PART 1  GENERAL

1.1  SUMMARY

A.  Section Includes

1.  Pipe and utility subsurface investigations, test pits, which are required in order to properly locate, plan for and/or connect to the various existing pipelines.

B.  Related Sections

2.  Section 312333 – Trenching and Backfilling

3.  Section 321216 – Bituminous Concrete Pavement

1.2  REFERENCES

A.  29 CFR Part 1926 Subpart P - OSHA Excavation Regulations 1926.560 through 1926.562 including Appendices A through F

1.3  SOIL INVESTIGATION

A.  The Drawings show available data relative to existing underground pipe and utilities.

B.  During the course of the Work, excavate to locate various existing pipelines and utilities, where they are involved in the Work.

PART 2  PRODUCTS – NOT USED

PART 3

3.1  TEST PITS

A.  Excavate test pits as indicated, or as requested by the Owner. Expose the top of the pipeline, and adjacent utilities, at each test pit location.

B.  Perform test pits in accordance with the requirements of Section 312333, Trenching and Backfilling. Excavate the bottom 2 feet of the test pit by hand. Excavate to top of pipeline by hand. Test pits shall be braced, sheeted and dewatered or as otherwise required for safe excavation and examination of the structure or utility to be exposed.

C.  Measure the depth to the top of the pipeline, as well as to adjacent utilities, from the ground surface, at each test pit location. Record location, depth and size of pipelines and utilities uncovered during the test pits.

D.  Prior to test pitting operations, delineate the general scope of the excavation or boring on the paved surface of the ground using white paint, or stakes or other suitable white markings on non-paved surfaces and coordinate with the appropriate agencies in accordance state regulations. Pre-marking will not be acceptable if such marks can interfere with traffic or
pedestrian control or are misleading to the general public. Pre-marking will not be required of any continuous excavation that is over 500 feet in length.

E. Excavate test pits of an appropriate size with equipment suitable for the location and character of the pit to be excavated.

F. All subsurface investigations shall be conducted in accordance 29 CFR Part 1926 Subpart P - OSHA Excavation Regulations 1926.650 through 1926.652 including Appendices A through F.

G. After examination by the Engineer, backfill and compact the test pits in accordance with Section 312333.

H. Repair paved surfaces in accordance with Section 321216.

I. Repair lawn areas or grass surfaces.

END OF SECTION
PART 1  GENERAL

1.1  SUMMARY

A.  Section includes

   1.  Clearing and grubbing
   2.  Grading
   3.  Stripping and stockpiling of soil and sod

1.2  SUBMITTALS

A.  Submit construction methods and equipment that will be utilized for the clearing, grubbing, and waste material disposal specified within this Section.

PART 2  PRODUCTS – NOT USED

PART 3  EXECUTION

3.1  CLEARING AND GRUBBING

A.  Except as otherwise directed, cut, grub, remove and dispose of all trees, stumps, brush, shrubs, roots and any other objectionable material within the limits of the Work on the site and where required to construct the work.

B.  Protect trees or groups of trees, designated by the Engineer to remain, from damage by all construction operations by erecting suitable barriers, or by other approved means. Conduct clearing operations to prevent falling trees from damaging trees designated to remain.

   1.  All damage done to the trees by the Contractor’s operation shall be trimmed and painted where cut as directed or as necessary to provide adequate vertical clearance for construction activities. The dressing or paint shall be applied no later than two days after the cuts are made.

   2.  Use all necessary precautions to prevent injury to other desirable growth in all areas. Contractor shall assume full responsibility for any damage.

C.  Protect areas outside the limits of clearing from damage. No equipment or materials shall be stored in these areas.

D.  No stumps, trees, limbs, or brush shall be buried in fills or embankments.
3.2 DISPOSAL OF MATERIALS

3.3 REMOVE ALL TREE TRUNKS, LIMBS, ROOTS, STUMPS, BRUSH, FOLIAGE, OTHER VEGETATION AND OBJECTIONABLE MATERIAL FROM THE SITE AND DISPOSE OF IN A LEGAL MANNER.

A. Burning or direct burial of cleared and grubbed materials on-site will not be permitted.

3.4 GRADING

A. In preparation for placing loam, paved drives and appurtenances, perform grading to the lines, grades and elevations shown on the Drawings, and otherwise directed by the Engineer and perform in such a manner that the requirements for formation of embankments can be followed. All material encountered, regardless of its nature, within the limits indicated, shall be removed and disposed of as directed. During the process of grading, maintain the subgrade in such condition that it will be well drained at all times. Install temporary drains and drainage ditches to intercept or divert surface water that may affect the work when necessary.

B. If at the time of grading it is not possible to place material in its final location, stockpile material in approved areas for later use. No extra payment will be made for the stockpiling or double handling of excavated material.

C. The right is reserved to make minor adjustments or revisions in lines or grades if found necessary as the work progresses.

D. Stones or rock fragments larger than 4 inches in their greatest dimensions will not be permitted in the top 12 inches of the finished subgrade of all fills or embankments except along the access roadways and rip-rap where shown on the Drawings.

E. In cuts, loose or protruding rocks on the excavated slopes shall be barred loose or otherwise removed to line or finished grade of slope. Cut and fill slopes shall be uniformly dressed to the slope, cross-section and alignment shown on the Drawings or as directed by the Engineer.

3.5 DUTCH ELM WOOD

A. Dutch Elm diseased wood shall be disposed of in accordance with any local regulations.

B. Where the work includes the removal of elm trees or the limbs of elm trees, such trees or limbs thereof shall be disposed of immediately after cutting or removal and in such a manner as to prevent the spread of Dutch Elm disease. This shall be accomplished by covering them with earth to a depth of at least 6 inches in areas outside the right-of-way locations where the Contractor has arranged for disposal.
C. Where the work includes the removal and disposal of stumps of elm trees, such stumps shall be completely disposed of immediately after cutting in the manner specified above.

END OF SECTION
PART 1  GENERAL

1.1  SUMMARY

A. This section specifies the work to be performed by Contractor for abandonment of utilities at the Project Site.

B. Section Includes

1. Removal and abandonment of pipe, manholes and catch basins.

2. Abandonment of above- and below-grade utilities and related facilities including but not necessarily limited to electric, tel-data, CATV, conduits, utility structures sewerage, grease traps, drainage, gas, and water, fire protection on, or serving the Project Area as shown on the Drawings or indicated herein.

