final backfill under existing or proposed pavement or structures or within the 1:1 zone of influence of existing or proposed pavement or structures shall be “Compacted Granular Backfill”. All final backfill not under existing or proposed pavement or structures or within the 1:1 zone of influence of proposed pavement or structures shall be “Compacted Backfill”.

B. Unless otherwise directed, all forms, bracing and lumber shall be removed during backfilling and the cavities and voids resulting from the removal shall be backfilled and compacted to 100% of Standard Proctor.

C. The Contractor must use special care in placing backfill so as to avoid injuring or moving the conduit or structure when compacting the backfill.

D. In areas used for temporary maintenance of traffic the top layer of final backfill from the elevation of the existing subbase base interface to the existing or proposed surface(s), shall be ODOT Item 304 Aggregate Base to provide a temporary surface traffic course.

E. Should after settlement occur, the Contractor must add and compact additional material.

F. Machine mounted mechanical tamper shall be used for backfill compaction. Flooding, jetting or puddling of backfill will not be permitted.

G. Excavated material in excess of that needed for backfilling and all unsuitable material shall be disposed of by the Contractor at his own expense and the cost of such disposal shall be included in the unit or lump sum prices bid.

2.10 TESTING AND ACCEPTANCE

A. Prior to final acceptance of the conduit or the placing of the conduit into service, testing and/or televising may be required.

B. For all sanitary, water, or other pressured conduits, pressure testing shall be required in accordance to the specifications contained herein. Televising shall be required for all sanitary sewer and may be required for storm sewers as outlined or required by plan note.

C. Final television inspection of conduit shall be performed by an experienced company and in a format satisfactory to the Owner. Televising shall be done in the presence of the Engineer unless so waived. The Engineer shall be provided with unedited video tapes and two (2) copies of the video log.

D. Televising shall not be done until all known repairs are completed and the line has been suitably flushed.

2.11 SITE RESTORATION

A. Restoration of the disturbed project area shall begin immediately after backfilling has been completed. All excess material, debris, and excavation shall be disposed of by the Contractor.

B. Restoration of paved surfaces and of seeded areas shall be done as soon as conditions permit. The manner in which this work shall be done is defined in other specifications or the contract plans.

C. While payment for site restoration may be included in other items, final acceptance of the underground conduit shall not occur until all work is complete. Where no separate pay items exist for restoration work, the Engineer may determine an appropriate value for this work to be retained until its completion.

END OF SECTION 312333

SECTION 320116.71 - PAVEMENT PLANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. This work shall consist of planing the existing pavement and disposing of the cuttings in accordance with these specifications in areas designated on the plans or established by the Engineer. When provided for in the contract, the work shall also consist of patching the planed surface.

1.3 JOB CONDITIONS

A. Existing Pavement Type

1. The item description indicates the predominate type of pavement. All pavement encountered in the areas designated on the plans shall be planed, measured, and paid for under the item unless a separate item is provided in the contract.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Planing equipment shall be self-propelled with sufficient power and stability to consistently and efficiently produce the required results. The cutting element may be made of the grinding, sawing, or milling type. Bituminous surfaces also may be planed using the blade type cutter of the heater planer, unless otherwise specified.

B. Planing cutters shall be mounted rigidly to the carrier and shall be adjustable and controllable as to depth of cut and cross-slope.

Longitudinal planing action may be produced either by means of a suitable carrier wheelbase or by means of an automatic control system having an external reference. Cross-slope adjustments or automatic controls shall be capable of producing either a variable or a constant cross-slope as required.

C. Planing cutters shall be designed, maintained and operated so as to produce a surface free from grooves, ridges, gouges or other irregularities detrimental to the safe operation of vehicles in traffic routed onto the planed surface, temporarily or permanently.

D. When heaters are used, adequate provisions shall be made for the safety of persons in the vicinity of the equipment and for preventing damage to adjacent property and facilities, public or private.

E. Suitable supplemental equipment or methods, approved by the Engineer, may be used in small or confined areas.

PART 3 - EXECUTION

3.1 PLANING

A. One or more planing passes shall be made over the designated area as necessary to remove such irregularities as bumps, corrugations, and wheel ruts, and when required, as necessary to establish a new pavement surface elevation or cross-slope.

B. Cuttings shall be removed from the surface following each pass of the equipment. Before opening the completed area to traffic, the surface shall be cleaned thoroughly of all loose material that would create a hazard, a nuisance, or would be redeposited into the surface texture. Cuttings shall become the property of the Owner and shall be delivered to a site as directed by the Engineer.

C. Effective measures shall be taken to control dust, smoke, contamination of the pavement, and the scattering of loose particles during planing and cleaning operations.

D. Where sound pavement has been gouged, torn, or otherwise damaged during planing operations, the damaged area shall be repaired at no additional cost in a manner satisfactory to the Engineer to conform to the adjacent pavement in smoothness and durability.

3.2 SURFACE PATCHING

A. Areas of the planed surface to be patched due to spalling or dislodgement of unsound pavement will be designated by the Engineer. The areas shall be cleaned of loose material, coated with ODOT 407.02 tack coat material, ODOT 702.02 or ODOT 702.04, and filled with asphalt concrete, ODOT 404, leveled and compacted to conform to the adjacent pavement.

3.3 SURFACE TOLERANCES

A. When the contract provides for planing without resurfacing, the surface shall be planed to a smoothness of plus or minus l/8 inch in 10 feet and the surfaces at the edges of adjacent passes shall be matched within plus or minus l/8 inch. When the contract includes resurfacing, these tolerances shall be plus or minus l/4 inch. The cross-slope of the planed surface shall conform to the specified cross-slope within plus or minus 3/8 inch in ten feet.

3.4 METHOD OF MEASUREMENT

A. The quantity of pavement planing including the removal and disposal of cuttings shall be the number of square yards planed.

B. The quantity of surface patching shall be the number of square yards patched including tack coat and asphalt concrete.

3.5 PAYMENT

A. See "Basis of Payment."

END OF SECTION 320116.71

SECTION 320190.16 – LANDSCAPE MAINTENANCE

PART 1 - GENERAL

1.1 SUMMARY

A. Related Requirements: Review the General Contract Conditions.

B. Work Included: Provide Landscape Maintenance, complete as specified.
   1. Work in this Section includes, but is not limited to, furnishing all labor, materials, equipment and incidentals needed to provide a complete landscape maintenance program to the Owner from the date of Substantial Completion.
   2. Maintenance items shall include all items constructed under the original landscape contract including: Landscape maintenance shall include necessary watering, cultivation, weeding, pruning, wound dressing, disease and insect pest control, protective spraying, adjustments of plants mowing, replacement of mulch that has been displaced, repairing and reshaping of saucers, and reseeding or replanting of those areas affected. Remove rubbish, waste, tools, and equipment used at end of each workday.
   3. Work specifically included for maintenance includes:
      a. Watering, pruning, weed control, inspection and replacement of mulch for trees and groundcover beds.
      b. Fertilization, watering and invasive weed control within the meadow areas.
      c. Site inspection of potential insect, pest and disease problems and filing of monthly status report.
      d. Clean-up of trash, litter and debris.
      e. Watering trees and grass.
      f. Mowing, edging and trimming of lawn areas.
      g. Monitoring, fertilizing, weeding, and cultivating of lawn areas.
      h. Pruning and trimming of plant material.
      i. Weed, cultivating and cleaning of planting beds.
      j. Application of fertilizers, insecticides, and herbicides.
      k. General site clean up; removal of trash and products of maintenance.
      l. Replacement of trees, shrubs, groundcovers and mulch.
      m. Sediment removal from stream.
      n. Insect, pest and disease control.
      o. Plant replacement due to theft, vandalism, wildlife or accidental damage by others after one year warranty period.

1.2 RELATED SECTIONS

A. Section 329200.19 - Seeding and Mulching

B. Section 329300.23 - Tree, Shrubs, and Ground Cover

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

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

C. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

D. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

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

1.4 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies
   1. Perform all work in accordance with all applicable laws, codes, and regulations required by authorities having jurisdiction over such work.
   2. Provide for all inspections and permits required by Federal, State, or local authorities in furnishing, transporting, and installing of all agricultural chemicals.

B. Applicable Standards:
   1. Workmanship and overall maintenance program shall conform to the highest level of industry standards.
   2. The contractors and their workforce shall conform to the standards, regulations and requirements set forth by the Owner.

C. Work Force:
   1. Experience:
      a. The site landscape maintenance firm shall have a full time foreman assigned to the job for the duration of the contract. He shall have a minimum of four (4) years experience in landscape maintenance supervision, with experience or training in entomology, pest control, soils, fertilizers and plant identification.
      b. The meadow maintenance shall be performed by an Environmental Management Company with five years of successful meadow management experience.
   2. Labor Force: The landscape maintenance firm's labor force shall be thoroughly familiar and trained in the work to be accomplished and perform the task in a competent, efficient manner acceptable to the Owner.

3. Supervision: The foreman shall directly employ and supervise the work force at all times. Notify Owner of all changes in supervision.
4. Identification: Provide proper identification at all times for landscape maintenance firm's vehicles and labor force per the Owner's requirements.
5. References:
   a. For maintenance of sites with similar landscaping for a minimum of three (3) years.
   b. For maintenance of successfully established meadows for a minimum of three (3) years.

1.5 SUBMITTALS

A. Submit three (3) copies each of the following items:
   1. Schedule of maintenance operations, including times of operation, and monthly status report including list of all equipment and materials proposed for the job.
   2. All licenses and insurance required by the local governing authority and the State of Ohio pertaining to this work.
   3. Monthly record of all herbicides, insecticides and disease control chemicals used for the project.

1.6 PROJECT CONDITIONS

A. Site Visit: At beginning of maintenance period, visit and walk the site with the Landscape Architect to clarify scope of work and understand existing project/site conditions.

B. Documentation of Conditions: Document general condition of existing trees, shrubs, vines, groundcovers and lawn recording all plant materials, which are damaged, or dying, if any, using video or photographic methods.

1.7 SCHEDULING

A. Perform all maintenance during hours mutually agreed upon between Owner and Contractor.

B. Work force shall be present at the project site at least once a week and as often as necessary to perform specified maintenance in accordance with the approved maintenance schedule.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: All materials and equipment, unless otherwise indicated, shall be provided by the Contractor.

B. Water: Clean, potable and fresh, furnished by the Contractor.

C. Fertilizers:
   1. Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium.
   2. Fertilizer shall be phosphate free 12-12-12, uniform in composition, free flowing and suitable for application with approved equipment delivered to the site in bags or other convenient containers, each fully labeled, conforming to applicable state fertilizer laws, and bearing the name, trade name or trademark, and warranty of the producer.
   3. Balanced, once-a-season application controlled-release fertilizers with a blend of coated prills which supply controlled-release nitrogen, phosphorus and potassium, and uncoated, rapidly soluble prills containing nitrogen and phosphorous.

D. Herbicides, Insecticides, and Fungicides:
   1. Obtain best quality materials with original manufacturers' containers, properly labeled with guaranteed analysis.
   2. Use non-staining materials.
   3. Where available, contractor shall use biological and/or orgainic friendly chemicals when possible. Submit list to the Owner.

E. Seed: Match existing seed mixes on the site. Refer to planting plan for location of specific seed areas. Obtain needed seed mixes from seed supplier Ohio Prairie Nursery 330-569-3380.

F. Live stakes: Match existing varieties.

G. Plant material: Refer to planting plan for specific tree, shrub and perennial varieties.

H. Replacement Tree Guys, Stakes, Ties and wildlife protection: Match existing materials on the site.

I. Mulch: All mulch shall be double shredded hardwood bark dark brown in color.

PART 3 - EXECUTION

1.3 GENERAL

A. Duration:

   1. Continuously maintain each plant and each portion of landscape area after the first year warranty has expired, and the original landscape contractor has completed their scope of work and outstanding warranty items.
   2. Maintain meadow areas until meadows have become established without undesirable plants and invasive plants and weeds.

B. Protection:
   1. Protect all planting areas from damage of all kinds from beginning of work until Final Acceptance.
   2. Maintenance includes temporary protection fences, barriers and signs as required for protection.

C. Replacements:

1. Immediately treat or replace all plants, which become damaged or injured as a result of site operations or negligence. Provide the Owner with list of plant materials requiring replacement and a cost of replacement for authorization prior to replacement.
2. Replacement plants shall be of acceptable size, condition, variety and shall match the original landscape plan specifications.

D. Watering:

1. Maintain desired level of moisture necessary to maintain vigorous, healthy growth. Contractor is responsible for watering as necessary to maintain vigorous, healthy growth during the first growing season.
2. Apply water in quantities sufficient to penetrate soil to minimum depth of 8-inches in shrub beds and 6-inches in turf areas at rate that will prevent saturation of soil.

E. Clean up: During course of maintenance, excess and waste materials shall be continuously and promptly removed to avoid disruption. Do not dispose of excess and waste materials on site.

F. Maintenance report and schedule of activities: Provide monthly schedules and reports to Owner detailing previous and subsequent planned maintenance activities. Utilize report form located at the end of this section. Include dated digital photographs as necessary with each monthly report showing full current clear views of entire landscaped and turf areas.

G. Site Access:

1. Maintenance operations shall be performed such that it does not interfere with access or operation of the facility.
2. Avoid interference with the use of, and passage to and from the building and parking. Notify the Owner at least two full working days prior to commencing work, which may cause interference. facilities.

3.1 TREES AND SHRUBS

A. Raised earth watering saucer:

1. Maintain all watering saucers around plants so that enough water can be applied to establish moisture through major root zones.
2. For supplemental hand watering of watering basins, use a water wand to break the water force. Do not permit crown roots to become exposed to air through dislodging of soil and mulch.
3. Maintain originally called for depth of mulch to reduce evaporation and frequency of watering.

B. Pruning:

1. Prune trees to select and develop permanent scaffold branches that are smaller in diameter than the trunk or branch to which they are attached, and which have vertical spacing of 18 in. to 48 in. in radial orientation so as not to overlay one another.
2. Prune trees to eliminate diseased or damaged growth, and narrow V-shaped branch forks that lack strength. Reduce toppling and wind damage by thinning out crowns.
3. Stripping of lower branches ("raising up") of young trees will not be permitted.
4. Retain lower branches in a "tipped back" or pinched condition to promote caliper trunk growth (tapered trunk). Do not cut back to fewer than six buds or leaves on such branches. Only cut lower branches flush with the trunk after the tree is able to stand erect without staking or other support.
5. Do primary pruning of deciduous trees during the dormant season. Do not permit any pruning of trees prone to excessive "bleeding" during growth season.
6. Prune damaged trees or those that constitute health or safety hazards at any time of year as required.
7. Make all cuts clean and close to the trunk, without cutting into the branch collar. "Stubbing" will not be permitted. Cut smaller branches flush with trunk or lateral branch. Make larger cuts (1 in. in diameter or larger) parallel to shoulder rings with the top edge of the cut at the trunk or lateral branch.
8. Branches too heavy to handle shall be precut in three stages to prevent splitting or peeling of bark. Make the first two cuts 18 in. or more from the trunk to remove the branch. Make the third cut at the trunk to remove the resulting stub.
9. Do not prune or clip shrubs into balled or boxed forms unless specifically called for by design.

C. Staking and tree protection:

1. Resetting: Reset any leaning or settled plants straightening plants which lean or sag, adjustments of plants which settle or are planted too low to proper grades or upright position.
2. Insect wildlife protection on tree trunks for damage, replace or reinstall as needed.
3. Provide additional tree staking only as needed to correct leaning trees.
4. Inspect stakes and guys at least once a month to check for rubbing that causes bark wounds.
5. Conform to the industry recommended procedures of staking and guying.

D. Mulching:

1. All weeds shall be removed from shrub beds and trees prior to mulch being put down.
2. Mulch shall not be placed directly against the trunk or stem of the plant material.
3. Application of mulch shall be done in mid spring after the soil has warmed sufficiently for active root growth and the mulch shall be ‘turned’ in the early fall.

E. Disease and Pest Control

1. Control of diseases and pests shall be insured by regular, thorough inspections by a certified Arborist and prompt treatment either by spraying, pruning, or removal and replacement of diseased or unhealthy plant material. Plants shall be inspected for scale from January through March. If scale is present, a dormant miscible spray shall be applied per manufacturer's directions. From April through October, all plants shall be checked monthly for insects and diseases and treated appropriately.

F. Maintenance of Existing Trees and Shrubs to Remain:

1. General: Conform to all applicable paragraphs regarding pruning, watering, spraying and fertilizing of new plant materials as specified in this section.
2. Be alert to symptoms of construction damage to root systems of existing trees and shrubs as evidenced by wilting, unseasonal or early flowering or loss of leaves, and insect or disease infestation due to declining vigor.
3. Give notification in writing of all evidence of declining tree or shrub vigor immediately upon discerning the problem. Take appropriate interim measures to mitigate the severity of the problem as specified in this section.
4. Perform site inspection of areas for downed, damaged and hazard trees after storm events. Prune or remove damaged plant material.
5. Submit written proposal and cost estimate for the correction of all conditions before proceeding with permanent correction work.

G. Stream:

1. Contractor will perform limited maintenance including trash and debris removal from stream area.
2. Contractor shall not operate motorized equipment or perform maintenance activities including mowing, trimming, herbicide, pesticide, or fertilizer applications within areas identified as stream.
3. Evaluate and report overall condition of floodplain areas on the monthly maintenance report provided below.
4. Determine applicable environmental laws and regulations regarding the use of chemicals adjacent to these areas and complying with all such applicable laws and regulations. Contractor shall not apply any chemicals directly or indirectly into stream areas.

3.3 LAWNS AND MEADOWS

A. Weed Control:

1. Spot weed control shall be applied by an Environmental landscape Management Company familiar with the meadow plantings.
2. Non-wildflower areas: Apply broad leaf herbicide to all meadow grass areas without forbe species per the recommendations of the seed supplier. Make a visual inspection of all seeded areas to verify the presence and growth of broadleaf weeds and invasive plant materials prior to herbicide application.

3. Wildflower areas: Remove weeds and invasive plant materials by cutting or by selective herbicide glove application.

B. Mowing: Refer to Maintenance Map:
   1. The Maintained Lawn seed mix shall be mowed weekly to a height of 2-1/2".
   2. The Clover Lawn Seed Mix shall be mowed bi-weekly to maintain a 4"-6" height and shall not be mowed shorter than four (4) inches.
   3. Paper, trash, leaves and other debris shall be picked up prior to mowing and removed from the premises. Do not dispose of on site.
   4. Cutting pattern shall be varied as frequently as will permit, but the same pattern shall not be used more frequently than every fourth (4) mowing.
   5. Premises shall be left free of grass clippings in groundcover beds, on sidewalks, driveways, parking lots, etc.
   6. Excessive accumulations of grass clippings shall be picked up after each mowing, and acceptable amounts of clippings shall be left to decompose into thatch layer, contributing nutrients to turfgrass.
   7. Concrete areas shall be edged so that grass is not growing over the sides. The edging shall not provide any gap between concrete and lawn, which could pose a safety hazard.

3.4 INSECTS, PESTS, WILDLIFE AND DISEASE CONTROL

A. Inspection: Inspect all plant materials for signs of damage, stress, damage and potential trouble from the following:
   1. Presence of insects, moles, gophers, ground squirrels, snails and slugs in planting areas.
   2. Excessive wildlife damage to trees.
   3. Discolored or blotching leaves or needles.
   4. Unusually light green or yellowish green color inconsistent with normal green color of leaves.
   5. Personnel: Perform spraying for insect, pest and disease control only by licensed, qualified, trained personnel.
   6. Application: Spray with extreme care to avoid all hazards to any person, building, parking and walking areas in the area or adjacent areas.

3.5 FERTILIZING

A. Existing trees shall be deep root fertilized as needed based on an Arborist recommendation.

3.6 FALL CLEAN-UP

A. Leaves shall be picked up from all weekly mowed lawn areas, pavement, walks, and planting bed areas by the end of the autumn season. An additional “pick-up” in late November shall be included in areas as needed due to trees such as oaks that hold their leaves longer.

3.7 SPRING CLEAN-UP

A. Leaves and debris shall be cleaned from all lawn and planting beds prior to first mowing, if applicable.

B. Remove all litter and debris.

3.8 THE ONE (1) YEAR MAINTENANCE PERIOD

A. The following items shall be done one year after installation, if appropriate, at an additional cost to the owner.

1. It is the responsibility of the installation contractor to notify the Owner or Owner’s representative that guys, stakes and deer protection be inspected and corrected as needed.
2. All dead or unhealthy plant material out of warranty shall be replaced upon the approval of plant selection and price by the owner.

3.9 NO-FAULT REPAIR AND CORRECTION:

A. No fault repair and correction work shall consist of work to correct faults or repair damage existing through no fault of the Contractor, but which is necessary for the continued proper maintenance and operation of the landscaping including correction of sprinkler system, on-site utilities, equipment, landscape plants, materials damage, or other corrections necessary for the duration of the Maintenance Contract. No fault repair and correction shall not include work as otherwise defined within the scope of Maintenance. The Contractor shall provide a cost to perform such necessary work to the Owner for approval prior to completing the work.

PART 4 - LANDSCAPE MAINTENANCE CHECKLIST GUIDE

Planned Maintenance Activities for the Upcoming Month:

Week #1 (1st – 7th):

Week #2 (8th – 14th):

Week #3 (15th – 21st):

Week #4 (22nd – End of the Month):

Landscape/Maintenance Contractor: _____ _____

Signature Date

_____

Print Name and Title)

END OF SECTION

SECTION 320190.33 – TREE AND SHRUB PRESERVATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Furnish all labor, equipment and incidentals required to protect existing vegetation areas not to be disturbed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Marking Tape

1. Red and yellow nylon or approved equal.

B. Fencing or other protective devices as approved by Engineer.

PART 3 - EXECUTION

3.1 PROTECTION

A. Marking and Identification

1. The extent of the area to be cleared and grubbed will be marked in the field by stakes and red fiberglass or nylon tape. Individual trees or shrubs to be removed from a location where most of the vegetation is to remain will also be marked by red tape. Any vegetation to remain within a larger area identified to be cleared and grubbed will be marked by yellow tape.

3.2 PROTECTION AND CARE OF TREES AND SHRUBS

A. Protect all other trees and shrubs from defacement, injury and destruction. Preserve trees within the right-of-way or construction area that are so delineated on the Drawings or are marked in the field.

B. During work operations, protect the trunk, foliage, and root system of all trees to be saved with boards or other guards placed as required to prevent damage, injury and defacement. Do not pile excavated material adjacent to the base of any trees. Do not allow runoff to

accumulate around bases of trees. Do not fasten or attach ropes, cable or guy wires to trees without permission of the Engineer. Provide climbing ropes during trimming.

C. All such trees, shrubs, and plants shall be carefully trimmed and protected from scarring, barking, or other injury during construction operations. All cuts and scars on trees shall be painted and treated with an approved wound dressing especially prepared for tree surgery, as directed by the Engineer.

3.3 TREE PRUNING

A. Pruning Existing Trees

1. Contractor shall prune all existing trees tagged or designated by the Engineer to remain.
2. Remove all dead, damaged and diseased wood completely. Do not leave stubs as it is unsightly and provides an entry point for disease spores. Also, remove crossed, girdling, or misplaced branches with care not to spoil the natural habit of the tree or shrub. The branch should always be removed flush with the trunk or parent branch while exposing the smallest area of cut surface possible without leaving an unnecessary stub.
3. Use the undercut method for the removal of all branches greater than 1/2". If necessary, cut a long, heavy branch into several convenient, manageable lengths to reduce the weight in easy stages. The undercut prevents any possible tearing of the bark below the branch. All wounds shall be carefully pared over with a sharp knife and covered with wound paint, approved by the Engineer, within 24 hours.
4. Trees and shrubs shall also be pruned in order to restore typical branching habits for that particular species, by trained and experience personnel.
5. Prune existing mature trees in late autumn or early winter, particularly for those trees that produce large quantities of sap.

3.4 DISPOSAL OF MATERIALS

A. All tree trunks, limbs, roots, stumps, brush, foliage, and other vegetation shall become the property of the Contractor and shall be removed and disposed of by him off the project site in a manner complying with applicable local, State and Federal regulations. No burning will be allowed.

END OF SECTION 320190.33

SECTION 321000- PAVEMENT REPLACEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. The Contractor shall furnish all of the equipment, labor and materials necessary to install, replace, and/or restore existing pavement structures together with their respective appurtenances as shown on the plans and as specified herein. This work shall include all of the subgrade preparation, subbase, base, intermediate pavement course(s), and finish pavement courses together with curbing, guttering, tack and/or prime coating, sealing and other pertinent work as necessary to meet the conditions of this contract.

1.3 QUALITY ASSURANCE

A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.4 REPAIR OR REPLACEMENT WORK

A. For the repair and/or replacement of all existing pavement structures and their respective appurtenances that are removed and destroyed or otherwise damaged by the Contractor in the course of his performance of the work required under this contract, the Contractor shall furnish all equipment, labor, and materials as necessary to properly restore to a condition equal to that at his entry, and to the satisfaction of the Engineer, the Ohio Department of Transportation, all cinder, slag, gravel, water-bound macadam, bituminous macadam, asphalt and brick or concrete driveways, curbs, sidewalks and roadways in strict accordance with the drawings and as specified herein.

B. In general, this item will include concrete, steel reinforcement, brick, stone, slag, cinders, gravel, asphalt and other bituminous materials and curbs, gutters, driveway culverts, road and curb drains and the demolition, excavation and removal of existing driveways, sidewalks and roadways.

1.5 REFERENCE TO OTHER PARTS

A. Other sections of these specifications shall apply, as and where applicable to this section and such sections will be the same as though they were included in this section.

B. For all old work where pavement is being repaired and/or replaced as a result of damages occurring thereto during the course of the work of this contract, all clearing and grubbing,

removal and storage of topsoil, excavation and/or placing of compacted fill and granular backfill, shall be done as required under other parts of these specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Generally, for all repair and replacement work, all new materials shall match the existing and adjoining work in both composition and quality unless otherwise ordered, specified herein, and/or shown on the drawings. In any stone driveway or roadway, the material used for stone fill shall conform to the existing material.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. All pavement work shall be done in strict accordance with the specifications of the governmental body concerned and the latest ODOT specifications as applicable or at the direction of the Engineer.

B. All pavements disturbed by the Contractor's operations shall be relaid to the thickness of the adjoining pavement and, in all cases, the restoring of pavements, shall apply both to foundation courses and to the wearing surface.

C. Should cracks or settlements appear in adjoining pavements, the paving shall be removed to the extent necessary to secure firm and undisturbed bearing and shall be replaced in a satisfactory manner.

D. No permanent pavement shall be installed, repaired, and/or restored unless, or until, in the opinion of the Engineer, the condition of the backfill is such as to properly support the pavement.

E. Where new or replacement concrete pavement or base is placed adjacent to existing concrete pavement or base, contraction joints shall be provided in the new or replacement pavement so as to form a continuous joint with that in the existing pavement.

3.2 ROADWAY SUBGRADE

A. The entire area to be occupied by the roadways and parking areas shall be cleared, topsoil removed and stored, and the excavation or compacted fill made as required and brought to the proper cross-sections. Pipe trenches and other excavations shall be backfilled as required, and thoroughly compacted within the limits of the roadways or parking areas.

B. After the surface of the subgrade has been properly shaped and before any stone or slag is placed, the entire subgrade shall be thoroughly rolled and compacted to a depth of 12 inches under this section. Rolling shall be done with an approved type of self-propelled roller, weighing not less than ten (10) tons. All hollows and depressions which develop during the rolling shall be filled with acceptable materials, and the subgrade rerolled. The

process of filling and rolling shall be repeated until no depressions develop, and the entire subgrade has been brought to a uniform condition of stability.

C. All places which, in the opinion of the Engineer cannot be properly rolled, shall be tamped with handheld mechanically or pneumatically powered tampers.

D. In making the compacted fill and in doing the final subgrade rolling, the Contractor shall see that the material to be compacted and/or rolled has the proper moisture content to secure maximum compaction. When, in the opinion of the Engineer, the material is too wet, the compacting shall be delayed until the material has dried sufficiently. When, in the opinion of the Engineer, the material is too dry, the material shall be sprinkled with water in an amount to secure the proper moisture content.

END OF SECTION 321000

SECTION 321200 - ITEM 407 TACK COAT, TRACKLESS TACK, INTERMEDIATE AND SURFACE COURSE

Description: This work consists of preparing and treating a paved surface with NTSS-1HM Trackless Tack produced by Blacklidge Emulsions, Inc., or an approved equivalent by OWNER. Meet all requirements of Construction and Material Specifications Item 407 Tack Coat except as noted below.

Material: Conform to the following typical physical properties:

Parameter	**Test Method**	**MIN.**	**MAX.**
Saybolt Furol Viscosity, SFS @ 25C	AASHTO T59	15	100
Storage Stability, 25 hours, %	AASHTO T59	---	1
Storage Stability, 5 days, %	AASHTO T59	---	5
Residue by Distillation, %	AASHTO T59	50	---
Oil Distillate, %	AASHTO T59	---	1
Sieve Test, %	AASHTO T59	---	0.30
Test on Residue:			
Penetration, @ 25C	AASHTO T49	---	20
Softening Point Range Deg. C	AASHTO T53	65	---
Solubility, %	AASHTO T44	97.5	---
Original Binder DSR @ 82C			
G*/SIN 8, 10 rad/sec	AASHTO T315	1.00	---

Note: Product should not contain filler such as clay, etc. Keep from freezing. Supply certified test data from an independent lab to the Engineer showing the material supplied was tested for and meets the above properties.

Equipment. All requirements of 407.03 apply. See manufacturer's representative for correct distributor settings. Thoroughly clean all equipment if cationic emulsion was previously used.

Weather Limitations. All requirements of 407.04 apply.

Preparation of Surface. All requirements of 407.05 apply.

Application of Asphalt Material. Uniformly apply the asphalt material with a distributor per the requirements of 407.06 except as noted. If product is stored for an extended period of time, prior to application, agitate or gently circulate the material. All nozzles and spray patterns shall be identical to one another along the distributor spray bar. The angle of the nozzle should be at a 15 to 30 degree angle to the spray bar axis to maximize overlap or as recommended by the nozzle manufacturer. Contact the manufacturer's representative for required spray nozzle size, and distributor and nozzle settings. Apply at a rate of 0.04 to 0.08 gallons per square yard. Recommended application temperature is 160°F. to 180°F. Do not exceed 180°F. Dilution is not allowed.

The Engineer and manufacturer's representative will approve rate of application, temperature, distributor settings, and areas to be treated before application of the tack coat. The Engineer will determine the actual application in gallons per square yard by a check on the project. The application is considered satisfactory when the material is applied uniformly with no visible evidence of streaking or ridging and the application rate is ±10% of the specified rate.

Method of Measurement. All requirements of 407.07 apply.

Basis of Payment. All requirements of 407.08 apply.

SECTION 321216 - ASPHALT CONCRETE PAVING AND MATERIALS

SECTION 1 - MATERIALS

1.1 The asphalt concrete mixture and installation thereof shall meet Ohio Department of Transportation (ODOT) Specifications except as modified in these specifications.

1.2 In the ODOT Specifications substitute "Engineer" for "Department" (except as stated below in reference to ODOT 403 for Department VA testing and acceptance).

1.3 No steel slag shall be used as coarse or fine aggregate for any asphalt concrete.

1.4 All asphalt cement utilized on this project shall meet AASHTO Provisional Standard MP1 or any superseding AASHTO specification for performance graded asphalt cement binder in conformance with PG 64-22.

1.5 The following exceptions shall be made for the Asphalt Concrete:

A. No Recycled Asphalt Product (R.A.P.) will be permitted

1.6 Except where designated otherwise in the plans or specifications all asphalt concrete mixes shall be designed for medium traffic volumes. Where light or heavy traffic pavements are designated in the plan, the contractor shall use an asphalt concrete mix designed for such traffic conditions.

1.7 Acceptance of the mixture will be based upon the certification that the mixture was produced according to the approved JMF within the production control and composition tolerances of the specifications. The Contractor shall hire and pay for an independent testing lab approved by the Engineer to perform all sampling, testing, monitoring, analysis and certification required by the Laboratory, Monitoring Team or Department in ODOT 403 and 441. All work by the independent laboratory shall be performed by personnel with ODOT Level II Bituminous Concrete certification.

1.8 ODOT 401.20 - "Asphalt Binder Price Adjustment" shall not apply to this contract.

1.9 All inlets and manholes shall be adjusted to grade after installation of the intermediate course(s), if any and prior to installation of the surface course.

1.10 All materials delivered to this project must have been weighed on a platform scale with electronic imprinter to show gross, tare, and net weights. No payment will be made for materials which are not correctly weighed as necessary. Material weight shall not exceed the current legal allowable limit.

1.11 Unless specified elsewhere in the specifications, material for berms shall be limestone only. Recycled concrete and asphalt concrete will not be permitted.

SECTION 2 - PAVING EQUIPMENT

2.1 All spreading equipment shall be self propelled. The Contractor shall identify the make and model of the paving machine that will be used for the intermediate and surface courses for approval prior to the pre-construction meeting.

2.2 All equipment, tools, and machines used in the performance of this work shall be maintained in satisfactory working order at all times. The Contractor shall be prepared to furnish proof of certification that all equipment to be used on the project has been calibrated within the past six (6) months.

SECTION 3 - GENERAL - PAVING

3.1 All paving shall be done on a single-lane basis.

3.2 Tack Coat, Item 407, shall be applied at the rate of from 0.40 gallons per square yard as appropriate for the surface conditions with sand cover if required.

3.3 Asphalt driveway aprons shall be matched to new pavement with 24" transition sections or as shown on the drawings or required by the Engineer. The Contractor shall install apron wedge as required in the detailed drawings.

3.4 Unless otherwise shown on the drawings, jointing of new to existing pavement shall be by milled butt joints six (6) feet in width (or as shown on the plans) from edge of pavement to edge of pavement. Depth of this milled area shall equal the total of subsequent intermediate course and surface course as specified.

3.5 One (1) copy of each hauled/weighed material truck load ticket (plant ticket) for materials incorporated in this project shall be provided to the project representative daily. All bulk materials delivered to this project must have been weighed on a platform scale with electronic imprinter to show gross, tar and net weights. No payment will be made for materials which are not correctly weighed as necessary. Material weight shall not exceed the current legal allowable limit. If a partial load is used, the Contractor's foreman and the project representative shall confer and come to an agreement as to what portion of the product was used. The percent of material of this load, as reported by the project representative, is what shall be recorded as utilized.

3.6 For variable depth courses where tonnage tickets are used for determining quantities for payment, the conversion to cubic yards shall be number of tons verified and approved by the Engineer divided by 2.00 regardless of the actual density of the mix.

3.7 Positive drainage is to exist subsequent to the completion of the surface course. The Contractor shall take any necessary measures to assure positive drainage of the surface course. It shall be the responsibility of the Contractor to repair any low/puddled areas at his own cost by milling out the affected areas to a minimum depth equal to the nominal depth of the course being repaired and replacing with the specified asphalt concrete to grades that will correct the drainage problem.

3.8 Surface tolerances for all completed surface courses shall be as noted in ODOT 401.19. This tolerance shall apply regardless of whether or not an intermediate course is installed.

3.9 At the direction of the Engineer, periodic weight checks of asphalt concrete in loaded trucks shall be made by the Contractor and verified by the Engineer.

3.10 All quality control testing data performed on material incorporated into this project shall be forwarded to the Engineer for review as soon as it is available.

3.11 Quantity verification (but not necessarily payment quantity) for all asphalt concrete incorporated into the work shall be by weight tickets as produced by the plant or supplier or other means approved by the Engineer. Tack coat shall be verified by a ticket filled out and signed by the Contractor's tack truck driver based on weights taken or observations of level indicators. All verification tickets are required to be submitted to the Engineer on the day the material is incorporated into the work; however, the Engineer may, at his sole discretion, accept verification tickets for any items up to seven (7) calendar days subsequent to the work being performed. **After that date additional verification tickets for material will not be accepted for consideration of payment.**

3.12 All edges of surface courses abutting curbs or other appurtenances shall be sealed with hot AC-20.

3.13 The asphalt concrete, intermediate or surface course work will conform to ODOT Items 448-1 – Intermediate and Surfaces Courses and 448-2 – Intermediate Course. The paving foreman, at the Engineer's request, will be required to correctly calculate the asphalt concrete "yield." "Yield" is defined as the rate of material used, in cubic yards, in proportion to the area paved. The Contractor must be aware if he is under or over plan quantities for the area in question.

END OF SECTION 321216

SECTION 321236.13 - ITEM SPECIAL: LD-7 POLYMER FOG SEAL EMULSION

LD-7.01 Description
LD-7.02 Materials
LD-7.03 Equipment
LD-7.04 Weather Limitations
LD-7.05 Preparation of Surface
LD-7.06 Application of Asphalt Material
LD-7.07 Method of Measurement
LD-7.08 Basis of Payment

LD-7.01 Description. This work consists of preparing and treating a newly seal coated (chip sealed) surface with a specialized anionic asphalt emulsion.

LD-7.02 Materials. Material shall conform to the following typical physical properties:

Parameter	Test Method	MIN.	MAX.
Saybolt Furol Viscosity, SFS @ 25ºC	ASTM D88	15	100
Storage Stability, 24 hrs., %	ASTM D244	--	1
Storage Stability, 5 days, %	ASTM D244	--	5
Residue by Distillation, %	ASTM D244	50	--
Oil Distillation, %	ASTM D244	--	1
Sieve Test, %	ASTM D244	--	0.3
Test on Residue			
Penetration, @ 25ºC	ASTM D5	--	20
Softening Point Range Deg.C	ASTM D36	65	--
Solubility, %	ASTM D2042	97.5	--
Original Binder DSR @ 82ºC			
G*/SIN8, 10 rad/sec	AASHTO T111	1	--

Note: Produce should not contain filler such as clay, etc.

LD-7.03 Equipment. Contractor shall provide adequate cleaning equipment and distributor. Use distributors designed, equipped, maintained, and operated to apply asphalt material at the specified rate per square yard (square meter) with uniform pressure over the required width of application. Ensure that the distributor includes a tachometer, pressure gauges, accurate volume measuring devices, or a calibrated tank. Mount an accurate thermometer with a range covering the specified application temperature for asphalt material at approximately center height of the tank with the stem extending into the asphalt material. Ensure that the distributor has a full-circulating system with a spray bar that is adjustable laterally and vertically. Ensure that the spray bar will maintain a constant height above the pavement under variable load conditions. Supply each distributor with suitable charts showing truck and pump speeds and other pertinent application data necessary to obtain the required results. **See manufacturer's representative for correct distributor settings.**

LD-7.04 Weather Limitations. Do not apply the material if the surface temperature is below 40ºF. Note: Subject to damage if frozen.

LD-7.05 Preparation of Surface. Ensure that the surface has been swept just before application and is thoroughly clean, dry and free of loose stone chips. Remove dirt, dust and loose chips cleaned from the surface and dispose of it as the Engineer directs. Material should not be applied to a new seal coated (chip seal) surface for a period of two weeks after seal coat installation.

LD-7.06 Application of Asphalt Material. Uniformly apply the asphalt material with a distributor. Surface to be clean, dry and free of loose stone chips.

Note: LD-7 is not compatible with Cationic emulsions (CRS, CQS, CMS, CSS, etc.). All equipment should be thoroughly cleaned if cationic emulsion was previously present. If product is to be stored for an extended period of time, the material should be agitated or gently circulated prior to use. Nozzle spray pattern should be identical to one another along the distributor spray bar. The angle of the nozzle should be a 15 to 30 degree angle to the spray bar axis to maximize overlap.

The polymer fog seal should be applied at a rate of 0.1 to 0.2 gallons per square yard. Recommended application temperature is 140ºF to 180ºF. Do not exceed 180ºF.

The Engineer and Manufacturer's Representative will approve the quantity, rate of application, temperature, distributor settings and areas to be treated before application of the polymer fog seal. Contractor must contact the Manufacturer's Representative for distributor settings and spray nozzle type. The Engineer will determine the actual application ate in gallons per square yard (liters per square meter) by a check on the project. The application is considered satisfactory when the actual rate is within ±10% of the required rate and the material is applied uniformly with no visible evidence of streaking, ridging or excess material bleeding or puddling.

The material shall be overlapped by 2-6 inches at all adjacent spray passes.

Traffic shall be allowed on the material after one hour or longer as directed by the Project Engineer's on-site representative after the material has been determined to be tack free and set reasonably firmly.

Pavement markings may be applied on the material after 24 hours if water-based. Thermoplastic or non-water based markings shall be applied not sooner than two weeks after material application.

LD-7.07 Method of Measurement. Fog Seal by the square yardage of undiluted asphalt material applied for each according to Item 109.

LD-7.08 Basis of Payment. The department will pay for accepted quantities at the contract prices as follows:

Item	Unit	Description
Special LD-7	SY	Polymer Fog Seal Emulsion

SECTION 321400 – UNIT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Installation of pavers shall be to the extent shown on the Contract Drawings and shall include supplying all pavers, (polymer) joint sand, sand setting bed, bases, and the incorporation of these materials into the work as specified.

1. Brick pavers
2. Turfstone grass pavers

B. Preparing subbase to receive base course materials.

C. Placing and compacting base course materials.

D. Adjust to grade all existing catch basins and other utility structures.

1.2 SUBMITTALS

A. Product Data: For the following:

1. Pavers
   a. Submit shop drawings
   b. Samples of pavers for verification of style and color.
   c. Manufacturer's catalog product data, installation instructions, and material safety data sheets.

2. Joint material

   a. Shop drawings
   b. Sample of joint material for verification and color of product.

3. Edging

   a. Samples of edging for verification of style and color.
   b. Manufacturer's catalog product data, installation instructions, and material safety data sheets.

4. For setting bed, base, and subbase aggregate
   a. Submit one pound samples of each.

5. Provide a minimum 9' x 9' mock-up of each required paving pattern for the Owner's Representative approval, to insure desired appearance. The mock-up shall include paver color and shapes as they will be used on the work. Once the mock-up has been approved, then this shall become the standard for the remainder of the work. If the mock-up is not acceptable, additional mock-ups shall be provided until approved, at no additional cost to the Owner.

a. Installers using mechanical installing equipment shall install sufficient pavers as determined by the Owner's Representative to clearly indicate blending of paver colors is acceptable and "checker boarding" is not apparent. The mock-up shall conform to all other requirements for hand installation listed above.
b. The mock-up shall be used to determine is any changes are required to the paver area dimensions as shown on the drawings.
c. The mock-up shall be kept onsite until permission is received from the Owner's Representative to remove it. Pavers placed for the work shall not be used as a mock-up.

1.3 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain each type of unit paver, joint material, and setting material from one source with resources to provide materials and products of consistent quality in appearance and physical properties.

B. Installer Qualifications: An experienced installer who has completed unit paver installations similar in material, design, and extent to that indicated for this project and whose work has resulted in construction with a record of successful in-service performance.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect pavers and aggregate during storage and construction against soiling or contamination from earth and other materials.

B. Cover pavers with plastic or use other packaging materials that will prevent rust marks from steel strapping.

1.5 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

. Field measurements: Pavers may vary in size depending on the manufacturer supplying the pavers. Therefore, it shall be the responsibility of the contractor to coordinate the exact dimensions of pavers to be installed (including allowable tolerances) with dimensions for paver areas indicated on drawings prior to the installation of any poured concrete. The contractor shall make modifications to paver area dimensions to eliminate as much cutting of pavers as possible. The owner's representative shall approve any changes in dimensions.

PART 2 - PRODUCTS

2.1 BRICK PAVERS

A. Physical Requirements

1. Meet Brick Industry Association for the type of brick specified.
   a. Light traffic and pedestrian clay pavers shall be pavers conforming to ASTM C-902, Class SX, Type I, Application PX.
      1) The average compressive strength of five test samples shall be 8,000 PSI with no individual unit less than 7,000 PSI.
      2) The average cold water absorption of five test samples shall not be greater than 8% with no individual unit greater than 11%.
      3) The average saturation coefficient of five test samples shall not be greater than 0.78 with no individual unit greater than 0.80.
      4) The abrasion index shall not exceed 0.11.
      5) Chipping requirements are a maximum of 1/4" for edge pavers and 3/8" for corner pavers.
      6) Pavers shall be 2 ¼" x 4" x 8".
      7) Pavers shall be provided with spacer ribs (lugged) and beveled.

   b. Brick pavers shall be as manufactured by Pine Hall Brick Co., Inc., Winston Salem, North Carolina as supplied by the Thomas Brick Company, Cleveland, Ohio (216) 831-9116; or approved equal. Paver color shall be English Edge red full range.

B. Aggregate base shall conform to ODOT Item 304.

C. Concrete base shall conform to ODOT Item 305.

D. Setting bed shall conform to ODOT Item 703.02.

1. Limestone screenings are not permitted.

E. Sand for joints shall be Polymeric jointing sand.

1. Sand shall conform to ASTM C 144, a mixture of graded sand and binder. Owner's representative shall choose color.

F. Aluminum Paver Edging

1. Clay paver edging shall be 3/16" thick by 2 ¼" high by 1-5/8" wide "L-shaped" aluminum Structuredge Paver Restraint with natural mill finish as manufactured by Permaloc Corp., Holland, MI (800) 356-9660, or approved equal.

2.2 GRASS PAVERS

A. Physical Requirements

1. Meet Brick Industry Association for the type of brick specified.
    a. Commercial traffic pavers shall be pavers conforming to ASTM C-902, Class SX, Type I, Application PX.
    b. The average compressive strength of five test samples shall be 8,000 PSI with no individual unit less than 7,000 PSI. The average cold water absorption of five test samples shall not be greater than 8% with no individual unit greater than 11%
    c. The average saturation coefficient of five test samples shall not be greater than 0.78 with no individual unit greater than 0.80.
    d. The abrasion index shall not exceed 0.11.
    e. Chipping requirements are a maximum of 1/4" for edge pavers and 3/8" for corner pavers.
    f. Pavers shall be 15 ¾" x 23 5/8" x 3 1/8"

B. Grass pavers shall be Turfstone as manufactured by Unilock., Rittman, Ohio or approved equal. Paver color shall be Natural.

C. Aggregate base shall conform to ODOT Item 304.

D. Setting bed shall conform to ODOT Item 703.02.

1. Limestone screenings are not permitted.

E. Soil for paver openings shall be topsoil.

1. Topsoil shall be backfilled into paver openings flush with top of pavers and seeded with specified seed mix.

F. Aluminum Paver Edging

1. Grass paver edging shall be 3/16" thick by 2 ¼" high by 1-5/8" wide "L-shaped" aluminum Structuredge Paver Restraint with natural mill finish as manufactured by Permaloc Corp., Holland, MI (800) 356-9660, or approved equal.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION OF CLAY AND CONCRETE PAVERS

A. Subgrade preparation: compacted density and elevations shall conform to the earth-work specifications.

B. Place geotextile fabric along bottoms and sides of grass paver base.

C. Aggregate base materials: thickness, compaction, surface tolerances, and elevations shall conform to the specifications.

D. The subbase and aggregate base shall be placed in uniform lifts not exceeding 6 in., loose thickness and compacted to at least 100 percent Standard Proctor Maximum Dry Density as per ASTM 698.

E. The pavers shall be laid in the pattern(s) as shown on the drawings or as recommended by the manufacturer. Straight pattern lines shall be maintained. Final elevations shall be checked for conformance to the drawings.

F. Place uncompacted bedding sand over base to a thickness so that after the pavers are placed and vibrated the bedding material shall be at the thickness shown on the plans and details.

G. Do not use unit pavers with chips, cracks, voids, discolorations, and other defects that might be visible or cause staining in finished work.

H. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

I. Cut unit pavers with motor-driven masonry saw equipment to provide lean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

J. Place pavers carefully by hand in straight courses, maintaining accurate alignment and uniform top surface. Protect newly laid pavers with plywood panels on which workers can stand. Advance protective panels as work progresses, but maintain protection in areas subject to continued movement of materials and equipment to avoid creating depressions or disrupting alignment of pavers.