C. Contractor shall coordinate work between all Subcontractors, sections, and trades required for the proper completion of the work.

D. Contractor is responsible for the health and safety of all Subcontractor workers during progress of the work.

1.2  SUBMITTALS

A. Abandonment procedures required by the owner of each utility prior to performing the work of utility termination/cutting/capping/plugging.

B. Material specifications and shop drawings for all materials and equipment furnished under this section, prior to performing the work of utility abandonment.

C. As-built drawings showing locations of all terminated/cut/capped/plugged utilities and service disconnections at or before project close-out.

PART 2  PRODUCTS

2.1  MATERIALS

A. Comply with the material specifications required by the owner of each utility. Where such material specifications may conflict with this Specification, utility owner’s requirements shall prevail.

B. Borrow Material: Conform to applicable Specifications.

C. Portland Cement: ASTM C 150, Type II.
D. **Mortar Aggregate:** ASTM C 144, standard masonry type, clean, dry, free of deleterious materials.

E. **Concrete:** Design of mix in accordance with ASTM C-94, ASTM C-150, Type II Portland Cement, washed and graded sand, and aggregate with maximum size of 1-inch; or pre-packaged concrete mix with maximum aggregate size of 1-inch, ASTM C 387. Minimum 28-day compressive strength of 4000 psi.

F. **Masonry Mix:** Washed and graded mason sand, lime, and Portland Cement, ASTM C 270; or pre-packaged, dry, sand/lime/cement mortar mixture, ASTM C 387. Minimum 28-day compressive strength of 1200 psi.

G. **Water:** Potable, free of deleterious materials.

H. **Solid Concrete Masonry Unit:** ASTM C55, sized per pipe diameter to minimize requirements for cutting.

I. **Controlled Low Strength Material (CLSM)** is a self consolidating, rigid setting material to be used in backfills, fills, structural fills and elsewhere as indicated on the plans, or as directed by the Engineer. The flow and set time characteristics of CLSM shall be designed to meet the specific job conditions. All CLSM material covered by this specification shall be designed to be hand excavatable at any time after placement. It shall be composed of a mixture of portland cement, aggregate, and water with the option of using fly ash, slag cement, air-entraining agents, and other approved admixtures.

**Materials:** All materials utilized in the CLSM mix design shall be in accordance with the applicable requirements of Article M.03.01

**Composition:** The composition of the CLSM shall be in accordance with the requirements set forth in Article M.03.01-General Composition of Concrete Mixes, as well as the applicable sections of ACI 229R.

The Contractor shall submit each proposed mix design, with all supporting data, to the Engineer for review and approval at least two weeks prior to its use. The setting time of CLSM materials shall be designed so as to achieve the strength necessary to comply with the time constraints called for under the Maintenance and Protection of Traffic requirements of the project specifications. The use of chloride accelerators is not permitted. The minimum compressive strength of the CLSM material shall be 30 pounds per square inch (psi) and the maximum compressive strength of the CLSM shall be 150 pounds per square inch (psi) when tested in accordance with ASTM D4832 after 56 days. The CLSM mix design shall utilize a nominal maximum size of No. 8 aggregate as specified in M.01.01. CLSM mixes shall have a minimum of 20% entrained air when tested in accordance with AASHTO T152.
PART 3 EXECUTION

3.1 GENERAL

A. Notify Call Before You Dig (CBYD) and obtain CBYD tracking number.

B. Notify utility owners in reasonable advance of the work and request the utility owner to stake out on the ground surface the underground facilities and structures. Notify the Engineer in writing of any refusal or failure to stake out such underground utilities after reasonable notice.

C. Contractor is solely responsible for providing coordination and obtaining permits with owners of the various utilities serving, or present at, the Project Site as required to complete termination and demolition work. Coordinate as required for termination of service, temporary termination of service, relocation of facilities, abandonment of facilities, demolition of facilities, cutting, capping, and bracing. Comply at all times with the procedures for terminations of utility services as required by the owner of each utility serving, or present at, the Project Site.

D. When utilities are encountered that are not indicated on the drawings, notify Engineer before proceeding with work in such area.

E. For brick sanitary sewer abandonment, CLSM shall only be placed when the ambient temperature is at least 32° F and rising. CLSM material shall be deposited within 2 hours of initial mixing. CLSM may be placed by chutes, conveyors, buckets or pumps depending upon the application and accessibility of the site. Should voids or cavities remain after the placement of the CLSM, the Contractor shall modify the placement method or flow characteristics of the CLSM. Voids or cavities which have not been filled properly shall be corrected as directed by the Engineer and at the Contractor’s expense.

3.2 UTILITY TERMINATION

A. Terminate utilities serving the Project Site as indicated on the Drawings. Terminate, cut, cap, or plug utilities in accordance with each utility owner’s requirements, including, but not necessarily limited to, scheduling of inspections by utility company personnel, permits, licenses, approvals, insurance, or bonds.

3.3 DEMOLITION

A. Do not demolish any utility until termination has been verified.
B. Unless identified on the Drawings to remain, remove and dispose of all overhead and underground utilities and related systems and appurtenances on the Project Site, including but not necessarily limited to water, electric, sanitary sewer, storm sewer, miscellaneous drainage, heating facilities, communications, exterior lighting supplies; utility poles, light standards, utility foundations, supports and ancillary equipment; hydrants and other similar supply facilities, valves and meters; site drainage and catch basins and related structures; sanitary sewerage piping, manholes, pumps, and related facilities; and other miscellaneous plumbing, piping and conveyances.

3.4 BACKFILL

A. Replace soil material excavated for utility removal, termination or abandonment in accordance with applicable Specifications.

1. Backfilling to grade is required with Compacted Granular Fill.

2. Imported Compacted Granular Fill material is required.

B. Provide OSHA-compliant barriers or smooth edges of all excavations to produce a stable slope, with smooth grade transitions and no vertical cuts from top of slope to lower limits of the excavation in compliance with the requirements of OSHA. Maximum slope into any excavated area under ideal soil conditions shall be 1 to 1 ½, vertical : horizontal.

3.5 PROTECTION

A. Contractor shall take measures to protect from damage those utilities, or portions thereof, which are designated to remain. Provide protection as required such as marking, blocking, bracing, stabilizing, supporting, and retaining.

B. Utilities to remain damaged by Contractor shall be repaired/replaced to the satisfaction of the utility owner at Contractor’s expense.