K. Joints: Place unit pavers with hand-tight joints, not to exceed 1/8-inch, in pattern shown on plans. Joints shall run in straight and continuous lines and shall not be offset by more than 1/8-inch.

L. Vibrating of pavers shall be accomplished with three (3) or more passes with a vibratory compactor; the first pass shall be made with the surface of the laid pavers brushed clean and joints open. Pavers shall be vibrated into bedding sand with a plate type soil compactor capable of 3,500 to 5,000 lbs. centrifugal compaction force and with a plate surface area of not less than 2.5 square feet. Use a rubber mat to prevent scuffing.

M. The remaining passes with the vibrator shall be accompanied with simultaneous brushing of joint sand into the joints.

1. Temperature shall remain above freezing during joint sand installation. Vehicles shall not drive on the pavers for a minimum of 48 hours after installation.

2. Spread polymeric sand uniformly over dry paver surface, using a push broom, so as to fill the joints completely, down to their full depth. Repeat until joints are completely packed, or at least 1/8" below the top of the pavers.

3. Remove all sand residue from surfaces with a leaf blower. Keep the leaf blower at a distance so as to not disturb the filled joints. Surfaces must be free of the polymeric sand product.

4. Spray 200 SF of surface at a time on a shower setting, starting at the bottom of a slope. Wet each section for approximately 30 seconds without displacing the sand. Stop for a few seconds and then wet the same section again for about 30 seconds to ensure the joints are completely wet. After joints are saturated to a minimum of 1 ½" depth, move on to the next section. Avoid excess flooding of the surface.

N. Finished surfaces shall not vary from true lines, levels, or grade by more than 5/16-inch in 3 feet when measured with a straight edge.

O. Tops of pavers shall not vary by more than 1/8-inch from adjacent surfaces.

P. Install topsoil and seeding in paver openings and compact.

Q. Paver edging shall be installed as detailed with manufacturer supplied joint connectors forming a smooth uninterrupted edge.

R. Edging shall be formed to have smooth, continuous curves as indicated on the drawings.

3.4 REPAIRING AND CLEANING

A. Remove and replace pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

END OF SECTION 321400

SECTION 321613.13 - CONCRETE CURBS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Under this section the Contractor shall furnish and construct curbing of various, designated types as shown or scheduled on the Drawings.

B. This section includes preparation of the base and/or subgrade construction of curbs, other work and materials incidental to the construction of curbing.

1.3 OWNER'S STANDARDS AND SPECIFICATIONS

A. Items preceded by ODOT shall refer to the latest edition of the State of Ohio, Department of Transportation, Construction and Material Specifications.

PART 2 - PRODUCTS

2.1 CONCRETE

A. All concrete used shall be Class C as specified in Section 030000.

2.2 CURBING

A. Other materials for curbing shall meet the applicable requirements of ODOT Item 609.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All soil subgrade under curbs shall be compacted in accordance with Section 310000.

B. All construction for curbing shall be in accordance with ODOT Item 609 for the type called for on the Drawings.

END OF SECTION 321613.13

SECTION 321623 - CONCRETE WALKS AND STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Under this section the Contractor shall furnish, and construct sidewalks shown or scheduled on the Drawings, specified or directed.

B. This section includes preparation of the base and/or subgrade construction of walks, adjustment of manhole castings and valve boxes to conform to new elevations and other work and materials incidental to the construction of walks.

1.3 OWNER'S STANDARDS AND SPECIFICATIONS

A. Items preceded by ODOT shall refer to the latest edition of the State of Ohio, Department of Transportation, Construction and Material Specifications.

PART 2 - PRODUCTS

2.1 CONCRETE

A. All concrete used shall be Class QC 1 as specified in section 030000.

2.2 WALKS

A. Other materials for walks shall meet the applicable requirements of ODOT Item 608.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All soil subgrade under walks shall be compacted in accordance with Section 312323.13.

B. All service boxes, manholes and inlet tops shall be set to the required grades.

C. All construction for walks shall be in accordance with ODOT Item 608 for the type called for on the Drawings.

D. Minimum thickness of concrete walks shall be 4 inches.

END OF SECTION 321623

SECTION 32 31 13 – FENCES

PART 1 - GENERAL

1.1 SUMMARY

A. This work consists of the supply and installation of PVC fencing (ornamental fence) and galvanized chain link fencing (split rail fence) as called out on the plans and details.

1.2 SUBMITTALS:

A. Comply with all provisions of Section 013323, Shop Drawings and Submittals.

B. Product Data: For the following:
   1. Submit manufacturer's technical data, and installation instructions for fencing, fabric, gates and accessories, for approval by the Owner's Representative.
   2. Samples for verification of PVC color in the form of 6" lengths of actual fence to be used in color selection, for approval by the Owner's Representative.

0.1 QUALITY ASSURANCE

A. Any subcontracted fence work shall be performed by a qualified firm specializing in fence work.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Dimensions indicated for posts, rails, boards, pipe and roll-formed are outside dimensions, exclusive of coatings.

B. Products: Subject to compliance with requirements, fence is to be provided from one of the following sources:

   1. Galvanized Steel Fencing and Fabric:

      a. Allied Tube and Conduit Corp.
      b. Master - Halco
      c. Merchants Metals, Inc.
      d. Richard's Fence of Akron

   2. PVC fencing:

      a. Certainteed
      b. Bufftech

b. Duramax
c. USA Vinyl

2.2 ORNAMENTAL POLYVINYL CHLORIDE (PVC) FENCE COMPONENTS:

A. General: Posts, rails, pickets, gate uprights, post caps, and accessories shall be of high impact, Ultra Violet (U.V.) resistant, rigid PVC, and shall comply with ASTM D 1784, Class 14344B.

B. Fence Posts: One piece extruded, of lengths indicated and pre-routed to receive rails at spacing indicated.

1. Surface to contain woodgrain texture
2. Cross Section: 5" x 5" minimum
3. Wall Thickness: 0.170" minimum
4. Corner Radius: 3/8" R minimum

C. Rails: One piece extruded, of lengths indicated pre-routed to receive pickets at spacing indicated.

1. Surface to contain Select Cedar texture
2. Cross Section: 1-3/4" X 3-1/2" (Nominal 2" x 4") minimum
3. Wall Thickness: 0.100" minimum
4. Corner Radius: 13/32" R minimum

D. Pickets: One piece extruded, of lengths indicated.

1. Surface to contain Select Cedar texture
2. Cross Section: 7/8" X 3" minimum
3. Wall Thickness: 0.060" minimum
4. Corner Radius: 3/16" R minimum
5. Picket Spacing: 2-15/16" .
6. Pickets per section: 15 pickets .

E. Post Caps: Molded, one piece.

1. Surface to contain Select Cedar texture
2. Cross Section: Match post or gate upright cross section.
3. Thickness: 0.095" minimum.
4. Configuration: Flat or four-sided as required for installation to top of posts and gate.

F. Accessories: Manufacturers' standard gate brace, screw caps, rail end reinforcers, and other accessories as required.

2.3 MISCELLANEOUS MATERIALS:

A. Stiffener Channels: Galvanized steel structural channel. Configure channels for concealed installation within PVC rails with pre-drilled holes for drainage. Aluminum extruded channel available upon request.

1. Cross Section: 3.00" x 3.00" x 1.500" hourglass shape to grip picket.
2. Thickness: 0.040 Gauge (minimum).

B. Fasteners and Anchorage: Stainless Steel. All fasteners to be concealed or colored heads to match. Provide sizes as recommended by fence manufacturer.

C. PVC Cement: As recommended by fence manufacturer.

D. Concrete for footers:

1. ODOT items 499 and 511 (Class C, F, or S).

2. Concrete: Provide concrete consisting of portland cement per ASTM C 150, aggregates per ASTM C 33, and potable water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 2000 psi. Use at lease four sacks of cement per cubic yard, 1-inch maximum size aggregate, 3-inch maximum slump. Use ½ inch maximum size aggregate in post where required.

3. Packages Concrete Mix: Mix dry-packaged normal-weight concrete conforming to ASTM C 387 with clean water to obtain a 2 to 3 inch slump.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Do not begin installation and erection before final grading is completed, unless otherwise permitted.
B. Install fence in compliance with manufacturer's written instructions. During installation, PVC components shall be carefully handled and stored to avoid contact with abrasive surfaces. Install components in sequence as recommended by fence manufacturer.

1. Install fencing as indicated on the drawings provided.

2. Variations from the installation indicated must be approved.

3. Variations from the fence and gate installation indicated and all costs for removal and replacement will be the responsibility of the contractor.

3.2 FENCE INSTALLATION

A. Excavation: Drill or hand-excavate (using post hole digger) holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.

1. If not indicated on drawings, excavate holes for each post to a minimum diameter of 12” inches.

2. Unless otherwise indicated, excavate hole depths not less than 30 inches or to frost line.

B. Posts: Install posts in one piece, plumb and in line. Space a maximum of 8’ feet o.c. unless otherwise indicated. Enlarge excavation as required to provide clearance indicated between post and side of excavation.

1. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment and hold in position during placement and finishing operations.

a. Unless otherwise indicated, terminate top of concrete footings 3 inches below adjacent grade and trowel to a crown to shed water.

b. Secure posts in position for manufacturers’ recommendations until concrete sets.

c. After installation of rails and unless otherwise indicated, install reinforcing in posts in opposing corners of post as shown and fill end and gate posts with concrete to level as indicated. Concrete fill shall completely cover the reinforcing steel and gate hardware fasteners. Consolidate the concrete by striking the post face with a rubber mallet, carefully tamping around the exposed post bottom.

d. Install post caps. Use #8 screws, nylon washers and snap caps.

e. Remove concrete splatters from PVC fence materials with care to avoid scratching.

C. Top and Bottom Rails: Install rails in one piece into routed hole fabricated into posts to receive top and bottom rails, and middle where necessary. Except at sloping terrain, install rails level.

1. Prior to installation of rails into posts, insert concealed steel channel stiffeners in top rail, where necessary. Bottom rails shall include minimum (2) ¼" drainage holes.

2. At posts to receive concrete fill, tape rail ends to prevent seepage when filling post with concrete.

D. Middle Rails: Where necessary, install middle rails in one piece into routed hole in posts with larger holes facing down. Except at sloping terrain, install middle rails level. Secure mid rail to pickets with 2-#8 x 1-1/2" screws evenly spaced.

1. At posts to receive concrete fill, tape rail ends to prevent seepage when filling post with concrete.

E. Pickets: Install pickets in one piece as per manufacturer recommendations. Install pickets plumb.

F. Fence Installation at Sloping Terrain: At sloping terrain rails may be racked (sloped) or stepped to comply with manufacturers’ recommendations.

G. Excavation: Drill or hand excavate (using posthole digger) holes for posts to diameters and spacings shown.

1. Posts shall be spaced a maximum of 8’ on center.
2. If not indicated on drawings, excavate holes for each post to minimum diameters as recommended by fence manufacturer, but not less than 4 times largest cross-section of post.
3. Unless otherwise indicated, excavate hole depths approximately 3” lower than post bottom, with bottom of posts set not less than 36” below finish grade surface.

H. Setting Posts: Center and align posts in holes 3” above bottom of excavation.

1. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hole in position during placement and finishing operations.

a. Unless otherwise indicated, extend concrete footings 2” above grade and trowel to a crown to shed water.

3.3 ADJUSTING AND CLEANING

A. Remove all traces of dirt and soiled areas on fence.

B. Remove excess spoils from excavations.

3.4 DEMONSTRATION

A. Instruct the owner’s personnel on proper operation and maintenance of fence components.

END OF SECTION 32 31 13

SECTION 329200.19 – SEEDING AND MULCHING

PART 1 - GENERAL

1.1 SUMMARY

A. Installation of seeded areas shall be to the extent shown on Contract Drawings and shall include supplying all seed, topsoil, soil conditioning materials, mulching materials and watering, and the incorporation of these materials into the work as specified.

B. The Contractor shall place topsoil at the depths specified in those areas requiring seeding. Topsoil shall be furnished by the Contractor.

1.2 SUBMITTALS

A. Product Data: For the following:

1. Provide copies of soils tests for both new topsoil (provided) and onsite topsoil for review and approval. This applies to all areas that require seeding, including reconditioned areas.

2. Provide location of properties from which topsoil is to be obtained, names and addresses of owners, depth to be stripped, and crops grown in the past 2 years.

3. Provide the name of the seed supplier, name and phone number, list of the seed, including varieties of seed, labels, and an analysis of the seed for review, 4 weeks prior to the start of seeding.

4. Provide soil amendments information based on soils test requirements.

5. Hydroseed mixture, mulch and application rates prior to performing the work.

1.1 QUALITY ASSURANCE

A. Any subcontracted restoration work shall be performed by a qualified firm specializing in landscape work.

B. The Contractor shall have a soils test done at his expense and analyzed by a state approved testing agency. Soil tests shall be done on both the topsoil stockpiled from the site and new topsoil brought to the site. A minimum of two (2) tests shall be done. The tests shall include percent organic matter, pH, Buffer pH, Phosphorus, Exchangeable Potassium, Calcium, Magnesium, Cation Exchange Capacity and Percent Base Saturation with recommendations for nitrogen, phosphate, potash, magnesium and lime based on plant type and use.

C. Seed: All seed specified shall meet O.D.O.T. specifications as to the percentage purity,

weed seed, and germination. All seed shall be approved by the State of Ohio, Department of Agriculture, Division of Plant Industry, and shall meet the requirements of these specifications.

D. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.

1.4 PROJECT CONDITIONS

. Utilities: Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

A. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, such conditions shall be rectified by the Contractor before planting, with approval from the Owner's Representative.

B. Soil Stabilization: The Contractor shall provide permanent or temporary soil stabilization to denuded areas within fifteen (15) days after final grade is reached on any portion of the site. Any such area which will not be regraded for longer than fifteen (15) days shall also be stabilized. Soil stabilization includes any measures which protect the soil from the erosive forces of raindrop impact and flowing water. Applications include seeding and/or mulching, or the use of other erosion control measures as directed by the Owner's Representative. If necessary, the Contractor shall coordinate soil stabilization practices with the local Soil and Water Conservation District.

D. Spring-sown work shall be installed between April 1st and May 30th and Fall-sown work shall be installed between September 1st and October 15th. No permanent seeding shall take place between May 30th and September 1st and between October 15th and April 1st. The dates for seeding may be changed at the discretion of the Owner's Representative.

PART 2 - PRODUCTS

2.1 TOPSOIL

A. Topsoil shall be furnished by the Contractor. Stockpiled material, if any, shall be utilized prior to obtaining additional topsoil.

B. All topsoil shall conform to the U.S. Department of Agriculture soil texturing triangle and shall contain between 3% to 8% organic matter. Topsoil shall be loamy and not consist of more than 38% clay. New topsoil shall be screened to remove clay lumps, brush, weeds, litter, roots, stumps, stones larger than ½" in any dimension and any other extraneous or toxic matter harmful to plant growth.

New topsoil shall be obtained only from naturally well drained sites where topsoil occurs in a depth of not less than 4". Do not obtain from bogs or marshes.

C. Soil amendments shall be added according to the soils test requirements. Amendments can

include, but are not limited to fertilizer, lime, compost, sand, and organic matter. Organic matter shall consist of composted leaves or other approved material.

2.2 SEED

A. Seed shall be vendor mixed, delivered in original bags and shall be proportioned as follows:

1. Maintained Lawn Seed Mix Class 3B

Common Name	Proportion by Weight
Hard Fescue	56%
Creeping Red Fescue	34%
Annual Ryegrass	10%

2. Hummingbird-Butterfly Seed Mix (refer to Appendix A)
   a. Basis of design shall be Ohio Prairie Nursery Item #: BF03 or approved equal, 330-569-3380.
   b. Application rate: PLS Lbs Per Acre Broadcast = 12
   c. Basis of design nurse crop Regreen, a sterile hybrid cross between an annual (wheat) and a perennial (wheatgrass). Application rate: 1/2 lb. per 1000 square feet. item #: REG01G or approved equal.
   d. Fertilize per manufacturer's recommendations.

3. Native Short Grass and Wildflower Mix (refer to Appendix B)
   a. Basis of design shall be Ohio Prairie Nursery Item #: NSGM03 or approved equal, 330-569-3380.
   b. Application rate: PLS Lbs Per Acre Broadcast = 12
   c. Basis of design nurse crop Regreen, a sterile hybrid cross between an annual (wheat) and a perennial (wheatgrass). Application rate: 1/2 lb. per 1000 square feet. item #: REG01G or approved equal.
   d. Fertilize per manufacturer's recommendations.

4. Floodplain Mix (refer to Appendix C)
   a. Basis of design shall be Ohio Prairie Nursery Item #: 112123-7 or approved equal, 330-569-3380.
   b. Application rate: PLS Lbs Per Acre Broadcast = 12
   c. Basis of design nurse crop Regreen, a sterile hybrid cross between an annual (wheat) and a perennial (wheatgrass). Application rate: 1/2 lb. per 1000 square feet. item #: REG01G or approved equal.
   d. Fertilize per manufacturer's recommendations.

5. Mesic Short Grass III (refer to Appendix D)

a. Basis of design shall be Ohio Prairie Nursery Item #: MSG03 or approved equal, 330-569-3380.
b. Application rate: PLS Lbs Per Acre Broadcast = 12
c. Basis of design nurse crop Regreen, a sterile hybrid cross between an annual (wheat) and a perennial (wheatgrass). Application rate: 1/2 lb. per 1000 square feet. item #: REG01G or approved equal.
d. Fertilize per manufacturer's recommendations.

6. Clover Lawn Mix (refer to Appendix E)
   a. Basis of design shall be Ohio Prairie Nursery Item #:CLM01 090822 or approved equal, 330-569-3380.
   b. Application rate: PLS Lbs Per Acre Broadcast = 12
   c. Basis of design nurse crop Regreen, a sterile hybrid cross between an annual (wheat) and a perennial (wheatgrass). Application rate: 1/2 lb. per 1000 square feet. item #: REG01G or approved equal.
   d. Fertilize per manufacturer's recommendations.

7. Floodplain Stream Bank Mix (refer to Appendix F)

   a. Basis of design shall be Ernst Seed Item #: ERNMX-154 or approved equal, 800-873-3321.
   b. Application rate: PLS Lbs Per Acre Broadcast = 12
   c. Basis of design nurse crop Regreen, a sterile hybrid cross between an annual (wheat) and a perennial (wheatgrass). Application rate: 1/2 lb. per 1000 square feet. item #: REG01G or approved equal.
   d. Fertilize per manufacturer's recommendations.

8. Nurse cover crop

   a. For rapid establishment and erosion control, mix in with seed mix regreen™ as a nurse crop for all seed mixes to reduce soil erosion or approved annual cover crop.
   b. Supplied by Ohio Prairie Nursery or approved equal, 330-569-3380.
   c. Apply per manufacturer's recommendations.

2.3 MULCH

A. Mulch shall be clean straw free of seed and weed seed.

1. Anchoring for mulch shall be an ODOT specified SS-1 at 60 gal./ton non-toxic tackifier such as Hydro-stik, or equal, or by securing with a photo degradable netting.

B. If hydroseeding is used, wood fiber mulching material shall be used and shall consist of virgin wood fibers manufactured expressly from whole wood chips and shall conform to the following specifications.

- Moisture content	10.0% $\pm$ 3.0%
- Organic content	99.2% $\pm$ 0.8% O.D. Basis
- pH	4.8 $\pm$ 0.5
- Water holding capacity, minimum (grams of water per 100 grams of fiber)	1,000

Wood fiber mulching material shall be processed in such a manner as to contain no growth or germination inhibiting factors, and must contain a biodegradable green dye to aid in visual metering during application.

2.4 COIR MATS AND LOGS

B. Coir mats shall be 100% natural biodegradeable coconut fiber woven into blankets.

1. Mat weave density type shall be specified by the manufacturer based on stream flow velocities and slopes.

2. Mat anchoring methods shall wood stakes be per the manufacturer's specifications based on application conditions. Matting shall be keyed into toe of slope and extend beyond bankfull width.

B. Coir logs shall be 100% natural biodegradeable coconut fiber with an outer layer of machine spun bristle coir twine coconut fiber and filled with compacted coir fibers.

1. Log anchoring methods shall be per the manufacturer's specifications based on application conditions.

2. Stake logs with wood stakes 24-36" apart. For stream applications stakes shall be installed on both sides of logs. Twine should be used to keep the log in place where there is waterflow over the logs.

2.5 EROSION CONTROL MAT

B. Mats shall be manufactured from straw or wood fiber and bound by photodegradable poly netting.

1. Mat type shall be determined based on slope where they will be used.

PART 3 - EXECUTION

3.1 PREPARATION - GENERAL

A. Rough grading to a depth necessary to accept the specified thickness of topsoil must be approved prior to placing topsoil.

B. Loosen subgrade, remove any stones greater than ½" in any dimension. Remove sticks, roots, rubbish, and other extraneous matter.

C. Spread topsoil to a minimum depth of 4 inches, to meet lines, grades, and elevations shown on plan, after light rolling and natural settlement. Remove sticks, roots, rubbish, stones greater than 1/2" in any dimension, and other extraneous matter. Topsoil shall be tilled thoroughly by plowing, disking, harrowing, or other approved methods. Add specified soil amendments and mix thoroughly into the topsoil.

D. Preparation of Unchanged Grades: Where seed is to be planted in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil for planting as follows: Till to a depth of not less than 6 inches. Apply soil amendments and initial fertilizers as specified. Remove high areas and fill in depressions. Till soil to a homogenous mixture of fine texture, free of lumps, clods, stones, roots and other extraneous matter. Soils test requirements apply here as well.

1. Prior to preparation of unchanged areas, remove existing grass, vegetation and turf. Dispose of such material outside of project limits. Do not turn existing vegetation over into soil being prepared for seed.

   If necessary, supply and install topsoil in areas where there is no topsoil left after vegetation has been removed.

2. Apply specified soil amendments at rates specified in the soils test and thoroughly mix into upper 2 inches of topsoil. Add topsoil if existing grade has less than 4" of topsoil. Delay application of amendments if planting will not follow within two (2) days.

E. Maintained lawn areas shall be fine grade areas to smooth, even surface with loose, uniformly fine texture. Roll, rake, and drag lawn areas, remove ridges and fill depressions, as required to meet finish grades. Remove sticks, roots, rubbish, stones greater than 1/2" in any dimension, and other extraneous matter. Limit fine grading to areas which can be planted immediately after grading.

F. Riparian and meadow areas shall be graded that provide ridges to hold seeding. In riparian seed area, rake or open the surface with a dozer cleats or other wise loosen the surface of these areas to a depth of 1 inch. Remove sticks, roots, rubbish, stones greater than 3" in any dimension, and any previously cut vegetation matter.

G. Moisten prepared areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.

H. Restore areas to specified condition, if eroded or otherwise disturbed, after fine grading and prior to planting.

3.2 SEEDING

A. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage. Seed shall not be sown when the ground is frozen, muddy, or when weather conditions prevent proper soil preparation, interference with sowing and/or proper incorporation of seed into the soil.

B. Sow seed using a spreader or hydroseeder. Do not seed when wind velocity exceeds 5 miles per hour. Distribute seed evenly over entire area by sowing 3 lbs. per 1000 S.F. at right angles to each other. Total amount to equal a minimum of 6 lbs. per 1000 S.F.

C. For seed sown with a spreader, mulch shall be spread uniformly to form a continuous blanket at a rate of 100 lbs. per 1,000 S.F. Mulch shall be 1 1/2" loose measurement over seeded areas and shall be anchored.

D. Contractor has the option to hydroseed large lawn areas, using equipment specifically designed for such application. The rate of application of wood fiber mulching materials is 40 lbs./1,000 S.F. Contractor shall not hydroseed within close proximity to buildings and structures, or when unfavorable wind conditions may blow the hydroseed material onto the structure. Contractor shall clean all areas not to be seeded of overspray.

E. The seeded area shall be watered, as soon as the seed is applied, at the rate of 120 gallons per 1000 square feet. The water shall be applied by means of a hydroseeder or a water tank under pressure with a nozzle that will produce a spray that will not dislodge the mulching material. Cost of this watering shall be included in the cost of seeding and mulching.