3.6 DOCUMENTATION

A. Contractor shall provide as-built documentation for each utility termination, including location, depth, and method and material of construction for termination. Such as-built documentation shall be on the appropriate site plans.

B. Contractor shall physically mark the location of each subsurface utility termination with a surveyor’s stake, with such stake identifying the utility type and depth below grade. Where the use of stakes at a utility termination location may be inappropriate, Contractor shall provide staking at an adjacent location(s) and include appropriate offset dimensions or other suitable demarcation.

END OF SECTION
PART 1  GENERAL

1.1 SUMMARY

A. This section specifies acceptable borrow material as it applies to site utility construction.
B. Section Includes
   1. Processed Aggregate Base for Bituminous Concrete Pavement Base
   2. Compacted Granular Fill
   3. Granular Fill
   4. Gravel/Sand Cushion
   5. Borrow
   6. Crushed Stone for Pipe Bedding – Storm Sewer
   7. Crushed Stone for Pipe Bedding – Footing Drain

1.2 REFERENCES

C. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
D. ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb./ft³)
E. ASTM D2434 - Standard Test Method for Permeability of Granular Soils (Constant Head)
F. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
G. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
I. Connecticut Department of Transportation (CTDOT), Standard Specifications for Roads, Bridges, and Incidental Construction, ‘Form 816’, latest revision.
J. Representative Samples of borrow materials taken from the source. Tag, label, and package the Samples as requested by Engineer. Provide access to the borrow site for field evaluation and inspection.

K. Provide sieve analysis (ASTM C136) and permeability analysis (ASTM D2434) from certified soils testing laboratory for all borrow materials. Take and test a sample, at no additional cost to the Owner for each 1,500 c.y. of borrow material placed.

L. Provide modified proctor analysis (ASTM D1557) from certified soils testing laboratory for all borrow materials.

M. The Engineer reserves the right to require more frequent testing than that which is specified above should the borrow characteristics change.

1.3 QUALITY ASSURANCE

A. No borrow shall be placed prior to the approval of Samples by the Engineer.

B. A Certificate of Clean Fill must be provided to Engineer and Owner for approval prior to delivery of any and all fill material including but not limited to, mineral soil, borrow material, structural fill, processed fill material, loam, or top soil to be placed on site during the course of the Work. The Certificate must include laboratory analytical reports for all material to be used at the site on a basis of one sample per every 500 cubic yards or lesser portions thereof. Analytical reports must demonstrate that the proposed material does not contain detectable concentrations of contaminants including but not limited to; petroleum hydrocarbons, semi volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), pesticides, and/or herbicides and that metals listed in the Connecticut Remediation Standard Regulations do not exceed minimal concentrations deemed allowable by Engineer and Owner. No fill material shall be placed on site until Contractor has received approval from Engineer and/or Owner. Engineer and Owner reserves the right to collect and analyze samples from any proposed fill material prior to or after delivery to the site and to allow use of off-specification material at their sole discretion.

The Certificate must clearly state the following and be signed by an authorized signatory employed by the Contractor:

1. Volume of material to be used
2. Process by which the material was obtained
3. Location of origin and summary of current and past site uses of the location of origin
4. Statement from Contractor that the analytical reports included with the Certificate represent the specific material to be used at the site
5. Statement that the Contractor does not know or have reason to believe that the proposed fill material contains foreign materials or contaminants.
1.4 PROJECT/SITE CONDITIONS

A. Existing Conditions

1. Keep all public and private roadway surfaces clean during hauling operations and promptly and thoroughly remove any borrow or other debris that may be brought upon the surface before it becomes compacted by traffic. Frequently clean and keep clean the wheels of all vehicles used for hauling to avoid bringing any dirt upon the paved surfaces.

PART 2 PRODUCTS

2.1 PROCESSED AGGREGATE BASE FOR BITUMINOUS CONCRETE PAVEMENT BASE

A. Shall conform to the requirements of CTDOT Form 816, article M.05.01-1. Coarse aggregate shall conform to the requirements of article M.05.01-2(a) or M.05.01-2(b). The reclaimed miscellaneous aggregate, article M.05.01-2(c) is not acceptable.

2.2 COMPACTED GRANULAR FILL

A. Shall conform to the requirements of CTDOT Form 816, article M.02.02-1 Bank or crushed gravel and shall meet the requirements of grading “B” article M.02.06.

Or material shall conform to the requirements of CTDOT Form 816, article M.02.02-2 Crusher-run stone. Material shall meet the requirements of grading “A” article M.02.06.

Reclaimed miscellaneous aggregate is not acceptable.

B. Stockpile the processed materials in such a manner to minimize segregation of particle sizes. All processed gravel shall come from approved stockpiles.

2.3 GRANULAR FILL (AND BASE COURSE FOR CONCRETE SIDEWALKS)

A. Shall conform to the requirements of CTDOT Form 816, article M.02.01-1 Broken or crushed stone or M.02.01-2 Bank or crushed gravel. Material shall meet the requirements of grading “A” article M.02.06.

Reclaimed miscellaneous aggregate is not acceptable.

B. Stockpile the processed materials in such a manner to minimize segregation of particle sizes. All processed gravel shall come from approved stockpiles.

2.4 GRAVEL/SAND CUSHION

A. Sand borrow material shall be supplied from an off-site borrow area approved by the Engineer. Testing of the off-site sand borrow shall be at the Contractor’s expense.

B. Sand borrow shall consist of clean, inert, hard, durable grains of quartz or other hard, durable, rock, free from loam or clay, surface coatings and deleterious materials. The allowable amount of material passing a No. 200 sieve as determined by ASTM-C117 shall not exceed 10% by weight.
C. Material shall consist of a clean, non-plastic, granular material conforming to the requirements of a SW, SP or SM under the Unified Soil Classification System (USCS) (ASTM D2487).

D. The material shall have the characteristics that when placed and compacted, the soil particles will bind together so as to form a solid, stable surface capable of supporting rubber-tired vehicular traffic during wet weather periods as well as extended dry weather periods. The borrow material shall not contain fines to the extent that the surface layer becomes “greasy” when wet.

E. The material shall not contain stones larger than 3/8 inch in diameter.

F. Material consisting of frozen clogs, ice and snow will be rejected.

G. All sand borrow material to be used shall be subject to approval by Engineer, and Engineer reserves the right to reject any borrow material from the job that does not meet the above requirements.

2.5 BORROW

A. Ordinary borrow shall have the physical characteristics of soils designated as type GW, GP, GM, SW, SP or SM, under USCS and shall not be specified as gravel borrow, sand borrow, special borrow material or other particular kind of borrow. It shall have properties such that it may be readily spread and compacted for the formation of embankments. The borrow shall not include rocks with a major dimension greater than 8 inches.

Borrow shall have a Certificate of Clean fill.

2.6 CRUSHED STONE FOR PIPE BEDDING – STORM SEWER

A. Shall conform to the requirements of CTDOT, “Form 816” Article M.01.01, No. 6 stone.

2.7 CRUSHED STONE FOR PIPE BEDDING – FOOTING DRAIN

A. Shall conform to the requirements of CTDOT, “Form 816” Article M.01.01, No. 6 stone.

PART 3 EXECUTION

3.1 INSTALLATION

A. Prior to the placement of borrow material, site preparation shall be completed as required by the Contract Documents, and approved by the Engineer.

B. Ensure that all materials are properly stockpiled on site to prevent contamination by other materials.

C. Place borrow material over the entire area in uniform lifts and compact in accordance with Section 312333 – Trenching and Backfilling.
D. Utilize on-site soils prior to using off-site borrow provided on-site soils meet the requirements of the specifications.

E. Utilize gravel borrow in all locations where a surface treatment has not been specified but requires a firm finish surface.

F. Processed aggregate base for bituminous concrete pavement base is intended to provide a stable foundation for driveways, bituminous concrete sidewalk and roadway repair.

G. Borrow materials shall be used as a replacement for unsuitable materials where poor soil conditions are encountered during the progress of the work, where approved by the Engineer. Borrow type will be determined by the Engineer. Borrow material used as a replacement for unsuitable soil is not intended to be an aid to dewatering.

H. Shape borrow used for pipe foundation material so that it supports the pipe properly and will not damage the pipe, bells, collars, or the pipe fittings.

I. Place all borrow to keep it free of other materials and to prevent segregation.

J. Place gravel/sand cushion for water main pipe bedding. Gravel/sand cushion shall have an in-place permeability of $1 \times 10^{-3}$ cm/sec or greater, and shall be compacted to 95% of maximum dry density.

K. Carry out compaction testing in accordance with ASTM D1556 (sand cone), or D6938 (Nuclear Methods). Unless stated elsewhere in the contract documents, the number of tests required shall be no less than 5 tests per acre or at random locations.

L. Maintain and repair all eroded areas during the life of this contract at no additional cost to the Owner.

END OF SECTION
PART 1  GENERAL

1.1  SUMMARY

A. Perform site utility preparation in accordance with the Contract Documents.

1.2  COORDINATION

A. Coordinate and schedule the work of this Section with all trades involved to prevent interference, and in order to allow adequate time at the proper stage of construction to properly perform all work of this Section.

1.3  PROJECT CONDITIONS

A. Coordinate all street closings and/or obstructions, including pavement and curbing removals with all governing authorities and utility companies.

B. The existing property lines and topographic contours noted on the drawings are given for the convenience purposes only. The Engineer and the Owner will not be responsible for interpretations or conclusions drawn from this information. Notify the Architect immediately of any discrepancies in the existing property lines or existing topographic elevations.

C. Do not rely upon the location of existing structures, utilities, storm drainage structures, and piping shown on the drawings. Check and verify the location of all existing structures, utilities, and piping prior to commencing work.

D. Call 1-800-922-4455 (Call Before You Dig) and register before beginning any excavation at least two (2) working days prior to the start of construction.

E. Locate and identify existing underground and overhead services and utilities within the Contract Limits. Provide adequate means of protection of utilities and services designated to remain. Repair utilities damaged during site work operations.

F. When uncharted or incorrectly charted underground piping or other utilities and services are encountered during site work operations, notify the applicable utility company immediately to obtain procedural directions. Cooperate with the applicable utility companies in maintaining active services in operation.

G. Perform site work operations and the removal of debris and waste materials to assure minimum interference with the streets.

H. Obtain written permission from governing authorities when required to obstruct the street. Provide alternate routes around obstructed traffic ways when required by governing authorities. Provide traffic control when and as required by the City of Middletown.

I. Remove all encumbrances which interfere with the proper fulfillment of all work without additional cost to the Owner.
J. Control dust caused by work operations. Dampen surfaces with water, as required to control all dust. Comply with air pollution control regulations of governing authorities. Exercise every reasonable precaution throughout the life of the contract to minimize dust arising from construction operations, hauling, storage, or demolition.

K. Protect existing and adjacent buildings, structures, pavement, light fixtures, and utilities to remain from damage caused by work operations. Repair and/or restore of damage caused by construction operations at no additional expense to the Owner. Protect all bench marks, control points, and engineering reference points; re-establish, if damaged or disturbed.

PART 2 PRODUCTS

2.1 MATERIALS
A. None.

PART 3 EXECUTION

3.1 EXAMINATION
A. Examine the areas and conditions where site preparation is to be provided. Notify the Owner, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.

3.2 SITE UTILITY LAYOUT, LINES, AND LEVELS
A. Before removals, topsoil stripping, excavation, filling or rough grading operations are started, stake out site areas for the work of this Contract. Provide layout for all site utility related items, including, but not limited to, access road limits crossing berm limits, and all miscellaneous site features. Site utility layout is to be performed by a professional engineer or surveyor licensed by the State of Connecticut.

B. Site utility layout, lines and levels may be subject to possible modifications, whether by inaccuracies in existing grades, or by other site conditions. Except in the case of substantial increases in material quantities, authorized in writing by the Owner, such modifications will not entitle General Contractor(s) to additional compensation.

C. The drawings indicate existing grade elevations and contours. The existing elevations are given for the convenience purposes in arriving at the quantities of excavation, grading and backfilling. The Engineer and the Owner do not assume any responsibility for the correctness of the existing grade elevations.

3.3 SITE UTILITY DEMOLITION AND REMOVALS
A. The work includes any and all other existing materials or work necessary to install new work as shown and/or specified and to connect same to existing structures or pavements in an approved manner. Completely remove all foundations, abandoned utilities, and all other items that interfere with new construction.
B. Remove existing construction features as required for the execution of the contract work. Perform such work in a manner to avoid any damages to the construction and finishes scheduled to remain. Where new work is required to be built adjacent to or connected with existing construction, cut or remove the existing construction and replace with new construction to the extent required to solidly build and anchor the new work in place.