F. Seed shall be sown in two directions, right angle to each other by hand then lightly rake the seed into the soil 1/8" to 1/4" in depth. do not cover seed more than 1/4-inch deep. after broadcasting is complete, then use a roller and roll one way and then at 90° to the first rolling.

G. Apply 1/8" layer of weed free straw mulch applied to seeded areas per odot item 659.06 and applied per section 659.09.

H. Maintain per odot item 659. maintain all seeded and mulched areas until final inspection. repair damaged areas to the original condition and grade. repair seeding and mulching. repair all damage or erosion of the seeded and mulched areas before the completion of the project.

3.3 DORMANT SEEDING METHOD

A. Lawn Seeding shall not take place from October 15 through November 20. During this period prepare the seed bed, add the required amounts of lime and fertilizer, and other amendments, then mulch and anchor.

B. From November 20 through April 1, when soil conditions permit, prepare the seed bed, lime and fertilize, apply the selected seed mixture, mulch, and anchor. Increase the seeding rate by 50 percent.

C. Wildflower seeding may occur late fall after soil temperatures are below 50°. typically, November 1 unless the seed manufacturer allows seeding from March 1 to May 31. If feasible, the seed can be sown throughout the winter if soil temps stay below 50ft.

D. Seeding shall be done dry and shall not be performed when there is standing water. seeding may be done when the ground is frozen if the area will not become inundated with water.

3.4 RECONDITIONING EXISTING LAWNS

A. A soils test shall be required for existing lawns prior to any reconditioning.

B. Recondition all existing lawn areas damaged by Contractor's operations including storage of materials and equipment and movement of vehicles. Also recondition existing lawn areas where minor regrading is required.

C. Provide soil amendments as called for in the soils test.

D. Provide new topsoil, as required, to fill low spots and meet new finish grades.

E. Cultivate bare and compacted areas according to the topsoil specifications.

F. Remove diseased and unsatisfactory lawn areas; do not bury into soil. Remove topsoil containing foreign materials resulting from the Contractor's operations, including oil drippings, stone, gravel, and other loose building materials.

G. All work shall be the same as for new seeding.

H. Water newly planted seed areas. Maintenance of reconditioned lawns shall be the same as maintenance of new lawns.

3.5 EROSION CONTROL MATS, COIR MATTING AND LOGS

A. Slope and channel protection shall be installed in locations per plan.

1. Coir matting and logs
    a. Stake matting with wood stakes 00" apart
    b. Stake logs with wood stakes 24-36" apart. For stream applications stakes shall be installed on both sides of logs. Twine should be used to keep the log in place where there is waterflow over the logs.

2. Erosion Control Mats.
    a. Stake logs with wood stakes 24-36" apart. For stream applications stakes shall be installed on both sides of logs. Twine should be used to keep the log in place where there is waterflow over the logs.

3.6 ESTABLISHMENT

A. Maintain work areas as long as necessary to establish a uniformly close stand of grass over the entire lawn area. A uniformly close stand of grass is defined as the seeded areas having 90%+ coverage of grass at 60 days after seeding. 90%+ coverage is defined as very little or no dirt showing when seeded area is viewed from directly overhead.

B. Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading and replanting as required to establish a smooth acceptable lawn.

1. Mowing
   a. Mow lawn areas during the period of maintenance to a height of 2 inches whenever the height of the grass becomes 3 inches. A minimum of 3 mowings is required during the period of maintenance.
2. Refertilizing
   a. Distribute fertilizer on the seeded area between August 15 and October 15, during the period when grass is dry, and in accordance with the manufacturer's recommendations. The fertilizer shall be as specified in the soils test.
3. Reseeding
   a. Reseed with the seed specified for the original seeding, at the rate of 4 lbs. per 1,000 S.F. in a manner which will cause minimum disturbance to the existing stand of grass and at an angle of not less than 15 degrees from the direction of rows of prior seeding.
4. Watering

   a. The Contractor shall keep all work areas watered daily to achieve satisfactory growth. Water shall be applied at a rate of 120 gallons per 1,000 square feet. If water is listed as a pay item, it shall be separately paid for based on the actual amount of water used, measured in thousands of gallons.
5. Any mulching which has been displaced shall be repaired immediately. Any seed work which has been disturbed or damaged from the displacement of mulch shall be repaired prior to remulching.

C. Maintain meadow seeding by inspection for invasive plants and removal of undesirable weeds and plant materials by targeted herbicide application. reseed areas as disturbed by weed removal with the same seed mix. tamp seed mix in place.

1. Any areas that do not show a satisfactory germination of grass shall be reseeded until a dense meadow, free of bare spots, areas of washout or erosion damage has been established.

2. Long-term management plan for the meadow areas includes monitoring, performing mowing with flail mower and selective herbicide applications to remove undesirable weeds.
   a. Year one: through the first year the meadow area shall be mowed with flail or brush hog to a short height (no shorter than 8", not more than 30% of the plant removed) and the clippings removed. continue mowing for the first year.

   b. Year two: continue mowing to 8"-10" height through july and assess the

control needed for any undesirable species.

c. Year three: assess and perform targeted undesirable species control once or twice per month depending on finding

3.6 INSPECTION AND ACCEPTANCE

A. When seeding work is complete and an acceptable stand of growth is attained, the Contractor shall request the Owner's Representative to make an inspection to determine final acceptance.

B. Acceptance shall be based upon achieving a vigorous uniformly stand of the specified grasses. If some areas are satisfactory and some are not, acceptance may be made in blocks, provided they are definable or bounded by readily identified permanent surfaces, structures, or other reference means. Partial acceptance decisions may be made by the Owner's Representative. Excessive fragmentation into accepted and unaccepted areas shall not be allowed. Unaccepted areas shall be maintained by the Contractor until acceptable.

C. No payment shall be made until areas are accepted.

D. All seeded areas shall be guaranteed for one full growing season to commence upon final acceptance of the areas.

Appendix A - Hummingbird-Butterfly Seed Mix

Hummingbird-Butterfly Seed Mix Item Code BF03

Recommended Seeding Rates

Hydro Seeded / Broadcast	Drilled
15.0 pounds / acre	12.0 pounds / acre
0.34 pounds / 1000 sq. ft.	64 seeds / sq. ft.
80 seeds / sq. ft.	

Category	% by Weight	% by Seed
Forb	29.58%	59.58%
Grass/Grasslike	70.42%	40.42%

Moisture	Dry Mesic
Light	Prairie/Meadow Sun
Application	Prairie
Attracts	Butterflies
	Hummingbirds
	Pollinators

Species Name	Common Name	%
Schizachyrium scoparium	Little Bluestem	28.74%
Elymus canadensis	Nodding Wild Rye	14.06%
Bouteloua curtipendula	Side-oats Grama	13.87%
Elymus virginicus	Virginia Wild Rye	13.75%
Echinacea purpurea	Purple Coneflower	5.00%
Heliopsis helianthoides	Ox Eye Sunflower	4.00%
Chamaecrista fasciculata	Partridge Pea	3.87%
Dalea purpurea	Purple Prairie Clover	3.12%
Rudbeckia hirta	Black-eyed Susan	2.50%
Monarda fistulosa	Wild Bergamot	2.19%
Coreopsis tinctoria	Plains Coreopsis	1.56%
Liatris spicata	Dense Blazingstar	1.25%
Asclepias tuberosa	Butterfly Weed	1.25%
Asclepias syriaca	Common Milkweed	0.94%
Aster azureus	Sky Blue Aster	0.62%
Dalea candida	White Prairie Clover	0.62%
Solidago rigida	Stiff Goldenrod	0.62%
Eupatorium purpureum	Sweet Joe Pye	0.62%
Asclepias incarnata	Rose Milkweed	0.62%
Zizia aurea	Golden Alexanders	0.62%
Eryngium yuccifolium	Rattlesnake Master	0.10%
Aster novae-angliae	New England Aster	0.05%

Appendix B - Native Short Grass and Wildflower Mix

Native Short Grass and Wildflower Mix Item Code NSGM03

Recommended Seeding Rates

Hydro Seeded / Broadcast	**Drilled**
15.0 pounds / acre	13.0 pounds / acre
0.34 pounds / 1000 sq. ft.	58 seeds / sq. ft.
67 seeds / sq. ft.	

Category	% by Weight	% by Seed
Forb	39.69%	58.27%
Grass/Grasslike	60.31%	41.73%

Moisture	Dry Mesic
Light	Prairie/Meadow Sun
Application	Meadow
Attracts	Butterflies
	Pollinators
	Songbirds

Species Name	Common Name	%
Schizachyrium scoparium	Little Bluestem	26.56%
Elymus canadensis	Nodding Wild Rye	15.00%
Chamaecrista fasciculata	Partridge Pea	12.50%
Bouteloua curtipendula	Side-oats Grama	9.38%
Elymus virginicus	Virginia Wild Rye	9.38%
Heliopsis helianthoides	Ox Eye Sunflower	3.44%
Gaillardia pulchella	Indian Blanket	3.38%
Dalea purpurea	Purple Prairie Clover	2.81%
Coreopsis lanceolata	Lanceleaf Coreopsis	2.75%
Echinacea purpurea	Purple Coneflower	2.56%
Dalea candida	White Prairie Clover	1.56%
Desmanthus illinoensis	Illinois Bundleflower	1.50%
Rudbeckia hirta	Black-eyed Susan	1.25%
Ratibida pinnata	Yellow Coneflower/Grey-Headed C	1.25%
Monarda fistulosa	Wild Bergamot	1.06%
Astragalus canadensis	Canadian Milk Vetch	0.94%
Asclepias tuberosa	Butterfly Weed	0.63%
Asclepias syriaca	Common Milkweed	0.63%
Aster laevis	Smooth Aster	0.63%
Lespedeza capitata	Roundheaded Bushclover	0.63%
Coreopsis tinctoria	Plains Coreopsis	0.63%
Solidago rigida	Stiff Goldenrod	0.63%
Eryngium yuccifolium	Rattlesnake Master	0.63%
Penstemon digitalis	Foxglove Beardtongue	0.31%

Appendix C - Floodplain Mix

Floodplain Mix Item Code 112123-7

Recommended Seeding Rates

Hydro Seeded / Broadcast	Drilled
15.0 pounds / acre	12.0 pounds / acre
0.34 pounds / 1000 sq. ft.	87 seeds / sq. ft.
109 seeds / sq. ft.	

Category	% by Weight	% by Seed
Forb	5.88%	30.25%
Grass/Grasslike	75.87%	54.77%
Shrub	18.25%	14.98%

Moisture	Seasonally Wet
Light	Sun/Partial Shade
Application	Floodplain
Attracts	Butterflies
	Pollinators
	Wildlife

Species Name	Common Name	%
Elymus virginicus	Virginia Wild Rye	25.00%
Andropogon gerardii	Big Bluestem	21.87%
Elymus canadensis	Nodding Wild Rye	18.75%
Cephalanthus occidentalis	Buttonbush	6.25%
Cornus amomum	Silky Dogwood	6.25%
Viburnum dentatum	Arrowwood Viburnum	5.75%
Panicum (Dichanthelium) clandestin	Deer-tongue Grass	3.12%
Elymus riparius	Riverbank Wild Rye	3.06%
Scirpus atrovirens	Dark Green Bulrush	1.56%
Carex frankii	Franks Sedge	1.25%
Verbena hastata	Blue Vervain	0.94%
Senna hebecarpa	Wild Senna	0.94%
Bidens aristosa	Tickseed Sunflower	0.62%
Asclepias incarnata	Rose Milkweed	0.62%
Rudbeckia laciniata	Green-headed Coneflower	0.62%
Verbena stricta	Hoary Vervain	0.62%
Carex grayi	Gray's Sedge	0.62%
Glyceria grandis	Reed Manna Grass/American Mann	0.44%
Eupatorium fistulosum	Hollow Joe Pye	0.37%
Vernonia fasciculata	Prairie Ironweed	0.31%
Scirpus cyperinus	Woolgrass	0.19%
Solidago ulmifolia	Elmleaf Goldenrod	0.19%
Mimulus ringens	Monkey Flower	0.12%
Lobelia cardinalis	Cardinal Flower	0.12%
Pycnanthemum tenuifolium	Narrow Leaved Mountain Mint	0.12%
Thalictrum dasycarpum	Purple Meadow Rue	0.12%
Aster novae-angliae	New England Aster	0.12%

Appendix D - Mesic Short Grass III

Mesic Short Grass III Item Code MSG03

Recommended Seeding Rates

Hydro Seeded / Broadcast	Drilled
20.0 pounds / acre	18.0 pounds / acre
0.46 pounds / 1000 sq. ft.	65 seeds / sq. ft.
72 seeds / sq. ft.	

Category	% by Weight	% by Seed
Grass/Grasslike	100.00%	100.00%

Species Name	Common Name	%
Schizachyrium scoparium	Little Bluestem	37.50%
Elymus virginicus	Virginia Wild Rye	22.19%
Elymus canadensis	Nodding Wild Rye	22.19%
Bouteloua curtipendula	Side-oats Grama	15.94%
Tridens flavus	Purple Top	1.25%
Sporobolus heterolepis	Prairie Dropseed	0.63%
Agrostis perennans	Autumn Bentgrass	0.31%

Moisture	Dry Mesic
Light	Full Sun
Application	Native Grassland
Attracts	Game Birds
	Songbirds
	Wildlife

Appendix E - Clover Lawn Mix

Clover Lawn Mix Item Code CLM01 090822

Recommended Seeding Rates

Hydro Seeded / Broadcast	**Drilled**
100.0 pounds / acre	100.0 pounds / acre
2.30 pounds / 1000 sq. ft.	1,500 seeds / sq. ft.
1500 seeds / sq. ft.	

Species Name	Common Name	%
Festuca rubra	Creeping Red Fescue	52.00%
Festuca trachyphylla	Hard Fescue	26.40%
Trifolium repens	Ladino Clover/White Clover	17.84%
Trifolium hybridum	Alsike Clover	2.00%
Fescue ovina	Sheep Fescue	1.60%
Trifolium repens "Pirouette"	White Micro Clover	0.15%

Moisture

Light

Application

Appendix F - Floodplain Stream Bank Mix

Floodplain Mix - ERNMX-154

	Botanical Name	Common Name	Price/Lb
20.00 %	*Elymus virginicus, Madison-NY Ecotype*	Virginia Wildrye, Madison-NY Ecotype	10.45
14.50 %	*Panicum clandestinum, Tioga*	Deertongue, Tioga	22.08
14.00 %	*Andropogon gerardii, 'Niagara'*	Big Bluestem, 'Niagara'	9.27
14.00 %	*Sorghastrum nutans, PA Ecotype*	Indiangrass, PA Ecotype	14.58
10.00 %	*Carex vulpinoidea, PA Ecotype*	Fox Sedge, PA Ecotype	28.80
6.30 %	*Carex lurida, PA Ecotype*	Lurid Sedge, PA Ecotype	67.20
6.30 %	*Carex scoparia, PA Ecotype*	Blunt Broom Sedge, PA Ecotype	81.60
3.00 %	*Verbena hastata, PA Ecotype*	Blue Vervain, PA Ecotype	38.40
2.40 %	*Zizia aurea, PA Ecotype*	Golden Alexanders, PA Ecotype	72.00
2.00 %	*Asclepias incarnata, PA Ecotype*	Swamp Milkweed, PA Ecotype	177.60
2.00 %	*Juncus effusus*	Soft Rush	48.00
1.00 %	*Verbena urticifolia, PA Ecotype*	White Vervain, PA Ecotype	144.00
0.60 %	*Solidago rugosa, PA Ecotype*	Wrinkleleaf Goldenrod, PA Ecotype	264.00
0.50 %	*Aster lanceolatus*	Lance Leaved Aster	432.00
0.50 %	*Aster novae-angliae, PA Ecotype*	New England Aster, PA Ecotype	336.00
0.50 %	*Aster puniceus, PA Ecotype*	Purplestem Aster, PA Ecotype	432.00
0.50 %	*Helliopsis helianthoides, PA Ecotype*	Oxeye Sunflower, PA Ecotype	33.60
0.40 %	*Eupatorium perfoliatum, PA Ecotype*	Boneset, PA Ecotype	192.00
0.40 %	*Monarda fistulosa, Fort Indiantown Gap-PA Ecotype*	Wild Bergamot, Fort Indiantown Gap-PA Ecotype	96.00
0.30 %	*Lycopus americanus, PA Ecotype*	American Water Horehound, PA Ecotype	72.00
0.30 %	*Mimulus ringens, PA Ecotype*	Square Stemmed Monkeyflower, PA Ecotype	216.00
0.30 %	*Scirpus cyperinus, PA Ecotype*	Woolgrass, PA Ecotype	115.20
0.20 %	*Lobelia siphilitica, PA Ecotype*	Great Blue Lobelia, PA Ecotype	384.00
100.00 %		**Mix Price/Lb Bulk:**	**$40.60**

Seeding Rate: 20 lb per acre with a cover crop of grain rye at 30 lb per acre

Grasses & Grass-like Species - Herbaceous Perennial; Herbaceous Flowering Species - Herbaceous Perennial; Riparian Sites

The diverse annual and perennial grasses and forbs are attractive to humans and animals. Designed for economical wildlife food and habitat in newly established wetlands where wildlife food value is needed. The wildryes establish quickly and tolerate low fertility in wet or dry soils. Seed from October-May in full sun or partial shade. Mix formulations are subject to change without notice depending on the availability of existing and new products. While the formula may change, the guiding philosophy and function of the mix will not.

END OF SECTION 329200.19

SECTION 329300.23 - TREES, SHRUBS, AND GROUND COVER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. Installation of trees, shrubs, and ground covers shall be to the extent shown on Contract Drawings and shall include supplying all plant material indicated on the plans, plant mix, soil conditioning materials, mulching materials, guying and staking, watering and the incorporation of these materials into the work as specified.

1.3 QUALITY ASSURANCE

A. Landscaping shall be done by a single firm specializing in landscape work.

B. Ship landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials.

C. All plant material shall conform to ANSI Z60.1 "American Standard for Nursery Stock"; and State of Ohio, Department of Transportation, "Construction and Material Specifications", current edition.

D. All plant material shall be labeled with a securely attached waterproof tag indicating species and size.

E. All tree trunks shall be wrapped prior to leaving the nursery to protect the trunk from injury during transport. Wrapping shall stay on until planting is completed and removed after the tree is planted.

F. All plant material shall be provided with protective covering (tarping) during transport to reduce desiccation.

G. The Contractor shall have soils tests done at his expense by a State approved soils testing laboratory to determine amendments to the existing soils. Copies of the soils tests shall be provided to the Owner’s Representative prior to planting the plant materials for review and approval.

1. Soils tests shall determine percent organic matter, pH, buffer pH, available phosphorus, exchangeable potassium, calcium, magnesium, Cation Exchange Capacity (CEC), and percent base saturation with recommendations for nitrogen, phosphate, potash, magnesium and lime based on plant type and use.

H. Plants may be subject to inspection and approval by the Owner's Representative at the place of growth or holding yard for conformity to specification requirements as to quality, size and variety. Notify Owner's Representative prior to transport of plant material to the site.

I. The Contractor shall hire an arborist certified by the International Society of Arboriculture (ISA). The arborist shall be on site full time during tree planting operations to ensure that correct planting procedures are followed.

1.4 JOB CONDITIONS

A. Utilities: Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, such conditions shall be rectified by the Contractor before planting with approval from the Owner's Representative.

C. All plants shall be guaranteed for the entire maintenance period covered by the Maintenance Bond.

1.5 PRE-BID SUBSTITUTIONS

A. Every reasonable effort shall be made to find the material specified by the architect. The landscape contractor is responsible for qualifying his/her proposal to document any plant suitability or availability problems. The landscape contractor may offer substitutions to the landscape architect for his/her consideration. The landscape contractor will notify the landscape architect if there are known diseases or insect resistant species that can be substituted for a selected pest-prone plant.

PART 2 - PRODUCTS

2.1 PLANT MATERIALS

A. All plant material shall be of the quantity, size, genus, species, and variety shown, and conforming to ANSI Z60.1, "American Standard for Nursery Stock". Provide healthy, vigorous stock, nursery grown, free of disease, insects, eggs, larvae, and defects such as sun-scald, injuries, abrasion or disfigurement.

B. All plant material shall be of typical proportion and form for the species.

C. Provide freshly dug trees and shrubs.

D. Provide ground cover plants and other plant materials as specified on the drawings.

2.2 OTHER PRODUCTS

A. Mulch shall be double shredded hardwood, free of deleterious materials.

B. Soil amendments shall conform to the soils tests.

C. Organic matter shall consist of composted leaves, composted sludge, or other approved material. Peat moss is not an acceptable material.

D. Filter fabric, i.e., soil separator shall be a non-woven, heat-bonded geotextile fabric made of 100% polypropylene, with a weight of 3.5 oz. to 4.02 oz. per square yard a minimum grab strength of 100 lbs. and a water flow rate of 100 gpm/ft.

E. Inorganic soil additives shall be Perlite (coarse texture), Vermiculite or approved equal.

G. A water retaining, soil conditioning polymer (polyacrylamide) such as “Soil Moist”, by JRM Chemical or approved equal.

H. Deer tree guards, a solid tube 4” diameter, 60” tall plastic tubing.

PART 3 - EXECUTION

3.1 PLANTING PREPARATION

A. All planting shall be done during the proper planting season for each species. Planting shall not be done under extreme wet, cold or dry conditions. Planting adjacent to heavily treated streets shall only be done in the spring.

B. All fall planted B&B trees shall have a minimum diameter root ball increased in size to that of the minimum diameter required for the next larger caliper size.

C. Deliver trees and shrubs after preparation for planting has been completed, and plant immediately. If planting is delayed more than 6 hours after delivery, set plant material in shade, protect from weather and mechanical damage and keep roots moist by covering with mulch, burlap, or other acceptable means of retaining moisture. No plants shall be stored more than 2 weeks unless with approval of Owner’s Representative. Do not remove container grown stock from containers until planting time.

D. Layout individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and secure Owner’s Representative’s approval prior to start of planting. Make adjustments as directed by the Owner’s Representative.

E. Planting beds shall be installed after lawn areas have been brought to finish grade and fine graded, but not seeded.

3.2 TREE PLANTING

A. Excavate pits with flared sides and with bottom of pit at the same depth as the rootball. An auger shall not be used to dig planting pits.

B. For balled and burlapped plants and container plants, pits shall be two and one-half times greater in diameter than the ball and the same depth as the ball.

C. Dispose of any unsuitable subsoil. Plant mix shall consist of existing soil which is free of debris, sticks, rubbish and stones greater than 1", and twenty percent (20%) organic matter by volume. Add amendments as per the soils test requirements.

D. For balled and burlapped material, set tree ball on bottom of pit, centered, and so the flare of the trunk sits at the same grade as it was in the nursery, when settled. Peel back burlap, cut first two rings of wire. When set, place additional plant mix around base and sides of ball, and work each layer to settle plant mix and eliminate voids and air pockets. Water after placing final layer of plant mix.

F. For container plants, remove plant from container and loosen rootball. Make 4 – 5 cuts ¾ the length of the rootball with a sharp knife. Spread out root mass and place on bottom of pit, centered, so the flare of the trunk sits at the same grade as it was in the nursery when settled. When set, place additional plant mix around base and sides of ball and work to settle plant mix and eliminate voids and air pockets. Water thoroughly.

G. Form a 3” high dish of backfill around the planting area to allow for mulching, as per detail.

H. Provide mulch to a uniform depth of 2". Do not touch mulch to trunk of plant.

G. Guy and stake trees immediately after planting, as indicated on the drawings. Remove wrapping around tree trunks.

H. Install tree trunk protection tubing per manufacturers installation specifications, secure with zip ties as needed.

3.3 PLANTING BEDS

A. Loosen subgrade of planting bed areas to a minimum depth of 12" using a culti-mulcher or similar equipment. Remove stones greater than 1” in any dimension, remove sticks, rubbish, and any other extraneous matter. Planting soil mixture shall be the same as plant mix in the tree planting section. Remove all stones greater than 1” in any dimension in plant mix. Remove sticks, rubbish and any other extraneous matter. Soil amendments apply here as well.

B. Spread planting soil mixture to a depth of 12" to meet line, grades, and elevations shown after light rolling and settlement. Place approximately 1/2 the total amount of planting soil required. Thoroughly mix into loosened subgrade to create a transition layer, then place remainder of plant soil.

C. Set container grown stock as specified for balled and burlapped stock, except remove container and loosen root system. Plants, when settled, must be set at the same elevation as when in the container.

D. Set bare root stock on cushion of planting soil mixture. Spread out roots without tangling or turning up to surface. Cut injured roots clean; do not break roots. Carefully work backfill around roots by hand, and puddle with water until plant mix layers are completely saturated. Plumb before backfilling and maintain plumb while working plant mix around roots and placing layers of soil mixture above roots. Plants, when settled, must be set at the same elevation as they were in the nursery.

E. Form a 3” saucer of backfill around the planting area, as per detail. Mulch planted areas to a uniform depth of 2" and finish level with adjacent grades. Do not touch mulch to trunk of plant.

F. Space ground cover plants as indicated on the planting plan. Dig holes large enough for spreading of roots, and backfill with planting soil mixture. Eliminate air pockets. Water thoroughly after planting, taking care not to cover crowns of plants with wet soils. Mulch areas between plants to a uniform depth of 2".

G. Newly planted trees and shrubs shall be pruned in accordance with supplier’s recommendations. All pruning must be done by experienced personnel.

H. Where there is no irrigation installation, add soil moist granules to shrub planting holes per the manufacturer’s specifications. Do no add granules on top of planting bed.

3.5 LANDSCAPE WATERING

A. The Contractor shall furnish water for watering plants on a weekly basis in absence of 1 ½” rainfall. All plant material shall be thoroughly watered throughout the period of establishment.

B. Saturate the root zone and mulched area of each plant without causing run-off. During the period from May 15 to September 15, the Contractor shall install one Tree Gator or approved equal drip irrigation bag with each tree planted. Use upright for deciduous tees and flat for evergreen trees. After completion of planting trees, the Contractor shall remove tape from drip irrigation bags and fill with water. Shrubs and trees too small to accept drip irrigation bags shall be watered by other means approved by the Owner.

C. The Contractor shall water plant material at least once a week through-out the period of establishment, unless there has been adequate rainfall. An average of 1-½" rainfall per week shall be considered adequate to suspend watering, at the Owner's Representative's direction.

D. The Contractor shall conduct an inspection of the trunk surrounded by and the area beneath each TreeGator irrigation bag on a bi-weekly basis. If any evidence of pests or disease is noticed, the Owner's Representative shall be notified in writing.

3.6 PERIOD OF ESTABLISHMENT

A. Before final inspection, all plants shall be in place and under the care of the Contractor for a period of establishment. This period shall begin immediately upon completion of the planting operations and shall continue until October 1st. In no case shall it be less than one growing season, June 1 to October 1.

B. During this period of establishment, follow all horticultural practices that will ensure the vigor and growth of the transplanted material. This includes watering, remulching, restaking, guying and cultivating. Weeding shall be performed either manually or by chemical control. If there is evidence of deer damage, then a deer inhibitor shall be applied.

C. On or about September 14 the Owner's Representative will inspect the planting and supply the Contractor with a list of missing and dead plants and those that have died back beyond normal pruning lines. Replant as required in accordance with the specifications of the original material. However, plants replaced and planted in the Fall, that die before or during the Spring planting season, shall be replaced immediately.

END OF SECTION 329300.23

SECTION 330130.01- SEWER COLLECTION SYSTEM REHABILITATION DEFINITIONS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specifications, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. The work covered by this project shall include the furnishing of all labor, equipment, materials, and supervision; and performing all work necessary to investigate, rehabilitate, and/or replace the designated sewer lines, manholes, etc., all in accordance with the specifications. The work shall consist of, but not necessarily be limited to, performing the following work tasks where specified:

1. Sewer Line Cleaning
2. Sewer Flow Control
3. Television Inspection
4. Sewer Pipe Joint Testing
5. Sewer Pipe Joint Sealing
6. Sewer Manhole Rehabilitation
7. Sewer Manhole Replacement
8. Sewer Manhole Separation
9. Sliplining of Sewers
10. Cured-in-Place Pipe Installation
11. Fold-and-Formed Pipe Installation
12. Sewer Point Repairs
13. Service Lateral Sealing and Televising

B. The area of work and the type of repair/rehabilitation to be performed shall be at those locations shown on the tables or drawings in the Specific Project Requirements section of these specifications.

1.3 DEFINITIONS

A. Wherever used in these specifications, the following words and terms shall have the meanings indicated:

1. AREAWAY: A paved surface, serving as an entry area to a basement or subsurface portion of a building, which is provided with some form of drainage device that may be connected to a sewer line.
2. AVAILABLE WATER: Water necessary for the performance of work, which may be taken only from fire hydrant(s) approved by the Owner, given conditions of traffic and terrain which are compatible with the use of the hydrant for performance of work.

3. BUILDING SEWER: The conduit which connects building wastewater sources to the public or street sewer (referred to also as "house sewer," "building connection," "lateral," or "service connection"), including lines serving homes, public buildings, commercial establishments, and industry structures. In this specification, the building sewer is referred to in two sections:

    a. The section between the building and the property line, right-of-way line, or to a point specified and supervised by the Owner's designated representative.
    b. The remaining section to the collector sewer, including the connection thereto.

4. BYPASS: An arrangement of pipes, conduits, gates, and valves whereby the flow may be passed around a hydraulic structure or appurtenance. Also, a temporary setup to route flow around a specified part of a sewer system.
5. BYPASS PUMPING: The transportation of sewage flows around a specific sewer pipe line section or sections via any conduit for the purpose of controlling sewage flows in the specified section or sections without flowing or spilling onto public or private property.
6. CELLAR DRAIN: A pipe or series of pipes which collect wastewater which leak, seep, or flow into subgrade parts of structures and discharge them into a building sewer, or by other means dispose of such wastewater into sanitary, combined or storm sewers.

    a. Referred to also as a "basement drain."

7. CHANGE ORDER: A written order to the Contractor authorizing an addition, deletion, or revision in the work within the general scope of work of the agreement, or authorizing an adjustment in the agreement price or agreement time.
8. COLLECTOR SEWER: A sewer located in the public way which collects the wastewater discharged through building sewers and conducts such flows into larger interceptor sewers and pumping and treatment works.

    a. Referred to also as "street sewer."

9. COMBINED SEWER: A sewer intended to serve as both a sanitary sewer and a storm sewer, or as both an industrial sewer and a storm sewer.
10. COMPRESSION GASKET: A device which can be made of several materials in a variety of cross sections and which serves to secure a tight seal between two pipe sections (e.g., "O"-rings).
11. CORBEL OR CONE: That portion of a manhole structure which slopes upward and inward from the barrel of the manhole to the manhole cover frame.
12. CREW: The number of persons required for the performance of work at a site as determined by the Contractor in response to task difficulty and safety considerations at the time or location of the work
13. DEBRIS: Soil, rocks, sand, grease, roots, etc., in a sewer line excluding items mechanically attached to the line such as protruding service connections, protruding pipe, joint materials, and the like.

14. EASEMENT: A liberty, privilege, or advantage without profit which the owner of one parcel of land may have in the land of another. In this agreement, all land, other than public streets, in which the Owner has sewer system lines or installations and right of access to such lines or installations.
15. EASEMENT ACCESS: Areas within an easement to which access is required for performance of work.
16. ENGINEER: The engineer (a person, joint venture, firm, or corporation) who works for or under a contract or subagreement with the Owner and is designated by the Owner as the Engineer of Record under the prime contract.
17. EXFILTRATION: The leakage or discharge of flows being carried by sewers out into the ground through leaks in pipes, joints, manholes, or other sewer system structures; the reverse of "infiltration".
18. EXISTING LINEAR FEET: The total length of existing sewer pipe in place within designated sewer systems as measured from center of manhole to center of manhole from maps or in the field.
19. FLOW CONTROL: A method whereby normal sewer flows or a portion of normal sewer flows are blocked, retarded, or diverted (bypassed) within certain areas of the sewer collection system.
20. FOUNDATION DRAIN: A pipe or series of pipes which collect groundwater from the foundation or footer of structures and discharge it into sanitary, storm, or combined sewers, or to other points of disposal for the purpose of draining unwanted waters away from such structures.
21. GROUTING: The joining together of loose particles of soil in such a manner that the soil so grouped becomes a solid mass which is impervious to water (see also SEWER PIPE JOINT SEALING).
22. HYDRAULIC CLEANING: Techniques and methods used to clean sewer lines with water, e.g.; water pumped in the form of a high-velocity spray and water flowing by gravity or head pressure. Devices include high-velocity jet cleaners, collapsible dams, etc.
23. INFILTRATION: The water entering a sewer system, including building sewers, from the ground, through such means as, but not limited to, defective pipes, pipe joints, connections, or manhole walls. Infiltration does not include, and is distinguished from, inflow.
24. INFILTRATION/INFLOW (I/I): A combination of infiltration and inflow wastewater volumes in sewer lines, with no way to distinguish either of the basic sources, and with the same effect of usurping the capacities of sewer systems and other sewer system facilities.
25. INFLOW: The water discharged into a sewer system, including service connections, from such sources as, but not limited to, roof leaders; cellar, yard, and area drains; foundation drains; cooling water discharges; drains from springs and swampy areas; manhole covers; cross connections from storm sewers, combined sewers, catch basins; storm waters; surface runoff; street wash water; or drainage. Inflow does not include, and is distinguished from, infiltration.
26. INSPECTOR: The Owner's on-site representative responsible for observation and recording of quantities of work performed as set forth in these specifications.
27. INTERCEPTOR SEWER: A sewer which receives the flow from collector sewers and conveys the wastewater to treatment facilities.

28. INTERNAL PIPE INSPECTION: The television inspection of a preselected sewer line section. A television camera is moved through the line at a slow, uniform rate and a continuous picture is transmitted to an aboveground monitor.
29. INVERT: The floor, bottom or lowest point of a conduit.
30. INVERT LEVEL (ELEVATION): The level (elevation) of the lowest portion of a liquid - carrying conduit, such as a sewer, which determines in part the hydraulic gradient available for moving the contained liquid
31. JOINTS: The means of connecting sectional lengths of sewer pipe into a continuous sewer line using various types of jointing materials. The number of joints depends on the lengths of the pipe sections used in the specific sewer construction work.
32. LINEAR FOOT: Being one foot as measured along the centerline of a sewer line.
33. LONG-TERM MODULUS OF ELASTICITY: The modulus of elasticity of the material after 50 years of service. This value may be extrapolated from a 10,000 hour test of the material.
34. MAJOR BLOCKAGE: A structural defect, collapse, or blockage which prohibits manhole-to-manhole cleaning with commercially available hydraulic or mechanical cleaning equipment.
35. MANHOLE SECTION: The length of sewer pipe connecting two manholes.
36. MECHANICAL CLEANING: Techniques and methods used to clean sewer lines of debris mechanically with devices such as power rodding machines, winch-pulled brushes, bucket machines, etc.
37. OVERFLOW:

    a. The excess water that overflows the ordinary limits such as the stream banks, the spillway crest, or the ordinary level of a container.
    b. To cover or inundate with water or other fluid.

38. PHYSICAL PIPE INSPECTION: The crawling or walking through manually accessible pipe lines. The logs for this inspection technique record the information of the kind detailed under Internal Pipe Inspection. This inspection technique is only undertaken when field conditions offer minimal hazard or jeopardy to personnel.
39. PIPE JOINT SEALING: A method of correcting leaking or defective pipe joints which permit infiltration of extraneous water into the sewers by means of applying chemical materials into and/or through the joint area from within the pipe.
40. REGULATOR: A device or apparatus for controlling the quantity of admixtures of sewage and storm water admitted from a combined sewer collector line into an interceptor sewer, or pumping or treatment facilities, thereby determining the amount and quality of the flows discharged through an overflow device to receiving waters or other points of disposal.
41. ROOF LEADER: A drain or pipe that conducts storm water from the roof of a structure downward and thence into a sewer for removal from the property, or onto the ground for runoff or seepage disposal.
42. SANITARY SEWER: A sewer intended to carry only sanitary or sanitary and industrial wastewater from residences, commercial buildings, industrial parks, and institutions.
43. SERVICE CONNECTION: see Building Sewer.
44. SEWER CLEANING: The utilization of hydraulic or mechanical techniques and/or devices to dislodge, transport, and remove debris from sewer lines.

45. SEWER PIPE: A length of conduit, manufactured from various materials and in various lengths, that when joined together can be used to transport wastewater from point of origin to a treatment works. Materials include, but are not limited to: Acrylonitrile-butadiene-styrene (ABS): Asbestos-Cement (AC): Brick Pipe (BP); Concrete Pipe (CP); Cast Iron Pipe (CIP); Ductile Iron Pipe (DIP); Polyethylene (PE); Polyvinylchloride (PVC); Reinforced Concrete Pipe (RCP); Reinforced Plastic Mortar (RPM): Steel Pipe (SP); Vitrified Clay Pipe (VCP).
46. SITE: Any location where work has been or will be done.
47. SITE ACCESS: An adequately clear area of a size sufficient to accommodate personnel and equipment required at the location where work is to be performed, including roadway or surface sufficiently unobstructed to permit conveyance of vehicles from the nearest paved roadway to the work location.
48. SPRING LINE: The horizontal midpoint of a sewer pipe.
49. STORM SEWER: A sewer intended to carry only storm waters, surface runoffs, street wash water, and drainage.
50. STREET ACCESS: Areas normally used for public vehicular traffic (including roads, streets, or areas within existing rights-of-way or easements) to which safe access is required for performance of work.
51. SUBCONTRACTOR: An individual, firm, or corporation having a direct contract with the Contractor for performance of part of the work.
52. SURCHARGE: When the sewer flow exceeds the hydraulic carrying capacity of the sewer line.
53. SURCHARGE CONDITION: When the sewer flow depth equals or exceeds the diameter of the discharging sewer line or lines.
54. SWALE (DIP, SAG): A significant deviation in pipe grade such as to cause entrapment of solids, semisolids, and liquids, thereby impeding the accuracy and/or effectiveness of flow measurements, cleaning, and internal inspection.

END OF SECTION 330130.01

SECTION 330130.02 - SEWER LINE CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specifications, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. The intent of sewer line cleaning is to remove foreign materials from the lines and restore the sewer to a minimum of 95% of the original carrying capacity or as required for proper lining of the pipe or seating of internal pipe joint sealing packers. Since the success of the other phases of work depends a great deal on the cleanliness of the lines, the importance of this phase of the operation is emphasized. It is recognized that there are some conditions such as broken pipe and major blockages that prevent cleaning from being accomplished or where additional damage would result if cleaning were attempted or continued. If in the course of normal cleaning operations, damage does result from pre-existing and unforeseen conditions such as broken pipe, the Contractor will not be held responsible.

B. The intent of chemical root treatment is to kill tree roots in sanitary/storm sewer lines and to inhibit root regrowth without damaging the trees, the environment, or the treatment plant.

1.3 QUALITY ASSURANCE

A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.4 SUBMITTALS

A. Equipment Data: Submit a listing of equipment to be used on the project. Provide equipment operating instructions if requested by the Owner.

B. Chemical Root Removal Data:

1. Submit manufacturer's technical data and application instructions.
2. Submit Material Safety Data Sheet(s) for the chemicals to be used in the root removal process.
3. Submit a specimen product label of foaming material to be used in chemical root treatment.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment and material shall be of a type that has been in general use for a period of five (5) years. Work performed with experimental equipment or material will not be permitted without prior written consent of the Owner.

2.2 CLEANING EQUIPMENT

A. Hydraulically Propelled Equipment: The equipment used shall be of a movable dam type and be constructed in such a way that a portion of the dam may be collapsed at any time during the cleaning operation to protect against flooding of the sewer. The movable dam shall be equal in diameter to the pipe being cleaned and shall provide a flexible scraper around the outer periphery to insure removal of grease. If sewer cleaning balls or other equipment which cannot be collapsed is used, special precautions to prevent flooding of the sewers and public or private property shall be taken.

B. High-Velocity Jet (Hydrocleaning) Equipment: All high-velocity sewer cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a selection of two or more high-velocity nozzles. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned. Equipment shall also include a high-velocity gun for washing and scouring manhole walls and floor. The gun shall be capable of producing flows from a fine spray to a solid stream. The equipment shall carry its own water tank, auxiliary engines, pumps and hydraulically driven hose reel.

C. Mechanically Powered Equipment: Bucket machines shall be in pairs with sufficient power to perform the work in an efficient manner. Machines shall be belt operated or have an overload device. Machines with direct drive that could cause damage to the pipe will not be allowed. A power rodding machine shall be either a sectional or continuous rod type capable of holding a minimum of 750 feet of rod. The rod shall be specifically heat-treated steel. To insure safe operation, the machine shall be fully enclosed and have an automatic safety clutch or relief valve.

2.3 CHEMICAL FOAM ROOT REMOVAL

A. The chemical root treatment material shall be EPA registered and labeled for use in sewer lines and acceptable to the state agencies having jurisdiction over its use.

B. The active ingredient for killing roots shall be a nonsystemic herbicide which will kill roots at low concentrations but will not permanently affect parts of the plant distant from the treated roots. The active ingredient must be spontaneously detoxified by natural chemical/biochemical processes following its use. The active ingredient shall not adversely affect the performance of wastewater treatment plants.

C. The active ingredient for inhibiting root regrowth in sanitary sewers shall inhibit root cell growth on contact but shall not be transported so as to damage other portions of the plant. The material shall form a persistent chemical barrier suppressing the growth of root tips. The material shall be sufficiently stable under conditions of use to provide protection for 12 months but shall be subject to decomposition in wastewater treatment plants without disturbing plant processes.

D. The root treatment material shall contain emulsifiers to degrease root masses and remove fatty acids from root tissue and surfactants to convert an aqueous solution of the root treatment agent into a volatile foam.

PART 3 - EXECUTION

3.1 CLEANING PRECAUTIONS

A. During sewer cleaning operations, satisfactory precautions shall be taken in the use of cleaning equipment. When hydraulically propelled cleaning tools (which depend upon 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 that the water pressure created does not damage or cause flooding of public or private property being served by the sewer.

B. When possible, the flow of sewage in the sewer shall be utilized to provide the necessary pressure for hydraulic cleaning devices. When additional water from fire hydrants is necessary to avoid delay in normal work procedures, the water shall be conserved and not used unnecessarily.

C. No fire hydrant shall be obstructed in case of a fire in the area served by the hydrant.

3.2 SEWER CLEANING

A. The designated sewer manhole sections shall be cleaned using hydraulically propelled, high-velocity jet, or mechanically powered equipment. Selection of the equipment used shall be based on the conditions of lines at the time the work commences. The equipment and methods selected shall be satisfactory to the Engineer. The equipment shall be capable of removing dirt, grease, rocks, sand, and other materials and obstructions from the sewer lines and manholes.

B. 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, again, successful cleaning cannot be performed or the equipment fails to traverse the entire manhole section, it will be assumed that a major blockage may exist, the cleaning effort shall be suspended, and the Engineer shall be notified.

3.3 ROOT REMOVAL

A. Roots shall be removed in the manhole sections where root intrusion occurs. Special attention should be used during the cleaning operation to assure complete removal of roots from the joints. Any roots which could prevent proper lining of the pipe, prevent the seating of a pipe joint packer, or prevent the proper application of chemical sealants shall be removed.

B. Mechanical procedures may include the use of equipment such as rodding machines, bucket machines and winches using root cutters and porcupines, and equipment such as high-velocity jet cleaners.

C. Chemical root treatment shall be used when directed by the Owner.

1. The Contractor's attention is directed to the safety requirements and precautions associated with the use of the root treatment material. The Contractor shall use precautions for the protection of all persons, vegetation, animals and property. The Contractor is responsible for damage to private property and vegetation.
2. The Contractor is required to be knowledgeable of and in compliance with federal and state requirements relative to the root treatment material and its use. Compliance with federal and state law shall supersede compliance with the provisions of this contract.
3. All mixing/application procedures for chemical root treatment shall be consistent with the latest standards, requirements and recommendations of the manufacturer of the chemical root treatment material used. Mixing and application of the root treatment material shall be done under the supervision of a state-certified pesticide (herbicide) applicator as required by law.
4. When the root tips are damaged or removed by sewer line cleaning, chemical treatment will be less effective. Consequently, no mechanical cleaning is recommended in lines prior to chemical root treatment unless extensive grease, root masses, or debris preclude proper application of the material.
5. Sewer service shall generally not be interrupted during root treatment. In situations where it is necessary to shut down upstream pumping stations of block/bypass upstream flows, the Contractor shall coordinate their activities with the Engineer and Owner and do the work at night or during periods of low flow.
6. All materials shall be delivered to the site in undamaged, unopened containers bearing the manufacturer's original label. Mixing of the root treatment material shall be done no more than 12 hours prior to use. The water used shall be clear and free of acid, alkali, oxidizing agents, oil, or other organic materials. Mixing water temperature shall be between 40°F and 80°F.
7. Where conditions permit, the volume of foam shall be sufficient to completely fill the air space above the flow, manhole to manhole. In all cases, the volume of foam delivered to the sewer line shall be sufficient to attach to and permeate all root masses.
8. The foam shall be applied at sufficient pressure to penetrate a minimum of 5 feet into service connections.
9. Root Removal: The Contractor shall wait a minimum of 90 days from application of the foam to removal of roots unless otherwise directed by the Engineer.

D. All roots must be removed prior to grouting or lining. If roots are detected during either of grouting or lining, the Contractor shall remove their equipment and reclean the line to ensure root removal. This work shall be performed at no additional cost to the Owner if the manhole section was previously cleaned as a pay item.

3.4 MATERIAL REMOVED

A. All sludge, dirt, sand, rocks, grease, and other solid or semisolid material resulting from the cleaning operation shall be removed at the downstream manhole of the section being cleaned.

B. Passing material from manhole section to manhole section, which could cause line stoppages, accumulations of sand in wet wells, or damage pumping equipment, shall not be permitted.

C. When necessary or when directed by the Engineer, an approved dam or weir shall be constructed in the downstream manhole in such a manner that solids and debris will be trapped and retained. The cost of such a dam or weir shall be included in the cost of cleaning.

3.5 DISPOSAL OF MATERIALS

A. All solids or semisolids resulting from the cleaning operations shall be removed from the site and disposed of at a location approved by the Owner.

B. Trucks hauling solids or semisolids from the site shall be watertight so that no leakage or spillage will occur.

C. All materials shall be removed from the site no less often than at the end of each workday.

D. Under no circumstances will the Contractor be allowed to accumulate debris, etc., on the site of work beyond the stated time, except in totally enclosed containers and as approved by the Owner.

3.6 FINAL ACCEPTANCE

A. Acceptance of sewer line cleaning shall be made upon the successful completion of the television inspection and shall be to the satisfaction of the Owner.

B. If TV inspection shows the cleaning to be unsatisfactory, the Contractor shall be required to reclean and reinspect the sewer line at no additional expense to the Owner.

C. In areas where television inspection is not performed, the Engineer may require the Contractor to pull a double squeegee (with each squeegee the same diameter as the sewer) through each manhole section as evidence of adequate cleaning.

END OF SECTION 330130.02

SECTION 330130.03 - SEWER FLOW CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specifications, apply to work of this Section.

B. Other Sections Referenced:

1. Section 330130.01 - Sewer Collection System Rehabilitation Definitions

1.2 DESCRIPTION OF WORK

A. The intent of this work is to control the flow in the sewer to enable the successful inspection, rehabilitation or replacement of the pipe.

B. Depth of flow shall not exceed that shown below for the respective pipe sizes when performing television inspection, joint testing and/or sealing.

	Pipe Diameter		Maximum Depth of Flow
1.	6" - 10" Pipe	-	25% of pipe diameter
2.	12" - 24" Pipe	-	33% of pipe diameter
3.	27" & up Pipe	-	40% of pipe diameter

C. Flow shall be controlled or bypassed from sewer sections being lined or replaced. The methods used shall be in accordance with the work being performed.