C. Completely remove existing paving, including all base material, as required to accommodate new construction. Saw cut and remove existing roadway paving a sufficient distance to permit installation of new work, as required.

3.4 DISPOSALS

A. Properly dispose of all materials and debris resulting from the demolition and removal operations; legally dispose of all materials off of the Owner's property.

B. Maintain all disposal routes clear, clean, and free of debris. Keep all streets clean along the disposal routes.

C. On-site burning of combustible materials is not permitted.

D. Accumulation of materials for disposal is not permitted. Disposal is to be made as fast as materials accumulate.

E. Obtain all required and necessary permits or approvals for off-site disposals.

3.5 EXISTING UTILITY AND STORM DRAINAGE ABANDONMENT

A. Completely remove all existing utilities, underground tanks and storm drainage structures and piping that interfere with new construction or as noted on the drawings. Properly cut, cap, and abandon all other utilities or storm drainage structures or piping that does not interfere with construction. Maintain all utilities to the existing buildings until the time of demolition.

B. Contact appropriate utility companies prior to abandonment and properly coordinate all work with the utility companies.

C. At all times, maintain a positive outlet for storm drainage and sanitary sewers on site where encountered.

END OF SECTION
PART 1  GENERAL

1.1  SUMMARY

A.  Section Includes

1.  Excavation, backfill and compaction for slopes, sidewalks, ramps, curbing

2.  Removal, handling and disposal of rock

3.  Excavation, backfill, and compaction for the formation of the roadway subgrade.

4.  Disposal of asphalt pavement in a legal manner to a facility permitted to accept this type of construction waste material.

5.  Temporary dewatering systems

B.  Related Sections

1.  Section 312500, Soil Erosion and Sediment Control

2.  Section 023000, Subsurface Investigations

3.  Section 311100, Site Borrow Material

4.  Section 321216, Bituminous Concrete Pavement

1.2  REFERENCES

A.  ASTM D1557-07 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))

B.  ASTM D1556-07 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

C.  ASTM D2487-06e1 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

D.  ASTM D6938-08a - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

E.  29 CFR Part 1926 Subpart P - OSHA Excavation Regulations 1926.650 through 1926.652 including Appendices A through F

1.3  DEFINITIONS

A.  Benching - A method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.
B. Earth Retention Systems - Any structural system, such as sheeting and bracing or cofferdams, designed to retain in-situ soils in place and prevent the collapse of the sides of an excavation in order to protect employees and adjacent structures.

C. Excavation - Any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

D. Protective System - A method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include earth retention systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

E. Registered Professional Engineer - A person who is registered as a professional engineer in the state where the work is to be performed. However, a professional engineer, registered in any state is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for "manufactured protective systems" or "tabulated data" to be used in interstate commerce.

F. Shield System - A structure that is designed to withstand the forces imposed on it by a cave-in and thereby protects employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shields can be either pre-manufactured or job-built in accordance with 29 CFR 1926.652(c)(3) or (c)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

G. Sloping - A method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

H. Temporary Dewatering System – A system to lower and control water to maintain stable, undisturbed subgrades at the lowest excavation levels. Dewatering shall be provided for all pipelines, structures and for all other miscellaneous excavations.

I. Trench - A narrow excavation (in relation to its length) made below the surface of the ground, of at least three feet in depth. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet (4.6 m).

1.4 SUBMITTALS

A. Performance data for the compaction equipment to be utilized

B. Construction methods that will be utilized for the removal of rock

1.5 QUALITY ASSURANCE

A. All Excavation, Trenching, and related Earth Retention Systems shall comply with the requirements of OSHA excavation safety standards (29 CFR Part 1926 Subpart P), and other
State and local requirements. Where conflict between OSHA and State regulations exists, the more stringent requirements shall apply.

B. The following test procedures will be performed by the Owner’s inspection agency. Results will be submitted to the Engineer for review.

1. Modified Proctor Test (ASTM D1557) results and soil classification (ASTM D2487) for all proposed backfill materials at the frequency specified below:
   a. For suitable soil materials removed during excavation, perform one test for every 1,000 cubic yards of similar soil type. Similarity of soil types will be as determined by the Engineer.
   b. For borrow materials; perform tests at frequency specified in Section 02320 - Borrow Materials.

2. Compaction test results (i.e. ASTM D6938 or ASTM D1556) at a frequency of one test for every 100 cubic yards of material backfilled. The Engineer will determine the locations and lifts to be tested.
   a. The Engineer may specify additional compaction testing when there is evidence of a change in the quality of moisture control or the effectiveness of compaction.
   b. If all compaction test results within the initial 25% of the total anticipated number of tests indicate compacted field densities equal to or greater than 95% of maximum dry density at optimum moisture content, the Engineer may reduce frequency of compaction testing. In no case will the frequency be reduced to less than one test for every 500 cubic yards of material backfilled.
   c. The Contractor is cautioned that compaction testing by nuclear methods may not be effective where excavation sidewalls impact the attenuation of the gamma radiation or where oversize particles (i.e. large cobbles or coarse gravels) are present. In these cases, other field density testing methods may be required.

C. Employ the services of a dewatering specialist or firm when well points, deep wells, recharge systems, or equal systems are required. Specialist shall have completed at least 5 successful dewatering projects of equal size and complexity and with equal systems.

1.6 PROJECT CONDITIONS

A. Notify Call Before You Dig and obtain CBYD identification numbers.

B. Notify utility owners in reasonable advance of the work and request the utility owner to stake out on the ground surface the underground facilities and structures. Notify the Engineer in writing of any refusal or failure to stake out such underground utilities after reasonable notice.
C. Make explorations and excavations to determine the location of existing underground structures, pipes, house connection services, and other underground facilities in accordance with Paragraph 3.2.D of this Section.

D. Obtain proper permits from the City of Middletown prior to the start of any excavation work.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

A. Fill material is subject to the approval of the Engineer and may be either material removed from excavations or borrow from off site. Fill material, whether from the excavations or from borrow, shall be of such nature that after it has been placed and properly compacted, it will make a dense, stable fill.

B. Satisfactory fill materials shall include materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, SW, and SP.

C. Satisfactory fill materials shall not contain trash, refuse, vegetation, masses of roots, individual roots more than 18 inches long or more than 1/2 inch in diameter, or stones over 6 inches in diameter. Unless otherwise stated in the Contract Documents, organic matter shall not exceed minor quantities and shall be well distributed.

D. Satisfactory fill materials shall not contain frozen materials nor shall backfill be placed on frozen material.

E. Excavated surface and/or pavement materials such as gravel or trap rock that are salvaged may be used as a sub-grade material, if processed to the required gradation and compacted to the required degree of compaction. In no case shall salvaged materials be substituted for the required gravel base.

2.2 DEWATERING MATERIALS

A. Provide haybales and silt fence in accordance with Section 312500.

B. Provide silt filter bags (Dandy Dewatering Bag, Dirtbag, JMP Environ-Protection Filter Bag, or equal) of adequate size to match flow rate.

PART 3 EXECUTION

3.1 PREPARATION

A. Public Safety and Convenience

1. Take precautions for preventing injuries to persons or damage to property in or about the Work.

2. Provide safe access for the Owner's and Engineer's representatives at site during construction.
3. Do not obstruct site drainage, natural watercourses or other provisions made for drainage.

3.2 CONSTRUCTION

A. Earth Retention Systems

1. Provide Earth Retention Systems necessary for safety of personnel and protection of the Work, adjacent work, utilities and structures.


3. Systems shall be constructed using interlocking corner pieces at the four corners. Running sheet piles by at the corners, in lieu of fabricated corner pieces, will not be allowed.

4. Drive sheeting ahead of and below the advancing trench excavation to avoid loss of materials from below and from in front of the sheeting.

5. Sheet ing is to be driven to at least the depth specified by the designer of the earth retention system, but no less than 2 feet below the bottom of the Excavation.

6. Remove sheeting, unless designated to be left in place, in a manner that will not endanger the construction or other structures. Backfill and properly compact all voids left or caused by the withdrawal of sheeting.

7. Remove earth retention systems, which have been designated by the Engineer to be left in place, to a depth of 3 feet below the established grade.

B. Excavation

1. Perform excavation to the lines and grades indicated on the Drawings. Backfill unauthorized over-excavation in accordance with the provisions of this Section, at no additional cost to the Owner.

2. Excavate with equipment selected to minimize damage to existing utilities or other facilities. Hand excavate as necessary to locate utilities or avoid damage.

3. Sawcut the existing pavement in the vicinity of the excavation prior to the start of excavation in paved areas, so as to prevent damage to the paving outside the requirements of construction.

4. During excavation, material satisfactory for backfill shall be stockpiled in an orderly manner at a distance from the sides of the excavation equal to at least one half the depth of the excavation, but in no case closer than 2 feet.

   a. Excavated material not required or not suitable for backfill shall be removed from the site.
b. Perform grading to prevent surface water from flowing into the excavation.

c. Pile excavated material in a manner that will endanger neither the safety of personnel in the trench nor the Work itself. Avoid obstructing sidewalks and driveways.

d. Hydrants under pressure, valve pit covers, valve boxes, manholes, curb stop boxes, fire and police call boxes, or other utility controls shall be left unobstructed and accessible until the Work is completed.

5. Make pipe trenches as narrow as practicable and keep the sides of the trenches undisturbed until backfilling has been completed. Provide a clear distance of 12 inches on each side of the pipe.

6. The final 6 inches of excavation and grading of the trench bottom shall be performed by hand so as not to disturb the material below the grade required for setting the pipe or appurtenances.

a. Where suitable bedding materials will be placed and compacted throughout the length of the trench, hand excavation of the final 6 inches will not be required.

b. Grade the trench bottom to provide uniform bearing and support for the bottom quadrant of each section of pipe.

c. Excavate bell holes at each joint to eliminate point bearing.

d. Remove stones greater than 6 inches in any dimension from the bottom of the trench to avoid point bearing.

7. If satisfactory materials are not encountered at the design subgrade level, excavate unsatisfactory materials to the depth directed by the Engineer and properly dispose of the material. Backfill the resulting extra depth of excavation with satisfactory fill materials and compact in accordance with the provisions of this Section.

C. Backfill and Compaction

1. Unless otherwise specified or indicated on the Drawings, use satisfactory material removed during excavation for backfilling trenches. The Engineer may require stockpiling, drying, blending and reuse of materials from sources on the Project.

2. Spread and compact the material promptly after it has been deposited. When, in the Engineer’s judgment, equipment is inadequate to spread and compact the material properly, reduce the rate of placing of the fill or employ additional equipment.

3. When excavated material is specified for backfill and there is an insufficient amount of this material at a particular location on the Project due to rejection of a portion thereof, consideration will be given to the use of excess material from one portion of the Project to make up the deficiency existing on other portions of the Project. Moving
this excess material from one portion of the Project and placing it in another portion of the Project will be at no additional cost to the Owner.

a. Use borrow material if there is no excess of excavated material available at other portions of the Project.

4. Backfilling and compaction methods shall attain 95% of maximum dry density at optimum moisture content as determined in accordance with ASTM D1557.

5. Do not place stone or rock fragment larger than six inches in greatest dimension in the backfill.

6. Maximum loose lift height for backfilling existing or borrow material shall be 12 inches, unless satisfactory compaction is demonstrated otherwise to the Engineer through field-testing. In no case shall loose lift height for backfilling exceed 3 feet.

7. Do not drop large masses of backfill material into the trench endangering the pipe or adjacent utilities.

8. Install pipe in rock excavated trenches on a dense graded stone bedding with a minimum depth of 6 inches. Shape the stone bedding at the pipe bells to provide uniform support. Encase the pipe in the dense graded crushed stone bedding to a grade 6 inches over the top of the pipe and 12 inches on each side of the pipe.

9. Backfill from the bottom of the trench to the centerline of the pipe with the specified material. This initial backfill is to be placed in layers of no more than 6 inches and thoroughly tamped under and around the pipe. This initial backfilling shall be deposited in the trench for its full width on both sides of the pipe, fittings and appurtenances simultaneously.

10. Electrical conduit not encased in concrete, shall be backfilled with sand borrow conforming to the requirements of Section 02320. The backfill shall be placed in the trench for its full width and shall extend to 12 inches over the pipe.

11. Where excavation is made through permanent pavements, curbs, paved driveways or paved sidewalks, or where such structures are undercut by the excavation, place the entire backfill to sub-grade with granular materials and compact in 6 inch layers. Use approved mechanical tampers for the full depth of the trench. If required, sprinkle the backfill material with water before tamping so as to improve compaction.