1.3 QUALITY ASSURANCE

A. When flow in a sewer line is plugged, blocked, or bypassed; sufficient precautions must be taken to protect the sewer lines from damage that might result from sewer surcharging. Further, precautions must be taken to ensure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved.

1.4 SUBMITTALS

A. The Contractor shall submit a written request for Sewer Flow Control, specify the method and equipment to be used, and receive approval from the Owner prior to performing the work.

B. For bypass pumping, submit shop drawings in accordance with the General Requirements showing pumps, piping layout plan and dimensions, schedule of pipe fittings and specials, materials and class for each size and type of pipe, joint details, and any special provisions required for assembly. Provide a wet weather operation plan which describes what procedures will be followed when flow exceeds pumping capacity.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Sewer plugs shall be so designed that all or any portion of the sewage can be quickly released.

B. Pumping and bypassing:

C. Pumps bypass pipe, fittings, and joining methods shall be suitable and of a type normally used for raw sanitary sewage.
   1. The bypass system shall be of sufficient capacity to handle existing peak dry weather flow plus additional flow that may occur during a rainstorm unless otherwise provided for by an approved wet weather operation plan.
   2. If pumping is required on a 24-hour basis, engines shall be equipped in a manner to keep noise to a minimum.
   3. Bypass piping to be furnished and installed shall include, but not limited to all pipe, fittings, specials, bends, beveled pipe, adapters, bulkheads, stoppers, plugs, joint restraints, joints and jointing materials, and pipe supports. Bypass piping shall be rated to twice the system operating pressure.

D. Hydrocleaning equipment shall be equipped with high-velocity nozzles capable of pulling flow away from the pipe section being televised. The equipment shall carry its own water tank, auxiliary engines, pumps and hydraulically driven hose reel.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. The Contractor shall continuously supervise the level of water in the upstream and downstream sewers to ensure that harmful surcharging does not occur. The Contractor shall be responsible for any damage to the system and/or to public or private property resulting from improper execution of flow control measures.

3.2 PLUGGING OR BLOCKING

A. A sewer line plug shall be inserted into the line upstream of the section being worked. During TV inspection, testing and sealing operations, flow shall be reduced to within the limits specified above. After the work has been completed, flow shall be restored to normal.

3.3 PUMPING AND BYPASSING

A. When pumping and bypassing is required, the Contractor shall supply and install the pumps, conduits, and other equipment to divert the flow around the section in which work is to be performed. Under no circumstances will the discharge of raw sewage to other than sanitary sewers be allowed.

B. The Contractor shall be responsible for furnishing the necessary labor and supervision to set up and operate the pumping and bypassing system.

C. The proposed bypassing system shall be set up to allow traffic flow to local residents and businesses.

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

E. Make connections to all existing force mains being bypassed.

F. Install temporary bypass piping with restrained joints at horizontal and vertical changes in direction.

G. Provide granular material for bedding and encasement of temporary piping when buried below pavement.

H. Field test bypass piping and obtain approval from the Engineer prior to placing bypass system in service.

I. Do not remove pumping and bypass system until it is no longer needed and can be replaced by authorized use of completed permanent facilities.

3.4 HYDRAULIC FLOW CONTROL

A. This method shall be used for sewer televising only. The Contractor shall position the high-velocity nozzle no less than five (5) feet ahead of the television camera. Pressures shall be just sufficient to reduce the flow level in front of the camera to the specified depth. The jet nozzle shall be reeled in at the same rate as the forward movement of the television camera to maintain the separation distance.

END OF SECTION 330130.03

SECTION 330130.13 - SEWER PIPE JOINT TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Other Sections Referenced:

1. Section 330130.01 - Sewer Collection System Rehabilitation Definitions
2. Section 330130.02 - Sewer Line Cleaning
3. Section 330130.03 - Sewer Flow Control
4. Section 330130.17 - Television Inspection

1.2 DESCRIPTION OF WORK

A. The intent of sewer pipe joint testing is to identify those sewer pipe joints that are defective thereby allowing extraneous water to enter the sewer system.

B. Testing cannot be performed and will not be required on cracked or broken pipe, service connections, or sections of pipe between joints. Testing will not be required on joints which are visibly leaking.

1.3 QUALITY ASSURANCE

A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.4 SUBMITTALS

A. Equipment Data: Submit equipment manufacturer's technical data and operation instructions for the testing equipment to be used.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment and material shall be of a type that has been generally been in use for a period of five (5) years. Work performed with experimental equipment or material will not be permitted without prior written consent of the Owner.

2.2 MATERIAL

A. Test Medium: Both water and air are acceptable, but the test procedure is different for each.

2.3 EQUIPMENT

A. The basic equipment used shall consist of a television inspection equipment, joint testing device (such as a packer), and test monitoring equipment.

1. The equipment shall be constructed in such a way as to provide means for introducing the test medium, under pressure, into the void area created by the expanded ends of the joint-testing device and means for continuously measuring the actual static pressure of the test medium at and within the void area only.
2. Void pressure data shall be transmitted to the televising recording equipment via an electrical pressure transducer located at the void.
3. The recording equipment shall be capable of recording on the video tape the manhole section being tested, the footage from the beginning manhole, and a real-time image of the void pressure.

B. Test monitoring equipment shall be housed in a suitable vehicle and arranged to allow for simultaneous and continuous observation of the television monitor and test monitoring equipment by the Engineer.

PART 3 - EXECUTION

3.1 PREPARATORY WORK

A. Prior to testing a section of sewer, the pipe shall be cleaned and the flow controlled to allow a suitable depth. See Sewer Line Cleaning and Sewer Flow Control. The cost of this work shall be considered incidental to Sewer Pipe Joint Testing and included in the price bid thereof.

3.2 CONTROL TEST

A. Prior to starting the pipe joint testing phase of the work, a two-part control test shall be performed.

1. To insure the accuracy, integrity, and performance capabilities of the testing equipment, a demonstration test will be performed in a test cylinder constructed in such a manner that a minimum of two known leak sizes can be simulated. This technique will establish the test equipment performance capability in relationship to the test criteria and insure that there is no leakage of the test medium from the system or other equipment defects that could affect the joint testing results. If this test cannot be performed successfully, the Contractor shall be instructed to repair or otherwise modify his equipment and re-perform the test until the results are satisfactory to the Engineer. This test may be required at any other time during the joint testing work if the Engineer suspects the testing equipment is not functioning properly.
2. After entering each manhole section with the test equipment, but prior to the commencement of joint testing, the test equipment shall be positioned on a section of sound sewer pipe between pipe joints, and a test performed as specified. This procedure will demonstrate the reliability of the test equipment and the soundness of

the pipe material. Should it be found that the barrel of the sewer pipe will not meet the joint test requirements, the requirements will be modified as necessary.

3.3 TESTING

A. Each sewer pipe joint which is visibly leaking shall be considered as having failed the test.

B. Each sewer pipe joint which is not visibly leaking shall be individually tested at a test pressure equal to l/2 psi per vertical foot of pipe depth (not exceeding a test pressure of l0 psi) in accordance with one of the following procedures:

1. Water Test Procedure:

a. The testing device shall be positioned within the line in such a manner as to straddle the pipe joint to be tested.
b. The testing device ends (end elements, sleeves) shall be expanded so as to isolate the joint from the remainder of the line and create a void area between the testing device and the pipe joint. The ends of the testing device shall be expanded against the pipe with sufficient pressure to contain a minimum of 10 psi within the void without leakage past the expanded ends.
c. Water shall then be introduced into the void area until a pressure equal to or greater than the required test pressure is observed with the void pressure monitoring equipment. If the required test pressure cannot be developed (due to joint leakage), the joint will have failed the test.
d. The flow rate of the test water shall then be regulated to a rate at which the void pressure is observed to be the required test pressure. A reading of the test water flow meter shall then be taken. If the flow rate exceeds l/4 gallon per minute (due to joint leakage), the joint will have failed the test.

2. Air Test Procedure:

a. The testing device shall be positioned within the line in such a manner as to straddle the pipe joint to be tested.
b. The testing device ends (end elements, sleeves) shall be expanded so as to isolate the joint from the remainder of the line and create a void area between the testing device and the pipe joint. The ends of the testing device shall be expanded against the pipe with sufficient pressure to contain a minimum of 10 psi within the void without leakage past the expanded ends.
c. Air shall then be introduced into the void area until a pressure equal to or greater than the required test pressure is observed with the void pressure monitoring equipment. If the required test pressure cannot be developed (due to joint leakage), the joint will have failed the test.
d. 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 2 psi within 15 seconds (due to joint leakage), the joint will have failed the test.

3.4 TEST RECORDS

A. Video tape and written records shall be kept of the joint testing on each manhole section. The records shall include:

1. Identification of the manhole section tested.
2. Location (footage) of each joint tested.
3. The test pressure used.
4. A statement indicating the test results (passed or failed) for each joint tested.

B. The complete test of each joint shall be recorded from the beginning of the pressure buildup in the void, through the pressure holding period, to the time of pressure release.

C. A copy of the written records and title to the videotape records shall be given to the Owner prior to payment for Sewer Pipe Joint Testing.

END OF SECTION 330130.13

SECTION 330130.17 - TELEVISION INSPECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specifications, apply to work of this section.

B. Other Sections Referenced:

1. Section 330130.01 - Sewer Collection System Rehabilitation Definitions
2. Section 330130.03 - Sewer Flow Control

1.2 DESCRIPTION OF WORK

A. After cleaning or when otherwise specified, the manhole sections shall be visually inspected by means of closed-circuit television. The inspection will be done one manhole section at a time and the flow in the section being inspected will be suitably controlled.

1.3 DEFINITIONS

A. Wherever used in these specifications, the following words and terms shall have the meanings indicated:

1. CCTV: Closed Circuit Television
2. NASSCO: National Association of Sewer Services Companies
3. PACP: Pipeline Assessment Certification Program

1.4 QUALITY ASSURANCE

A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

B. All CCTV and reporting shall be performed in accordance with NASSCO PACP recording, coding, and grading. Operator and coder shall be certified to perform work by NASSCO.

1.5 SUBMITTALS

A. Equipment Data: Submit equipment manufacturer's technical data and operation instructions for the televising and recording equipment to be used.

B. Product Data: Submit brand name and specifications of video tape to be used for the recording of the televising data.

C. Report: Submit sample televising log report for review and approval of content and format.

PART 2 - PRODUCTS

2.1 GENERAL

A. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the Owner's Representative, and if unsatisfactory, equipment shall be removed and no payment will be made for an unsatisfactory inspection.

2.2 MATERIAL

A. Video recording shall be submitted on USB thumb drive. Two (2) copies shall be sent to the Engineer for review.

2.3 EQUIPMENT

A. The television camera used for the inspection shall be one specifically designed and constructed for such closed-circuit sewer pipe inspection. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The camera shall televise and transmit the image in color and shall have pan and tilt capabilities.

B. The propulsion system shall be either a tractor, skid and winch arrangement, or with special approval from the Owner, a float.

C. The recording system shall be digital with capability for annotating and narrating the video image, and for producing digital photographs of the television picture.

PART 3 - EXECUTION

3.1 PROCEDURE

A. Normally, the camera will be set up in the upstream manhole. Where the setup causes the camera lens to be positioned a distance upstream or downstream of the manhole wall, the operator shall make a visual observation of that portion of the sewer pipe not captured on the video tape and record the observations by voice over on the video tape.

B. The height of the camera shall be adjusted so that the lens is at the center of the pipe.

C. The camera will be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewer's condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line.

D. The camera will be moved to the far manhole and the recording shall show the condition of the manhole trough. The operator shall make a visual observation of the far manhole. Connecting pipes and manhole defects not captured on the video shall be recorded by voice over on the video tape and written in the television inspection log.

E. Connections to the sewer shall be televised using the pan and tilt capabilities of the camera. The camera shall be positioned in the sewer at a location which maximizes the sight distance up the connecting pipe. The acceptable length of televising shall be a distance of 6 feet, or to the end of the pipe (if capped), or to the first bend (if a wye).

F. If, during the inspection operation, the television camera will not pass through the entire manhole section, the Contractor shall perform a reverse setup (set up his equipment so that the inspection can be performed from the opposite manhole). If, again, the camera fails to pass through the entire manhole section, the manhole section will be referred to the Engineer for evaluation.

G. When manually operated winches are used to pull the television camera through the line, telephones or other suitable means of communication shall be set up between the two manholes of the section being inspected to insure good communications between members of the crew.

H. The importance of accurate distance measurements is emphasized. Measurement for location of defects shall be by means of a footage counter with the value displayed on the video tape. The footage counter shall be set such that zero is the center of the beginning manhole. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Accuracy of the footage counter shall be checked above ground by use of a walking meter, roll-a-tape, or other suitable device. The footage counter shall be calibrated to an accuracy that is satisfactory to the Engineer.

I. Documentation of the television results shall be as follows:
   1. Television Inspection Logs: Printed location records shall be kept by the Contractor and will clearly show the location in relation to an adjacent manhole of each infiltration point observed during inspection. In addition, other points of significance such as locations of building sewers, unusual conditions, roots, storm sewer connections, broken pipe, presence of scale and corrosion, and other discernible features will be recorded and a copy of such records will be supplied to the Owner. Each feature called out on the inspection log shall be identified as to its location on the videotape by means of a footage counter. When more than one manhole section is recorded on a video tape, the television inspection log shall record the elapsed tape time from the beginning of the tape to the beginning of the manhole section.
   2. Photographs: Digital photographs of the television picture of problems shall be taken by the Contractor upon request of the Engineer, as long as such photographing does not interfere with the Contractor's operations.

3. Videotape Recordings: The purpose of tape recording shall be to supply a visual and audio record of problem areas of the lines that may be replayed. Videotape recording playback shall be at the same speed that it was recorded. Slow motion or stop-motion playback features may be supplied at the option of the Contractor. Title to the tape shall be given to the Owner upon completion of the project. The Contractor shall have all videotapes and necessary playback equipment readily accessible for review by the Owner during the project.

END OF SECTION 330130.17

SECTION 330130.61 - SEWER PIPE JOINT SEALING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications sections, apply to work of this section.

B. Other Sections Referenced:
1. Section 330130.01 – Sewer Collection System Rehabilitation Definitions
2. Section 330130.02 – Sewer Line Cleaning
3. Section 330130.03 – Sewer Flow Control
4. Section 330130.13 – Sewer Pipe Joint Testing
5. Section 330130.17 – Television Inspection
6. Section 330130.63 – Chemical Sealing Materials

1.2 DESCRIPTION OF WORK

A. A two-part chemical sealing material will be injected into the pipe joint. The chemicals will react to form a gelatinous material within and on the outside of the pipe. This gel will act as a flexible gasket to seal the joint and prevent groundwater from entering the pipe. An additive will be added to inhibit root growth through the gel material.

B. It is the intent of the sewer pipe joint sealing work to seal all sewer pipe joints utilizing an internal joint sealing method. It is realized that this method may only be used on sewer pipe sections in sound physical condition. Longitudinally cracked or broken pipe will not be sealed. When bell cracks or chips are evident from pipe section offset, sealing may be undertaken where the offset is small enough to allow proper seating of the sealing packer on both sides of the joint to be sealed.

1.3 QUALITY ASSURANCE

A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and application instructions.

B. Submit Material Safety Data Sheets for the chemicals used in the grout and root inhibitor.

C. Equipment Data: Submit equipment manufacturer's technical data and operating instructions for the joint packing equipment to be used.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment and material shall be of a type that has been in general use for a period of five (5) years. Work performed with experimental equipment or material will not be permitted without prior written consent of the Owner.

2.2 MATERIAL

A. Grout: The sealing material shall be formed from a two-part chemical grout that is mixed within the void area formed by the grouting packer. (See Chemical Sealing Materials).

B. Root Inhibitor: A root inhibitor, such as dichlobenil or approved equal, shall be incorporated into every batch of grout.

2.3 EQUIPMENT

A. The basic equipment shall consist of a television inspection system, necessary chemical sealant containers, pumps, regulators, valves, hoses, etc., and joint sealing packers for the various sizes of sewer pipes.
   1. The equipment shall be constructed in such a way as to provide means for introducing the sealing materials, under pressure, into the void area created by the expanded ends of the joint-testing device and means for continuously measuring the actual static pressure of the materials at and within the void area only.
   2. Void pressure data shall be transmitted to the televising recording equipment via an electrical pressure transducer located at the void.
   3. The recording equipment shall be capable of recording on the video tape the manhole section being tested, the footage from the beginning manhole, and a real-time image of the void pressure.

B. Sealing equipment shall be housed in a suitable vehicle and arranged to allow for continuous observation of the television monitor and sealing equipment by the Engineer and three (3) other representatives of the Owner.

C. The packer shall be cylindrical and have a diameter less than the pipe size and have cables attached at each end to pull it through the line. The packer device shall be constructed in a manner to allow a restricted amount of sewage to flow. Generally, the equipment shall be capable of performing the specified operations in lines where flows do not exceed the maximum line flows for joint testing/sealing (see Sewer Flow Control).

D. The pumping unit, metering equipment, and the packer device shall be designed so that the proportions and quantities of materials can be regulated in accordance with the type and size of the leak being sealed.

E. The equipment shall be manufactured of materials suitable for the addition of the root inhibitor.

PART 3 - EXECUTION

3.1 PREPARATORY WORK

A. Prior to sealing a section of sewer, the pipe shall be cleaned and the flow controlled to enable a suitable depth for the sealing equipment (see Sewer Line Cleaning and Sewer Flow Control). The cost of this work shall be considered incidental to Sewer Pipe Joint Sealing and included in the price bid thereof.

B. Root inhibitor shall be stored on the vehicle in unit doses (one dose per each batch of sealing material). Prior to starting the project, root inhibitor shall be transferred from bulk containers to individual containers. Bulk containers shall not be stored on the vehicle. Each dose shall be contained in a sealed container which shall not be opened until just prior to its inclusion in the batch.

3.2 JOINT SEALING PROCEDURE

A. All joints, leaks or breaks shall be sealed. Sealing shall be accomplished by forcing the chemical sealing materials into or through joints, leaks or breaks by a system of pumps, hoses, and sealing packers.

B. Jetting or driving pipes from the surface that could damage or cause undermining of the pipe lines shall not be allowed. Uncovering the pipe by excavation of pavement and soil (which would disrupt traffic, undermine adjacent utilities and structures, and cause further damage to the pipe lines being repaired) shall not be allowed.

C. The packer shall be positioned over each joint, leak or break by means of a closed-circuit television camera in the line. It is important that the procedure used by the Contractor for positioning the packer be accurate to avoid over pulling the packer and thus not effectively sealing (grouting) the intended defect.

D. The packer ends (end elements, sleeves) shall be expanded using controlled pressure. The expanded ends shall 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.

E. Into this isolated area, sealant materials shall be pumped through the hose system at controlled pressures which are in excess of groundwater pressures.

3.3 SEAL VERIFICATION

A. Upon completion of the sealing of each individual joint, leak or break, the packer shall be deflated until the void pressure meter reads zero pressure, then reinflated and the joint retested as specified (see Sewer Pipe Joint Testing). The cost of this testing shall be included in the cost of Sewer Pipe Joint Sealing.

B. Should the void pressure meter not read zero, the Contractor shall clean their equipment of residual grout material or make the necessary equipment repairs/adjustments to produce accurate void pressure readings.

C. Joints that fail to meet the specified test criteria shall be resealed and retested until the test criteria can be met in order to receive payment.

3.4 RESIDUAL SEALING MATERIAL

A. Residual sealing materials that extend into the pipe, reduce the pipe diameter, or restrict the flow shall be removed from the joint. The sealed joints shall be left reasonably "flush" with the existing pipe surface.

B. If excessive residual sealing materials accumulate in the line and/or if directed by the Engineer the manhole section shall be cleaned to remove the residual materials. In no case shall excess grout material be flushed down the sewer.

3.5 RECORDS

A. Video recordings shall be kept of the joint sealing performed in each manhole section. The following information shall be recorded on the videotape:
   1. Identification of the manhole section sealed.
   2. The footage location of each joint sealed, measured from the upstream manhole.
   3. Void pressure continuously recorded throughout the joint sealing procedure.
   4. Number of gallons or pounds of sealant used.
   5. A verbal statement indicating the sealing results (passed or failed) for each joint sealed.
   6. If a joint is not grouted, a verbal statement indicating the reasons for not sealing the joint.

B. Written records also shall be kept of joint sealing performed in each manhole section. Written records shall include:
   1. Identification of the manhole section sealed.
   2. The footage location of each joint sealed, measured from the upstream manhole.
   3. Sealing pressure at refusal.
   4. Number of gallons or pounds of sealant used.
   5. A statement indicating the sealing results (passed or failed) for each joint sealed.

C. The complete sealing of each joint, leak or break shall be recorded on the video tape from the beginning of the pressure buildup in the void, through the pressure holding period, to the time of pressure release.

D. A copy of the written records and title to the video recordings shall be given to the Owner prior to payment for Sewer Pipe Joint sealing.

3.6 GUARANTY

A. All sewer pipe joint sealing work performed shall be guaranteed against faulty workmanship and/or materials for a period of one year after the completion of the work.

1. Prior to the expiration of the guaranty period, an initial retest area consisting of specific manhole sections shall be selected by the Engineer/Owner. Manhole sections to be retested shall be randomly selected throughout the project area and shall be representative of the majority of the sealing work originally performed. The initial test area shall consist of at least 5%, but not exceed 10%, of the linear feet contained in the original project.
2. Within the initial retest area, the Contractor shall retest all previously sealed joints as specified (see Sewer Pipe Joint Testing). Any joints failing the retest shall be resealed. If the failure rate of the retested joints is less than 1% of the joints retested, the work shall be considered satisfactory and no further retesting will be required. Payment for retesting the initial area shall be at the unit price bid for each item of work required (e.g.: cleaning, TV inspection, testing, etc.). No compensation shall be provided for resealing (grouting) joints that fail.
3. If, in the initial retest area, the failure rate of the retested joints exceeds 1% of the joints retested, an additional retest area of equivalent size shall be selected and all previously sealed joints shall be retested. This additional testing and sealing, if necessary, will continue until a failure rate of less than 1% is met. Any additional testing/sealing required beyond the initial retest area shall be accomplished at no cost to the Owner.
4. Should as much as 25% of the original project be retested and fail to meet the 1% requirement, the Contractor will be required to provide the same number of crews as utilized in the original project so that the retesting will proceed at a more rapid rate.

END OF SECTION 330130.61

SECTION 330130.63A - CHEMICAL SEALING MATERIALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications sections, apply to work of this section.

B. Other Sections Referenced:

1. Section 330130.61 - Sewer Pipe Joint Sealing

1.2 DESCRIPTION OF WORK

A. The intent of this section is to define the properties that a sealing material must have to perform effectively in the intended application and under expected field conditions.

B. Generic chemical sealing materials currently in use are listed with the basic properties, performance standards, and mix ratios which are known to give acceptable performance.

C. It is recognized that new and improved chemical sealing materials will become available from time to time. Sources, manufacturers, and product names of chemical sealing materials will thus change from time to time and therefore specific sources, manufacturers, and product names are not referred to in this specification.

D. It should be understood that all of the generically classified chemical sealing materials can achieve desired long-lasting results when used in the proper application and properly applied. The knowledge and skill of the applicator has a greater effect on achieving the desired results than the specific sealing material applied.

E. In every case, mixing and handling of chemical sealing materials shall be in strict accordance with the manufacturer's recommendations.

1.3 QUALITY ASSURANCE

A. All chemical sealing materials used in the performance of the work specified must have the following properties and characteristics:

1. While being injected, the chemical sealant must be able to react/perform in the presence of water.
2. The cured material must be capable of withstanding submergence in water without degradation.
3. The resultant sealant formation must prevent the passage of water.
4. The sealant material, after curing, must be flexible as opposed to brittle or rigid.
5. In place, the resultant sealant formation should be able to withstand freeze/thaw and wet/dry cycles without adversely affecting the seal.