12. Place and compact backfill around manholes, vaults, pumping stations, gate boxes or other structures in six inch layers, from a point 1 foot over the pipe. Exercise care to protect and prevent damage to the structures.

D. Test Pit Excavation

1. General requirements of test pits are specified in Section 023000.
E. Dewatering

1. Provide, operate and maintain adequate pumping, diversion and drainage facilities in accordance with an approved dewatering plan to maintain the excavated area sufficiently dry from groundwater and/or surface runoff so as not to adversely affect construction procedures nor cause excessive disturbance of underlying natural ground. Locate dewatering system components so that they do not interfere with construction under this or other contracts.

2. Take actions necessary to ensure that dewatering discharges comply with permits applicable to the Project. Dispose of water from the trenches and excavations in such a manner as to avoid public nuisance, injury to public health or the environment, damage to public or private property, or damage to the work completed or in progress.

3. Repair any damage resulting from the failure of the dewatering operations and any damage resulting from the failure to maintain all the areas of work in a suitable dry condition, at no additional cost to the Owner.

4. Exercise care to ensure that water does not collect in the bell or collar holes to sufficient depth to wet the bell or collar of pipes waiting to be jointed.

5. Take precautions to protect new work from flooding during storms or from other causes. Control the grading in the areas surrounding all excavations so that the surface of the ground will be properly sloped to prevent water from running into the excavated area. Where required, provide temporary ditches for drainage. Upon completion of the work, all areas shall be restored to original condition.

6. Brace or otherwise protect pipelines and structures not stable against uplift during construction.

7. Do not excavate until the dewatering system is operational and the excavation may proceed without disturbance to the final subgrade.

8. Unless otherwise specified, continue dewatering uninterrupted until the structures, pipes, and appurtenances to be installed have been completed such that they will not float or be otherwise damaged by an increase in groundwater elevation.

9. If open pumping from sumps and ditches results in “boils”, loss of fines, or softening of the ground, submit a modified dewatering plan to the Engineer within 48 hours. Implement the approved modified plan and repair any damage incurred at no additional cost to the Owner.

10. Where subgrade materials are unable to meet the subgrade density requirements due to improper dewatering techniques, remove and replace the materials in accordance with Section 311100 at no additional cost to the Owner.

11. Notify the Engineer immediately if any settlement or movement is detected of survey points adjacent to excavations being dewatered. If settlement is deemed by the
Engineer to be related to the dewatering, submit a modified dewatering plan to the Engineer within 24 hours. Implement the approved modified plan and repair any damage incurred to the adjacent structure at no additional cost to the Owner.

12. Dewatering discharge:

a. Install sand and gravel, or crushed stone, filters in conjunction with sumps, well points, and/or deep wells to prevent the migration of fines from the existing soil during the dewatering operation.

b. Transport pumped or drained water without interference to other work, damage to pavement, other surfaces, or property. Pump water through a silt filter bag prior to discharge to grade of drainage system.

c. Do not discharge water into any sanitary sewer system.

d. Provide separately controllable pumping lines.

e. The Engineer reserves the right to sample discharge water at any time.

13. Install erosion/sedimentation controls for velocity dissipation at point discharges onto non-paved surfaces.

14. Removal

a. Do not remove dewatering system without written approval from the Engineer.

b. Backfill and compact sumps or ditches with screened gravel or crushed rock in accordance with Section 311100.

c. Remove well points and deep wells. Backfill abandoned well holes with cement grout having a water cement ratio of 1 to 1 by volume.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Perform trench excavation and backfill in accordance with the Contract Documents. The Work includes but is not limited to trench excavation and backfill to within five (5) feet of proposed building for the following:

1. Storm drainage, sanitary sewers, water distribution and utility services construction.

2. Provide temporary paving or surfacing such as stabilized crushed stone so that traffic may be restored as soon as possible after completion of drainage and utility Work.

B. Related Sections include the following:

1. Section 312500 – Sedimentation and Erosion Control

2. Section 334113 – High Density Polyethylene Pipe and Fittings

3. Section 312300 – Earthwork

1.2 COORDINATION

A. Coordinate and schedule the work of this Section with all trades involved to prevent interference, and in order to allow adequate time at the proper stage of construction to properly perform all work of this Section.

PART 2 PRODUCTS

2.1 MATERIALS

A. Materials shall comply with CTDOT Form 816, “Standard Specifications for Road, Bridges, and Incidental Construction” latest revision.

B. Materials installed within City of Middletown Roadway Right-of-Way shall conform to the City of New Haven standards and requirements.

C. A Certificate of Clean Fill must be provided to Engineer and Owner for approval prior to delivery of any and all fill material including but not limited to, mineral soil, borrow material, structural fill, processed fill material, loam, or top soil to be placed on site during the course of the Work. The Certificate must include laboratory analytical reports for all material to be used at the site on a basis of one sample per every 500 cubic yards or lesser portions thereof. Analytical reports must demonstrate that the proposed material does not contain detectable concentrations of contaminants including but not limited to; petroleum hydrocarbons, semi volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), pesticides, and/or herbicides and that metals listed in the Connecticut Remediation Standard Regulations do not exceed minimal concentrations deemed allowable by Engineer and Owner. No fill material shall be placed
on site until Contractor has received approval from Engineer and/or Owner. Engineer and Owner reserves the right to collect and analyze samples from any proposed fill material prior to or after delivery to the site and to allow use of off-specification material at their sole discretion.

The Certificate must clearly state the following and be signed by an authorized signatory employed by the Contractor:

1. Volume of material to be used
2. Process by which the material was obtained
3. Location of origin and summary of current and past site uses of the location of origin
4. Statement from Contractor that the analytical reports included with the Certificate represent the specific material to be used at the site
5. Statement that the Contractor does not know or have reason to believe that the proposed fill material contains foreign materials or contaminants.

PART 3  EXECUTION

3.1  EXCAVATION, TRENCHING AND BACKFILLING

A. Perform excavation to the depths shown or specified.

B. During excavation, pile material suitable for backfilling in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins.

C. Remove all excavated materials not required or suitable for backfill from the site.

D. Grade as necessary to prevent surface water from flowing into trenches or other excavations. Remove any water accumulating therein by pumping or by other approved method.

E. Install sheeting and shoring as necessary for the protection of the Work and for the safety of personnel.

F. Unless otherwise indicated, excavation to be open cut.

G. Excavation is classified as earth excavation and includes excavation to subgrade elevations indicated, regardless of character of materials and obstructions encountered, pavements, and other obstructions visible on ground surface, underground structures, utilities and other items indicated to be demolished and removed, together with earth and other materials, excluding rock.