6. The sealant formation must not be biodegradable. Additives may be used to meet this requirement.
7. The cured sealant should be chemically stable and resistant to concentrations of acids, alkalis, and organics found in normal sewage.
8. Packaging of component materials must be compatible with field storage and handling requirements. Packaging must provide for worker safety and minimize spillage during handling.
9. Mixing of component materials must be compatible with field operations and not require precise measurements.
10. Clean-up must be done without inordinate use of flammable or hazardous chemicals.
11. Residual sealing materials must be removable from the sewer after injection to insure no flow reduction, restriction, or blockage of normal sewage flows.
12. Chemical sealants shall be free of byproducts that may be released after curing that may infiltrate into groundwater or the flow within the sewer. The Contractor must provide documentation from manufacturer stating the chemical materials are safe to use in stormwater sewer applications and that no banned or unsafe chemicals will be released during the injection process or after the materials fully cure.

PART 2 - PRODUCTS

2.1 CHEMICAL SEALING MATERIALS

A. The following is a generic listing of chemical sealing materials currently in use and the basic requirements, properties and characteristics of each:

1. Acrylamide base gel chemical sealing material requirements, properties and characteristics:

    a. A minimum of ten percent (10%) acrylamide base material by weight in the total sealant mix. A higher concentration of acrylamide base material may be used, when desirable, to increase strength or offset dilution during the induction period.
    b. The ability of tolerate some dilution and react in moving water during the induction period.
    c. A viscosity of approximately two (2) centipoise which can be increased with additives.
    d. A constant viscosity during the induction period.
    e. A controllable reaction time (induction period) from ten (10) seconds to one (1) hour.
    f. A reaction (curing) which produces a homogeneous, chemically stable, nonbiodegradable, firm, flexible gel.
    g. The ability to increase mix viscosity, density and gel strength by the use of additives, e.g.: diatomaceous earth.

2. Single component polyurethane base foam chemical sealing material requirements, properties, and characteristics:
    a. Single component prepolymer base
    b. A liquid prepolymer having a specific gravity of 1.12 (9.35 pounds per gallon), and flash point of 20°F.
    c. A liquid prepolymer having a viscosity of 100 to 200 centipoise at 70°F that can be pumped through 500 feet of one-half (1/2) inch hose with a 500 psi head at a one (1) ounce/second flow rate.
    d. During injection; foaming, expansion, and viscosity increase take place.
    e. Physical properties of the cured foam of approximately; fifty five (55) pounds per cubic foot density, 110 to 140 psi tensile strength, and a confined expansion to forty (40) times its initial liquid volume.

3. Dual component polyurethane base foam chemical sealing material requirements
    a. Foam system shall be TerraThane 24-003 or approved equivilant
    b. Component A: Methylene diphenyl diisocyanate (MDI)
        1) specific gravity of 1.17.
        2) viscosity of 500 centipoise at 72°F.
    c. Component B: Resin
        1) specific gravity of 1.24.
        2) viscosity of 200 centipoise at 72°F.
    d. Physical properties of the cured foam of approximately; 5-7 pounds per cubic foot density, 100 to 120 psi tensile strength.

4. Urethane base foam chemical sealing material requirements, properties and characteristics:
    a. Approximately one (1) part of urethane prepolymer thoroughly mixed with one (1) part of water by weight (50% prepolymer).
    b. A liquid prepolymer having a solids content of eighty-two percent (82%) to eighty-eight (88%), specific gravity of 1.1 (9.15 pounds per gallon), and flash point of 20°F.
    c. A liquid prepolymer having a viscosity of 300 to 500 centipoise at 72°F that can be pumped through 500 feet of one-half (1/2) inch hose with a 500 psi head at a one (1) ounce/second flow rate.
    d. A cure time of 15.0 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, 3.5 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 take place.
    g. Physical properties of the cured foam of approximately; fourteen (14) pounds per cubic foot density, 80 to 90 psi tensile strength, and 700% to 800% elongation when a mixture of fifty percent (50%) prepolymer and fifty percent (50%) water undergoes a confined expansion to five times its initial liquid volume.

5. Urethane base gel chemical sealing material requirements, properties and characteristics:
    a. One (l) part prepolymer thoroughly mixed with between five (5) and ten (10) parts of water by weight. The recommended mix ratio is one (1) part urethane prepolymer to eight (8) parts of water (11% prepolymer).

b. A liquid prepolymer having a solids content of seventy-seven percent (77%) to eighty-three percent(83%), specific gravity of 1.04 (8.65 pounds per gallon), and flash point of 20°F.
c. A liquid prepolymer having a viscosity of 600 to 1200 centipoise at 70°F that can be pumped through 500 feet of one-half (1/2) inch hose with a 1000 psi head at a one (1) ounce/second flow rate.
d. The water used to react the prepolymer should be in the pH range of five (5) to nine (9).
e. A cure time of eighty (80) seconds at 40°F, fifty-five (55) seconds at 60°F, and thirty (30) seconds at 80°F when one (1) part prepolymer is reacted with eight (8) parts of water only. Higher water ratios give longer cure times.
f. A cure time that can be reduced five (5) to ten (10) seconds for water temperatures of 40°F to 80°F when one (1) part prepolymer is reacted with eight (8) parts of water containing gel control agent.
g. A relatively rapid viscosity increase of the prepolymer/water mix. Viscosity increases from about ten (10) to sixty (60) centipoise in the first minute for one (1) to eight (8) prepolymer to water ratio at 50°F.
h. A reaction (curing) which produces a chemically stable, nonbiodegradable, tough, flexible gel.
i. The ability to increase mix viscosity, density, gel strength and resistance to shrinkage by the use of additives to the water.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 330130.63A

SECTION 330130.72 – SPRAY IN PLACE PIPE LINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Other Sections Referenced:
   1. Section 330130.01 - Sewer Collection System Rehabilitation Definitions
   2. Section 330130.02 - Sewer Line Cleaning
   3. Section 330130.03 - Sewer Flow Control
   4. Section 330130.17 - Television Inspection
   5. Section 013323 – Shop Drawings, Product Data and Samples

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM - F1216 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
   2. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field
   3. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
   4. ASTM C78 – Flexural Strength of Concrete
   5. ASTM C109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens)
   6. ASTM C469 – Static Modulus of Elasticity & Poisson’s Ratio of Concrete Compression
   7. ASTM C496 – Splitting Tensile Strength of Cylindrical Concrete Specimens
   8. ASTM C666 – Freeze Thaw Durability
   9. ASTM C807 – Set Time of Hydraulic Cement Mortar
   10. ASTM C 868 – Standard Test Method for Chemical Resistance of Protective Linings
   11. ASTM C882 – Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
   12. ASTM C1090 – Shrinkage Test
   13. ASTM C1138 - Standard Test Method for Abrasion Resistance of Concrete (Underwater Method)
   14. ASTM C 1583/1583M – Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method
   15. ASTM C1898 – Standard Test Methods for Determining the Chemical Resistance of Concrete Products to Acid Attack
   16. ASTM C1904 – Standard Test Methods for Determination of the Effects of Biogenic Acidification on Concrete Antimicrobial Additives and/or Concrete Products
   17. ASTM D 4060 – Standard Test Method for Abrasion Resistance of Organic Linings by the Taber Abraser

18. ASTM D4414 – Standard Practice for Measurement of Wet Film Thickness by Notch Gages
19. ASTM D7682 – Standard Test Method for Replication and Measurement of Concrete Surface Profiles Using Replica Putty
20. ASTM F2304 – Standard Practice for Rehabilitation of Sewers Using Chemical Grouting
21. ASTM F2414 – Practice for Sealing Sewer Manhole Using Chemical Grouting
22. ASTM F2551 – Practice for Installing a Protective Cementitious Liner System in Sanitary Sewer Manholes

B. NACE International, (NACE)
1. NACE SP0188 – Standard Practice for Discontinuity (Holiday) Testing of Protective Linings
2. NACE No. 6/SSPC-SP13 – Surface Preparation of Concrete

C. Occupational Safety and health Administration, (OSHA)
1. Safety and health Standards (29 CFR 1910/1926)

D. The Society for Protective Coatings, (SSPC)
1. SSPC-SP13/NACE No. 6 – Surface Preparation of Concrete
2. SSPC-Guide 12 – Guide for Illumination of Industrial Painting Projects

1.3 DESCRIPTION OF WORK

A. The product furnished shall be a complete spray-applied-pipe-liner (SAPL) system including materials, equipment, and installation procedures. Submitted SAPL or multi-component products for consideration shall be required to meet the submittal requirements as contained herein.

B. The Contractor shall provide materials, labor, equipment, and design services necessary for traffic control (if required), bypass pumping and/or diversion of flows, cleaning, measurement and television inspection of sewers to be rehabilitated, SAPL installation, reconnection of service connections, quality controls, provide samples for performance of required material tests, final television inspection, testing of the rehabilitated pipe system, warranty work and other work, as specified herein.

C. The intent of SAPL is to rehabilitate sewer lines by installing mortar-based, single-component, or multi-component spray applied liner which, once cured, shall be continuous and tight-fitting in a constrained condition with a shear interface with the host throughout the entire length of the original pipeline. The SAPL shall extend the full length of the original pipeline and provide a structurally sound, jointless rehabilitation-solution with no annular space and permanent adhesion between the SAPL and the original pipeline (host pipe). The Contractor is responsible for proper, accurate and complete installation of the SAPL using the system selected by the Contractor meeting the Owners requirements and these specifications. Deficiencies which will be corrected by the finished product include:

1. Cracked and broken pipe caused by poor construction, unstable soil, earth movement, infiltration, roots, destructive loadings, cleaning tool damage, etc.
2. Corrosion of pipe caused by acid attack above the flow line.
3. Erosion of pipe caused by abrasion below the flow level.

4. Degradation of brick pipe caused by loss of masonry.
5. Infiltration of groundwater and soil through leaking pipe joints and structural defects.
6. Exfiltration of transported fluid through leaking pipe joints and structural defects.
7. Inflow of surface water and infiltration of groundwater through unused or illegal connections.

D. The SAPL system shall be designed for a life of 50 years or greater and an equal service life unless specifically specified otherwise by the Owner.

E. The installed SAPL system shall withstand all applicable surcharge loads (soil overburden, live loads, etc.) and external hydrostatic (groundwater) pressure, if present, for each specific installation location.

F. The installed SAPL system shall have a long term (50 year or greater) corrosion resistance to the typical chemicals found in stormwater runoff and defined in the referenced and applicable ASTM standards.

G. Neither the SAPL product, system, nor its installation, shall cause adverse effects to any of the Owner's processes or facilities. The installation pressure for the product shall not damage the system in any way, and the use of the product shall not result in the formation or production of any detrimental compounds or by-products at the wastewater treatment plant or to local receiving waters. The Contractor shall notify the Owner and identify any by-products produced as a result of the installation operations, test and monitor the levels, and comply with any and all local waste discharge requirements. The Contractor shall cleanup, restore existing surface conditions and structures, and repair any of the SAPL system determined to be defective. The Contractor shall conduct installation operations and schedule cleanup in a manner to cause the least possible obstruction and inconvenience to traffic, pedestrians, businesses and property owners or tenants.

1.4 QUALITY ASSURANCE

A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

B. Installer's Qualifications: Firms with at least 3 successfully completed projects having installed an aggregate total of 4,000 linear feet of the submitted manufacturer's SAPL.

C. Contractor shall submit a written plan with means and methos for installing specified SAPL system. Plan shall be called Performance Work Plan (PWS). This will be made available to the Engineer prior to approval of work and shall identify quality checks to be performed and installation crew qualifications.

D. The Contractor shall outline specific repair or replacement procedures for potential defects that may occur in the installed SAPL.Repair/replacement procedures shall be as recommended by the SAPL system manufacturer and shall be submitted as part of the PWS

E. Defects in the installed SAPL that will not affect the operation and service life of the product shall be identified and defined.

1.5 SUBMITTALS

A. Comply with all provisions of Section 013323 – Shop Drawings, Product Data and Samples

B. Manufacturer-certified copies of all test reports on each product used, including:
   1. Test results indicating the product conforms to and is suitable for its intended use per these specifications. Test reports shall be performed at the Licensed Applicator's expense and shall be carried out by an approved independent third-party testing laboratory or by a reputable independent testing body. As a minimum, the test reports should include properties listed in Paragraph 2.5 of this specification.

C. Submit Material Safety Data Sheet(s) for the materials, any other chemical additives, and any other chemicals used in the SAPL system.

D. Minimum Thickness Calculations with approvable design calculations, in accordance with manufacture's specifications, for ensuring that the installed SAPL meets the minimum thickness.

1.6 SAFETY

A. The Contractor shall conform to all work safety requirements of pertinent regulatory agencies and shall secure the site for the working conditions in compliance with the same. The Contractor shall erect such signs and other devices as are necessary for the safety of the work site.

B. The Contractor shall perform all of the work in accordance with applicable OSHA standards. Emphasis shall be placed upon the requirements for entering confined spaces and with the equipment being utilized for pipe renewal.

C. The Contractor shall submit a proposed Safety Plan to the Owner, prior to beginning any work, identifying all competent persons. The plan shall include a description of a daily safety program for the job site and all emergency procedures to be implemented in the event of a safety incident. All work shall be conducted in accordance with the Contractor's submitted Safety Plan.
   1. Safety plan shall include a notification of work flyer that will be distributed to all properties connected to the sewer that will be worked on. Notification shall include details of work, dates for expected installation of SAPL, and best measures for preventing fumes from SAPL curing from entering through connected laterals.

D. Compensation for all work required for the submittal of the Safety Plan shall be included in the various pipelining items contained in the bid proposal.

1.7 STORAGE OF MATERIALS

A. Deliver materials in original containers with seals unbroken and labels intact and free of moisture. Do not use materials that have been directly exposed to moisture or if there is visible damage to the packaging.

B. Project materials shall be inspected by the Contractor upon receipt and the Bill of Lading reviewed to confirm it properly documents amount(s) and type(s) of material(s) received, date and time of delivery as well as the shipping company delivering the material. Contractor shall log and make available for review Bill of Lading and material batch numbers upon receipt of the material(s). Receipt of material should also be noted in daily activity logs.

C. Materials may be stored offsite, such as in a yard, for a period prior to use on the project. Upon delivery to the project, Contractor shall designate a specific protected space at the project site for staging and mixing materials. Do not store kerosene, gasoline, or other flammable liquids in this space. Remove oily rags at the end of each day's work. Regardless of storage location, materials used for rehabilitation are to be kept dry, protected from weather, and stored under cover within the temperature ranges recommended by the Manufacturer. Products are to be stored and handled according to their SDSs or appropriate classification. Damaged or unsuitable products shall be promptly

1.8 AS-BUILT DRAWINGS/RECORDS

A. Digital copies of As-Built drawings/records and pre & post inspection videotapes shall be submitted to the Owner via a USB or email, by the Contractor, within 2 weeks of final acceptance of said work or as specified by the Owner. As-Built drawings/records will include the identification of the work completed by the Contractor and shall be prepared on one set of Contract Drawings/Records provided to the Contractor at the onset of the project.

1.9 WARRANTY

A. The materials used for the project shall be certified by the manufacturer for the specified purpose. The Contractor shall warrant the SAPL material and installation for a period of one (1) year. During the Contractor warranty period, any defect which may materially affect the integrity, strength, function and/or operation of the pipe, shall be repaired at the Contractor's expense in accordance with procedures as recommended by the manufacturer.

B. After a pipe section has been rehabilitated and for a period of time up to one (1) year following completion of the project, the Owner may inspect all or portions of the rehabilitated system. The specific locations will be selected at random by the Owner's inspector and should include all sizes of SAPL from this project. If it is found that any of the SAPL has developed abnormalities since the time of "Post Construction Television Inspection," the abnormalities shall be repaired and/or replaced in accordance with plans, specifications, and Owner standards.

C. On any work completed by the contractor that is defective and/or has been repaired, the contractor shall warrant this work for (1) year in addition to the warranty required by the contract.

1.10 GENERAL

A. All equipment and material shall be of a type that has been generally been in use for a period of five (5) years. Work performed with experimental equipment or material will not be permitted without prior written consent of the Owner.

PART 2 - MATERIALS

2.1 MATERIALS

A. The SAPL system must meet the physical performance requirements of these contract documents.

B. All materials used in the installation of SAPL system shall be equal to or exceed the manufacturer's standards.

C. Minimum Design Properties

1. The Contractor shall provide a detailed calculation using the appropriate methods and standards to determine the thickness of the SAPL system so that it meets minimum design criteria listed below:
    1) All pipe shall be considered fully deteriorated.
    2) All pipe shall be subjected to soil loads of 120 pounds per cubic foot.
    3) All pipe shall be subject to AASHTO HS-20 highway loading.
    4) The water table shall be assumed to be five (5) feet below the ground surface.
    5) All pipe shall be assumed to have five percent (5%) ovality.
    6) Creep Retention Factor 50%.
    7) Constrained Soil Modulus per AASHTO LRFD Section 12 and AWWA Manual M45.
    8) Minimum Service Life 50 years.
    9) Design Safety Factor of 2.0 (1.5 for pipes 36” or larger)

D. Minimum Thickness

1. *Design thickness for cementitious or geopolymer liner shall at a minimum be the following unless otherwise specified on drawings or submitted by the Contractor and approved by the Engineer:*

Diameter/Span of Pipe	*Min. Liner Thickness*
54 inch or less	*1.0 inch*
54 inch < D < 96 inch	*1.5 inch*
96 inch or greater	*2.0 inch*

2. For non-corrugated host pipe materials, conduit materials, the minimum design thickness shall be measured from the interior face of the host conduit wall
3. For corrugated host pipe materials, the minimum thickness shall be measured from the peaks/crests of the corrugation. The corrugations shall be filled to create a flush, smooth pipe surface.
4. If the minimum thickness exceeds that of the calculated thickness provided by the Contractor, the minimum thickness for shall govern as the design thickness for the SAPL system.

E. Physical Properties

The cured pipe material shall conform to the minimum structural standards as listed below. Evidence shall be presented to demonstrate that the long-term modulus of elasticity of the cured product is no less than fifty percent (50%) of the herein specified Modulus of Elasticity (Short-term).

CEMENTIOUS AND GEOPOLYMER MINIMUMAL PHYSICAL PROPERTIES

Cured Pipe Material Test	Test Method	Performance Value
Compressive Strength	ASTM C39	Min. 8,000 psi @ 28 days
Flexural Strength	ASTM C78	Min. 800 psi @ 28 days
Modulus of Elasticity	ASTM C469	Min. $3.9x10^6$ psi @ 28 days
Split Tensile Strength	ASTM C496	Min. 700 psi @ 28 days
Freeze Thaw Durability	ASTM C666	Max 0.5% loss @ 300 cycles
Bond Strength to Concrete	ASTM C882	Min. 2,500 psi @ 28 days
Shrinkage Test	ASTM C1090	Max 0.02% loss @ 28 days
Abrasion Resistance	ASTM C1138	Max 36.3 in^3 total vol. loss @ 6 cycles on 28-day sample

F. Approved SAPL system are listed below. Alternative products may be accepted if they are considered equivalent and meet or exceed the specifications detailed in this section.
   1. Quadex Lining System with Geokrete Geopolymer by Vortex Companies
   2. GeoSpray HCE geopolmer system by Geotree Solutions

PART 3 - EXECUTION

3.1 PREPARATORY PROCEDURES

A. The Contractor shall notify all homeowners on the manhole section to be lined forty-eight (48) hours in advance of the work to be done. The Contractor shall inform the homeowner of precautions necessary to prevent backup of sewage into the house. Notification shall include language that the work may extend beyond normal permitted working hours, if necessary to reinstate service laterals

B. The following preparatory procedures shall be adhered to unless otherwise approved by the Engineer:
   1. Cleaning of Sewer Line: Before ordering liner materials for the project, the Contractor shall remove all internal debris from the pipeline that will interfere with the installation and the final product delivery of the SAPL materials, as required in these specifications, and accurately measure and document the exact size of the existing pipeline to be rehabilitated. Solid debris and deposits shall be removed from the system and disposed of properly by the Contractor. Moving material from manhole section to manhole section shall not be allowed. As applicable, the contractor shall either plug or install a flow bypass pumping system to properly clean the pipelines. Precaution shall be taken by the Contractor in the use of cleaning equipment to avoid damage to the existing pipe. The repair of any damage, caused by the cleaning equipment, shall be the responsibility of the Contractor. The Owner will designate a site for the disposal of all debris removed from the Owner's sewer system as a direct result of the cleaning operation. Unless otherwise specified by the Owner, the Contractor shall dispose of all debris at no charge. Should any dumping fees apply, the Contractor shall be compensated at the respective unit price bid in the Proposal for cleaning.

2. Inspection of Sewer Line: In accordance with the Television Inspection requirements, the Contractor shall televise the pipe with PACP certified personnel specially trained in locating breaks, obstacles, and service connections. The interior of the sewer line shall be carefully inspected to determine the location and extent of any structural failures. The location of any conditions which may prevent proper installation of the SAPL shall be noted so that such conditions can be corrected. The Contractor shall provide the Owner a copy of the pre-cleaning and post-cleaning video and suitable log, and/or in digital format, for review prior to installation of the SAPL and for later reference by the Owner.
3. Connections: While televising the mainline sewer, the Contractor shall accurately measure and record the locations and positions of service connections using a fiberglass or other tape approved by the Engineer. Additionally, the Contractor shall utilize the pan and tilt capabilities of the televising equipment to determine which connections are live (active) and which are not in use. If required by the Contract documents, each connection will be dye tested to determine whether the connection is live or abandoned.
4. Bypassing Sewage: The Contractor shall provide for the flow of existing mainline and service connection effluent around the section or sections of pipe designated for SAPL installation. With most small diameter pipelines, particularly on terminal sewers, plugging will be adequate but must be monitored on a regular basis to prevent backup of sewage into adjacent homes. Service connection effluent may be plugged only after proper notification to the affected residence and may not remain plugged overnight. Installation of the liner shall not begin until the Contractor has installed the required plugs or a sewage bypass system and all pumping facilities have been installed and tested under full operating conditions including the bypass of mainline and side sewer flows. Once the installation has begun, existing flows shall be maintained, until the resin/tube composite is fully cured, cooled down, full televised and the SAPL ends finished. The Contractor shall coordinate sewer bypass and flow interruptions with the Owner at least 14 days in advance and with the property owners and businesses at least 1 business day in advance. The pump and bypass lines shall be of adequate capacity and size to handle peak flows. The Contractor shall submit a detail of the bypass plan and design to the Owner before proceeding with any SAPL installation. Compensation for bypass pumping and all associated plans and approvals shall be at the price bid in the Proposal. All bypassing of flow shall be performed as specified under 330130.03 - SEWER FLOW CONTROL.
5. Line Obstructions: It shall be the responsibility of the Contractor to clear the line of obstructions such as solids, dropped joints, protruding service connections, or collapsed pipe that will prevent installation. If the obstruction(s) could have been removed by bucket machines or by using conventional cleaning methods, no compensation will be granted.
    a. Internal repairs are protruding service connections, dropped portions of pipe which can be removed or pushed back in place, and other obstructions which cannot be cleared using conventional cleaning methods, but which can be cleared from within the pipe. Such internal repairs shall be approved in writing by the Engineer prior to the commencement of the work and shall be considered as a pay item.
    b. Point repairs are obstructions that cannot be removed by either conventional sewer cleaning equipment or by internal equipment. The Contractor shall make an excavation to expose and remove or repair the obstruction. Such excavation

shall be approved in writing by the Engineer prior to the commencement of the work, shall be performed as specified under Point Repairs, and shall be considered as a pay item.

c. Patching shall be performed at locations where holes or soil are visible within the pipe, but the pipe is otherwise in a condition that it is able to have the SAPL system applied. The Contractor shall apply patching material that is able to properly fill any holes and voids, be smoothened to match the existing pipe surface once cured, and properly adhere to the SAPL. Such work shall be approved in writing by the Engineer prior to the commencement of the work and shall be specified under Patching or Joint Repair, and shall be considered its own pay item(s).

6. Pre-Insertion Television Inspection: The Contractor shall televise and record the sewer pipe immediately before installing SAPL. This televising is to assure that the pipe is clean and existing pipe conditions are acceptable for lining. Should additional cleaning be required, it shall be provided at no additional cost to the Owner. The cost of this televising shall be included in the cost of SAPL.

3.2 INSTALLATION PROCEDURES

A. The liner shall be mixed, installed, and cured (as applicable) in the host pipe per the manufacturer's specifications as described and submitted in the PWS. For non-water based SAPL, materials shall be mixed (when applicable) with the SAPL manufacturer's recommendations component ratio, mix time, temperature, dispersion, and other requirements. Appropriate documentation shall be kept in a Daily Application Log throughout the installation process. The mixing and preparation operations must be performed so that the minimum amount of dust is released into the surrounding environment.

B. The SAPL installation shall be in accordance with the applicable ASTM/ACI standards and manufacturer's instructions.

C. The SAPL material may be spray applied and/or centrifugally spin-cast to the inside of an existing pipeline or structure depending on size of pipe and manufacturer application requirements. The necessary equipment and application methods to apply the liner materials shall be only as provided by the SAPL material manufacturer. Material shall be mixed in accordance with manufacturer's recommendations to proper consistency, then the materials shall be pumped through a high-pressure material hose for delivery to the appropriate and / or selected application device.

D. The Manufacturer's recommended cure instructions (as applicable) shall be strictly adhered to and reviewed with Engineer prior to application.

3.3 FINISH

A. The installed SAPL shall be continuous over the entire length of a lined section (unless specified) and be free from visual defects such as foreign inclusions, infiltration) major surface profile deviation and delamination. The SAPL shall be impervious and free of any leakage through the SAPL wall.

B. Defects that affect the structural integrity or strength of the SAPL shall be repaired at the Contractor's expense in accordance with the procedures submitted under Section 1.4

C. Using the records from the pre-construction inspections, the Contractor shall ensure that connections are properly reinstated and service restored. Excess SAPL material at the connection shall be removed and disposed to an approved waste facility by the Contractor. The Contractor shall ensure that no infiltration is originating at the point of connection by sealing any leaks with appropriate product(s). The laterals and pipe connections shall then be completed by hand, applying the SAPL to the outer surface of the connection to the pipe and smoothly tapering it into the lateral or connecting pipe. No rough edges or abrupt transitions that could catch debris or hinder the flow shall remain.

D. Termination of the SAPL at the end of a pipe or manhole shall be completed by hand applying the SAPL to the outer surface of the pipe or into the interior of the manhole.

3.4 TESTING OF INSTALLED SAPL

A. The physical properties of the installed SAPL shall be verified through field sampling and laboratory testing. Mixed materials for testing shall be furnished by the Contractor to the testing laboratory for sample preparation at the job site, transport to the lab and testing. Sample preparation, transport and materials testing shall be performed at the Contractor's expense by an independent third-party laboratory selected by the Contractor as recommended by the SAPL manufacturer. All tests shall be in accordance with applicable ASTM test methods to confirm compliance with the requirements specified in these contract documents.

B. The Contractor shall provide mixed material samples from the actual installed SAPL for sample preparation to the testing laboratory. Samples shall be provided from the first and last day of installation and every 42,000 lbs | 19,050 kg of material during application of SAPL or as required by the Owner. The sample shall be collected from the mixer/hopper or if appropriate, the end of the application hose. Sample collection and testing hold times will be per manufacturer's recommendations.

C. For ASTM C39 Compressive samples, it is recommended that nine (9) four (4) by eight (8) inch | 100 x 200 mm test cylinders be prepared following ASTM C 31. Alternatively, ASTM C109 Compressive samples in the form of two (2) by two (2) by two (2) | 50 x 50 x 50 mm test cubes can be prepared. It is recommended that three (3) samples be tested at 7 days, three (3) at 28 days and three (3) retained as directed by the Contractor

D. The laboratory results shall identify the project, the test sample date, location as referenced to the nearest manhole and station, product batch and mix information. Final payment for the project shall be withheld pending receipt and approval of the test results. If properties tested do not meet the minimum physical and thickness requirements, the SAPL shall be repaired or replaced by the Contractor unless the actual physical properties and the thickness of the sample tested meet the design requirements as required in the contract.

E. The installed SAPL thickness shall be confirmed during application through the visual observation and monitoring of the permanent depth gauges and use of a handheld depth gauge by the installer. Pre- and Post-installation video should show the presence of the depth gauge (pre) and coverage of the depth gauge indicated by it no longer being visible (post).

F. Visual inspection of the installed SAPL lining for installation defect to include cracks, infiltration, surface texture and spray defects.

G. Adhesion testing shall be performed for SAPL systems that have been applied to steel or concrete hose pipes. Testing shall be in accordance with ASTM D4541 or ASTM D7234 and performed based on manufacturer guidelines for quality assurance.

H. All costs to the Contractor associated with providing mixed SAPL material to an independent third-party testing laboratory for sample preparation, transport, curing and testing shall be included in the Lump Sum price bid for Mobilization.

3.5 FINAL ACCEPTANCE SAPL.

A. A visual inspection should be made by Owner and Contractor periodically throughout the progression of construction, prior to the completion of a lining stage. Any deficiencies in the finished lining shall be marked and repaired by the Contractor according to the procedures set forth herein.

B. SAPL sample testing and repairs for the installed SAPL, as applicable, shall be completed before final acceptance, meeting the requirements of these specifications, and documented in written form.

C. The Contractor shall perform an internal pipe inspection per PACP requirements in the presence of the Engineer after installation of the SAPL and reconnection of the side sewers. Unedited digital documentation of the inspection shall be provided to the Owner within ten (10) working days of the SAPL installation acceptance.

D. Flow control from the upstream manhole shall be utilized to minimize sewage or stormwater from entering the line during the inspection. In the case of bellies in the line, the pipe shall be cleared of any standing water to provide continuous visibility during the inspection.

E. After the installation work has been completed and all testing acceptable, the Contractor shall clean up the entire project area. All excess material and debris not incorporated into the permanent installation shall be disposed of by the Contractor. Any leaks through the wall of the pipe shall be repaired.

END OF SECTION 330130.72

SECTION 334100 - STORM DRAINAGE SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. Furnishing all labor, materials, tools, equipment, and services for all storm sewers as shown on the Drawings.

B. Although such is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a functional and complete installation.

1.2 RELATED DOCUMENTS AND SECTIONS

A. Section 013543 – Environmental Protection

B. Section 013319 – Field Testing Requirements

C. Section 310000 - Earthwork

1.3 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Granular pipe bedding and cover material specified in Section 310000 - Earthwork

B. Special backfill material specified in Section 310000 - Earthwork

1.4 SUBMITTALS

A. Product Data
   1. PVC pipe, each type specified
   2. Polyethylene pipe
   3. Reinforced concrete pipe, each type specified
   4. Inlet castings & grates
   5. Precast concrete manholes and inlets

B. Shop Drawings
   1. Precast concrete manholes showing:
      a. Orientation plan for each manhole or inlet indicating where all pipes connect.

b. The size and elevation of connecting pipes.
c. Details of drop connections.
d. Invert concrete channeling details.
e. Pipe to manhole connection details.
f. Casting and step orientation.

2. Precast concrete inlets

C. Samples

D. Quality Control Submittals
1. Design Data
2. Test Reports
3. Certificates
a. Evidence of current membership in specified manufacturer's associations.
b. Evidence of ODOT precertification for the manufacturing RCP pipe.
c. Evidence of National Precast Concrete Association (NPCA) certification for the manufacture of precast concrete manholes, inlets and catch basins.
4. Manufacturers Instructions

E. Contract Closeout Submittals
1. Project Record Documents
2. Operation and Maintenance

1.5 REFERENCES

A. ASTM A-48 Standard Specification for Gray Iron Castings

B. ASTM A-536 Standard Specification for Ductile Iron Castings

C. ASTM C-76 Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

D. ASTM C-139 Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes

E. ASTM C-150 Standard Specification for Portland Cement

F. ASTM C-270 Standard Specification for Mortar for Unit Masonry

G. ASTM C-425 Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings

H. ASTM C-443 Standard Specifications for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

I. ASTM C-478 Standard Specifications for Precast Reinforced Concrete Manhole Sections

J. ASTM C-507 Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe

K. ASTM C-700 Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated

L. ASTM C-990 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

M. ASTM C-1173 Standard Specification for Flexible Transition Couplings for Underground Piping Systems

N. ASTM D-2321 Standard Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe

O. ASTM D-3034 Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

P. ASTM D-3212 Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

Q. ASTM F-477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

R. ASTM F-679 Standard Specification for Poly(Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings

S. ASTM F-1336 Standard Specification for Poly(Vinyl Chloride) (PVC) Gasketed Sewer Fittings

T. ANSI/AWWA C111/A21.11 American National Standard for Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

U. ANSI/AWWA C151/A21.51 American National Standard for Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water and Other Liquids

V. AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., for Water Distribution

W. State of Ohio - Department of Transportation - Construction and Material Specifications as amended to date, Item 703.03, Fine Aggregate for Mortar or Grout.

AA. State of Ohio - Department of Transportation - Construction and Material Specifications as amended to date, Item 706.04, Reinforced Concrete Elliptical Culvert, Storm Sewer, and Sewer Pipe.

AB. State of Ohio - Department of Transportation - Construction and Material Specifications as amended to date, Item 706.10, Bituminous Pipe Joint Filler

AC. State of Ohio - Department of Transportation - Construction and Material Specifications as amended to date, Item 706.13, Precast Reinforced Concrete Manhole Riser Sections, Catch Basin and Inlet Tops, and Temporary Barrier

AD. State of Ohio - Department of Transportation - Construction and Material Specifications as amended to date, Item 707.33, Corrugated Polyethylene Smooth Lined Pipe

1.6 QUALITY ASSURANCE

A. Qualifications

B Regulatory Requirements

C. Certifications

D. Field Samples

E. Pre-Installation Conference

1.7 PROJECT CONDITIONS

A. Environmental Requirements

B. Existing Conditions
1. Verify locations of underground utilities.
2. Protect existing structures and utilities from damage. Repair if damaged by this work.
3. Do not change pipe sizes without securing written approval of Engineer.

C. Field Measurements
1. If it becomes necessary to change location of storm drainage lines due to underground utility interference, secure approval of Engineer.
2. If Contractor initiated, make changes approved by the Engineer without added cost to Owner.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping

B. Acceptance at Site

1. All material and all equipment shall be subject to visual inspection and acceptance or rejection after delivery to the site of the work. All rejected material shall immediately be removed from the site.

C. Storage and Protection

1.9 SEQUENCING AND SCHEDULING

A. Perform no pipe work in fill areas until embankment or fill has been completed to at least two (2) feet above proposed top of pipe and fill has been properly compacted.

PART 2 - PRODUCTS

2.1 PIPE

A. Polyvinyl Chloride Pipe (PVC) 4" - 15" Diameter
1. All polyvinyl chloride pipe in this size range shall conform to ASTM D-3034 (*SDR 26*), shall be integral bell and spigot type, with joints conforming to ASTM D-3212 and elastomeric seals conforming to ASTM F-477.
2. All pipe and fittings shall be marked or stenciled in conformance with ASTM D-3034. All gaskets shall be marked or stenciled with the ASTM specification designation, name or trademark of the manufacturer, and pipe size.
3. Acceptable manufacturers shall be current members of the Uni-Bell Plastic Pipe Association.

B. Corrugated Polyethylene Pipe 12" Diameter and Larger
1. All corrugated polyethylene pipe in this size range shall be smooth lined conforming to ODOT 707.33. All pipe and fittings shall be marked or stenciled with the appropriate classification.

D. Reinforced Concrete Pipe
1. All reinforced concrete circular pipe shall be Class III pipe, conforming to ASTM C-76. Joints shall conform to the requirements of ASTM C-443 as it pertains to the use of confined O-Ring rubber gaskets placed in grooves cast in the spigot of the pipe such that the gaskets will be enclosed on all sides when the pipe is laid and the joint is completed. Cement used in manufacturing pipe and fittings shall be Type I conforming to ASTM C-150.
2. All pipe and fittings shall be marked or stenciled with the applicable ASTM specification designation on the interior surface of the pipe. All gaskets shall be marked or stenciled with the ASTM specification designation, name or trademark of the manufacturer, and pipe size.
3. Acceptable manufacturers shall be precertified by the Ohio Department of Transportation for the type of pipe specified.

2.2 PRECAST REINFORCED CONCRETE MANHOLE RISER SECTIONS, INLETS AND CATCH BASINS

A. All precast concrete units shall conform to ASTM C-478 and ODOT Item 706.13.

B. Joints between manhole units shall be gasketed and shall comply with the requirements of ASTM C-443. All gaskets shall be marked or stenciled with the ASTM specification designation, name or trademark of the manufacturer, and pipe size.

C. Joints between inlet or catch basin sections shall be sealed with material conforming to ODOT Item 706.10.

D. The standard length of manhole riser units shall be 48 inches. Lengths of 32 inches or 16 inches shall be used to meet required dimensions.

E. Openings for connecting pipes in riser units, bottom riser units, integral base units, and for access in flat slabs shall be preformed or cored by the manufacturer. Cut-out openings shall be made immediately after the pipe is removed from the casting form.

F. Connectors between new precast concrete manholes and pipes shall be made by casting the connector integrally with the manhole wall. The connectors shall be "X-Cel" Type as manufactured by A-Lok Products; or an approved equivalent.

G. All openings in existing manholes, inlets or catch basins shall be field cored.

H. Annular spaces at pipe entrances shall be field sealed with a one component, hydraulic cement based, fast setting repair mortar equal to Thoro Products Waterplug as manufactured by ChemRex Inc., Shakopee, MN.

I. The top four (4) inches to twelve (12) inches of the manhole shall provide for adjustment of casting to grade. Adjustment shall be through the use of a maximum of two (2) precast concrete adjusting collars.

J. Precast concrete shall be manufactured by an NPCA certified plant.

2.4 PVC INLETS AND CATCHBASINS

A. All PVC inlets shall be manufactured from PVC pipe stock conforming to ASTM D-3034 and ASTM F-1336, using a thermo-molding process to reform the pipe stock to the configuration shown on the Drawings. The connection stubs shall conform to ASTM 3212.

2.5 MANHOLE STEPS

A. All steps shall be minimum of twelve (12) inches in width with safety side lugs to prevent slipping and shall conform to the latest OSHA requirements. Manhole steps shall be of polypropylene plastic reinforced with a 3/8", No. 60 grade epoxy coated reinforcing rod.

B. Manhole steps shall conform to the requirements of ASTM C-478.

C. Acceptable manufacturers are:
   1. American Step Company, Inc.
   2. Lane International, Inc.
   3. M. A. Industries, Inc.

2.6 CASTINGS

A. All castings shall be true to pattern and free from cracks, gas holes, flaws and excessive shrinkage. Surfaces shall be free from burnt-on sand and shall be reasonably smooth. Runners, fins, risers and other cast-on pieces shall be removed. Castings for frames, grates, covers and for any other purpose under these specifications shall conform to all the requirements for Class No. 35B for Gray Iron Castings conforming to ASTM A-48. All castings shall be commercially machineable and, in the case of manholes, the frame and cover shall be so machined that it will be impossible to rock the cover after it has been seated in the proper position in the frame.
   1. Frames, grates and covers shall be as detailed on the Drawings.

B. Acceptable manufacturers are:
   1. East Jordan Iron Works
   2. Neenah

C. Castings for PVC inlets shall meet the requirements of Paragraph A above, except that castings may be ductile iron conforming to ASTM A-536 grade 70-50-05 and shall be supplied by the inlet manufacturer.

2.7 COUPLINGS

A. Couplings for connecting dissimilar pipe materials or pipe sizes shall be a rubber type coupling with a sealing "O" ring under each of two sealing clamp bands and a Type 316 stainless steel shear ring. Coupling shall be manufactured with natural and synthetic rubbers conforming to ASTM C 425 and ASTM C 1173.

B. Coupling shall be Flex-Seal Adjustable Repair Coupling as manufactured by the Mission Rubber Company, Corona, CA, or approved equal.

PART 3 - INSTALLATION

3.1 ALIGNMENT AND GRADE

A. Horizontal and Vertical Control
   1. All horizontal and vertical control required for the complete layout and performance of the Work under this contract shall be done by a registered surveyor at the Contractor's expense, and any observations by the Engineer of the Contractor's methods will not relieve the Contractor of his responsibility.
   2. The Contractor shall be solely responsible for the accuracy of all horizontal and vertical control.

B. Alignment and grade shall be established by means of a laser beam.

C. The Contractor shall furnish all material and labor to establish line and grade of the generated laser beam from the benchmarks and control points indicated on the Drawings. The laser shall be securely anchored and checked periodically by the Contractor. The laser calibration shall be demonstrated when requested by the Engineer. Strict adherence to the manufacturer's operation procedure shall be observed. Only qualified and trained employees may be assigned to install, adjust, or operate laser equipment, and proof of qualifications of the equipment operator must be available at all times. Areas in which lasers are used must be posted with standard laser warning placards, and the laser beam shall be turned off when not needed. During rain, snow, dust, excessive heat, or fog the operation of laser systems shall be prohibited where practicable because of beam scatter.

3.2 PIPE INSTALLATION

A. All pipe installation shall conform to the trench and bedding details shown on the Drawings.

B. PVC pipe shall be installed in full compliance with ASTM D-2321. Clay pipe shall be installed in full compliance with ASTM C-12. All concrete pipe shall be installed in conformity with recommended practices published by the American Concrete Pipe Association in the "Concrete Pipe Installation Manual".

C. Only one type and strength of pipe shall be used between any two consecutive manholes, unless otherwise shown on the Drawings.

D. After the trench has been excavated and the pipe bedded , the pipe shall be laid to the line and grade as shown on the Drawings. All joints shall be made as hereinafter specified. In no case shall any material except bedding material be placed under the bell of the pipe to secure proper grade.

E. Prior to being lowered into the trench, each pipe shall be carefully inspected and those which are damaged or not meeting the specified requirements shall be rejected and clearly marked as rejected and removed from the Work. Satisfactory means shall be used to hold the pipe in line until embedment of pipe is complete.

Precautions shall be taken to insure that the spigot end of the pipe being laid is pushed the proper depth into the bell of the preceding pipe.

F. All conduit shall be laid starting at the outlet end and laid with the bell end upstream.

G. In no case shall more than thirty (30) feet of trench be opened in advance of the pipe laying operations.

H. Conduit shall not be laid in water, mud, or any otherwise unsuitable trench No drainage shall run through the newly laid pipe. All sewers shall be temporarily capped with a watertight seal at the open ends at the completion of each day's work and no drainage water shall be permitted to flow through the sewer.

I. All trenches and excavations shall be backfilled as specified as soon as possible after the pipe is laid and jointed. Where concrete encasement or cradle is used, pipe shall not be backfilled for at least twenty four (24) hours after placing concrete except that pipe may be covered to a depth of not to exceed sixteen (16) inches over the top of the pipe.

3.3 JOINTING

A. Concrete Pipe
   1. Dust, dirt and foreign matter shall be removed from joint surfaces. A lubricant as furnished or recommended by the gasket manufacturer shall be applied to the gasket and joint surfaces with a brush, cloth pad, sponge or glove. For all gaskets not cemented to the pipe, a smooth round object shall be inserted under the gasket and run around the circumference two or three times to equalize stretch in the gasket. No jute or other caulking will be permitted. The spigot shall then be entered into the socket and the pipe shoved home in an approved manner to fully complete the particular type of joint which is being used.
   2. When laying the pipe in concrete bedding, care shall be exercised to prevent the joint materials from coming in contact with the fresh concrete until after the joint has been completed.

B. Corrugated Polyethylene Pipe
   1. Corrugated polyethylene pipe shall be jointed using split couplers. The ends of pipe to be joined must be cut along the centerline of the valleys of the annular corrugations. The gasket shall be placed in the first full corrugation valley. The coupler shall be placed in position on the pipe in the trench. The next pipe shall be brought up against the first and aligned with the corrugations on the coupler. A check on the pipe and coupler should be made to ensure that no foreign material is present to interfere with the connection. The coupler shall then be snugged around the pipes and secured with bands. The coupler shall be wide enough to cover two (2) pipe corrugations on each side of the joint.

3.4 PERMISSIBLE DEFLECTION AT JOINTS

A. No pipe deflections or springing of joints, to effect a change in direction will be allowed, except by permission or direction of the Engineer, or as shown on the Drawings. Any permitted or directed deflection shall be a maximum of 80 percent of the allowable deflection value established by the pipe manufacturer.

3.5 MANHOLES

A. Build each manhole to dimensions shown on Drawings and at such elevation that pipe sections built into wall of manhole will be true extensions of line of pipe.

B. Set frames for manholes, within areas to be paved, to final grade. In asphalt pavement, surround frames set to grade with a ring of compacted asphalt concrete base material immediately after backfilling operations are complete. Place asphalt concrete mixture up to one (1) inch below top of frame, slope to grade, and compact with hand tamp.

C. Storm manholes shall be constructed of precast concrete manhole sections, concrete masonry block, or concrete brick.

D. Precast Concrete Manholes
   1. Precast bases shall be placed on a bed of crushed gravel or crushed limestone, meeting AASHTO M 43 gradation, having a minimum thickness of three (3) inches. The bedding shall be compacted and provide uniform support for the entire area of the base.
   2. Provision shall be made for a minimum of four (4) inches and a maximum of twelve (12) inches of precast concrete grade rings between the uppermost precast section and the bottom of the cast iron manhole frame in order to set manhole cover to grade.
   3. No more than two lifting holes or other lifting devices shall be utilized for handling the precast sections. All lifting holes shall be acceptably sealed with a hydraulic cement based, fast setting repair mortar, meeting the requirements of Article 2.2 of this Section, prior to backfilling around the manhole.
   4. Inverts shall be formed to the equivalent of half-pipes in concrete and as follows:
      a. Carry concrete out to the manhole wall with a slope of ½ in./ft. from the top of the half-pipe.
      b. The bottoms of all manholes shall be channeled to conduct flow in the planned direction. Channels shall be the true shape of the lower half of the sewer pipe and shall match inverts of connecting pipe at the manhole wall.

3.7 INLETS AND CATCH BASINS

A. Catch basins and inlets shall be built in accordance with the Drawings. Precast units shall be placed on a sand bed having a minimum thickness of three (3) inches. The bedding shall be compacted and provide uniform support for the entire area of the base.

B. Set frames for catch basins and inlets, within areas to be paved, to final grade. Surround frames set to grade with a ring of compacted asphalt concrete base material immediately after backfilling operations are complete. Place asphalt concrete mixture up to one (1) inch below top of frame, slope to grade, and compact with hand tamp.

3.8 MAINTAINING FLOW

A. The Contractor shall be required to maintain the flow in all existing live sewers during construction and the method employed shall be approved by the Engineer.

3.9 REPLACING, MOVING AND REPAIRING OF EXISTING UTILITIES

A. The Contractor shall replace, move, support, or repair and maintain all pipes for water, steam, air or gas, and all wire conduit(s), and all other structures encountered in the work and repair all damage done to any of the said structures and appurtenances through his acts or neglect and shall keep them in repair during the life of the Contract. The Contractor shall in all cases leave them in as good condition as they were previous to the commencement of the work and to the full satisfaction of the Owner.

3.10 CONNECTION TO EXISTING SEWER SYSTEM

A. The Contractor shall make connections to the existing sewer system as shown on the Drawings. The connections shall be made by the Contractor at such hours that will cause the least disturbance to the flow in the existing sewer system. The Contractor, however, shall notify the Engineer at least five working days in advance of the time he desires to make the connections and no such connections shall be made until the permission of the Engineer is obtained.

3.11 CLEAN-UP

A. Before final acceptance for the Work, the Contractor shall clear the sewers of any mortar, dirt or other refuse that may have been left or accumulated in the sewers. All manholes and other structures shall be cleared of all forms, scaffolding, bulkheads, centering, surplus mortar, rubbish or dirt and left in a clean and proper condition.

3.12 DEFECTS TO BE MADE GOOD

A. If, at any time before the completion of the contract, any broken pipes, or any defects, are found in the storm sewers or in any of their appurtenances, the Contractor shall cause the same to be removed and replaced by proper material and workmanship, without extra compensation for the labor and material required. All materials shall be carefully examined by the Contractor for defects before placing and any found defective shall not be placed in the line.

END OF SECTION 334100