H. Rock, for the purposes of classification shall consist of rock material in beds, ledges, unstratified masses, conglomerate deposits and boulders of rock material that exceed 1 cubic yard that cannot be removed by rock excavating equipment without systematic drilling, ram hammering, ripping or blasting. Rock excavating equipment is defined as a late-model, track-mounted, hydraulic excavator equipped with a 42-inch wide, maximum, short-tip radius rock bucket, rated at not less than 138-hp flywheel power with bucket-curling force
of not less than 28,090 lbf and stick-crowd force of not less than 18,650 lbf; measured according to SAE J-1179.

I. Backfill and surface excavations for utilities occurring in or across streets or sidewalks with temporary paving or crushed stone as soon as possible after Work is completed.

J. Maintain temporary paving or surfacing in a condition acceptable to the Owner until permanent pavement can be installed.

3.2 SIZES OF TRENCHES

A. Ensure trenches are the necessary width for the proper laying of the pipe, and ensure the banks areas nearly vertical as practicable.

B. Accurately grade the bottom of the trenches to provide uniform bearing and support for each section of the pipe on undisturbed soil at every point along its entire length.

C. Except where rock is encountered, take care not to excavate below the depths indicated or specified.

D. Where rock excavations are required, excavate the rock to a minimum overdepth of 6 inches below the trench depths indicated on the drawings or specified.

E. Backfill overdepths in the rock excavation and unauthorized overdepths with thoroughly compacted sand or gravel as specified.

F. Whenever wet or otherwise unstable soil that is incapable of properly supporting the pipe, as determined by the Owner's Geotechnical Consultant, is encountered in the bottom of the trench, remove such soil to the depth required and backfill the trench to the proper grade with coarse sand, fine gravel or other suitable material.

G. Ensure trenches for utilities are of a depth that will provide the following minimum depths of cover from existing grade or from indicated finished grade, whichever is lower, unless otherwise specifically shown:

1. 4.5' minimum cover for water lines, sanitary sewers; gas mains and the like carrying fluids.

2. 2.5' feet minimum cover for electrical and telephone conduit and storm sewers.

H. For bedding of piping, ensure the width of the trench at and below the top of the pipe is such that the clear space between the barrel of the pipe and the trench wall is 12 inches minimum on either side of the pipe.

I. Ensure the width of the trench above the pipe crown is as wide as necessary for sheeting and bracing and the proper performance of the Work.
J. Round the bottom of the trench so that at least the bottom quadrant of the pipe rests firmly on bedding material for as nearly as the full length of the barrel as proper joining operations will permit.

K. Ensure the part of the excavation described in subsection J above is performed manually only a few feet in advance of the pipe laying by men skilled in this type of Work.

3.3 EXISTING UTILITY LINES

A. Contact "Call Before You Dig" at 1-800-922-4455 at least 48 hours in advance of any construction to verify the location of utilities.

B. Protect existing utility lines to be retained that are shown on the drawings or the locations of which are made known to the General Contractor prior to excavation operations from damage during excavation and backfilling. If such lines are damaged, the Contractor will repair at his expense.

3.4 BACKFILL RESTRICTIONS AND REQUIREMENTS

A. Do not backfill trenches until all required pressure and other tests have been performed and until the utilities systems as installed conform to the requirements of the drawings and specification.

B. Carefully backfill the trenches with the excavated materials approved for backfilling consisting of earth, loam, sand, sand and gravel, soft shale or other approved materials, free from large clods of earth, stones over 2-1/2 inches maximum dimension, or other undesirable material as specified in Section 311100 – Site Utility Borrow Material. Deposit backfill in 6 inch layers then thoroughly and carefully tamp until the pipe has a cover of not less than one (1) foot.

C. Carefully place the remainder of the backfill material in the trench in one foot layers and tamp. Settling the backfill with water is not permitted.

D. Grade the surface to a reasonable uniformity and leave the mounding over trenches in a uniform and neat condition.

E. The Owner’s Geotechnical Consultant may reject any on-site or borrow materials which he considers unsuitable for intended backfill or fill usage.

F. Under all paved areas, compact the fill and/or backfill to 95% of the maximum density at optimum moisture when tested in accordance with ASTM Designation D1557.

G. Perform field density tests by the approved Soil Testing Laboratory at locations and elevations as directed. In general, take test samples for every 250 cubic yards of fill or backfill placed or at 100 linear foot intervals of trench backfilled.
H. Backfill trenches excavated under footings and within 18 inches of bottom of footings with compacted select backfill; fill with concrete to elevation of bottom of footings.

3.5 TRAFFIC CONTROL

A. Maintain access for vehicular and pedestrian traffic required for other construction activities and for public when working in roadway right-of-way.

B. Provide public flagmen, barricades, warning signs and warning lights as required. Obtain required City street opening permits before start of work.

END OF SECTION
PART 1  GENERAL

1.1  SUMMARY

A. Section Includes
   1. Dust control
   2. Drainage and erosion control
   3. Haybales and siltation fence
   4. Sediment trapping devices

B. Related Sections
   1. Section 312300 – Earthwork
   2. Section 312300 – Trenching and Backfilling

1.2  SUBMITTALS – NOT USED

PART 2  PRODUCTS

2.1  HAYBALES

A. Haybales required for siltation control shall be wire tied bales of the type normally used for siltation or erosion control or construction projects.

2.2  FILTER FABRIC

A. Filter fabric siltation fencing shall be a woven filter fabric having a weight of at least 2.5 ounces per square yard, a thickness of at least 17 mils, a coefficient of permeability of not less than 0.0009 centimeters per second and allows a water flow rate of a minimum 40 gallons per minute per square yard. The material shall have a high sediment filtration capacity, high slurry flow and minimum clogging characteristics. The material shall be equal to FW-300 as manufactured by Mirafi, Inc., Charlotte, North Carolina; Amoco 2130 by Nilex, Inc., Centennial, CO; MISF 180 by Mutual Industries, PA; or equal.

2.3  SEDIMENT TRAPPING DEVICES

A. Sediment trapping devices shall be Siltsack®, Dandy Bag II®, or equal.

2.4  MULCH

A. Hay mulch shall consist of mowed cured grass, clover, alfalfa, timothy, oats, or wheat. No salt hay shall be used.
PART 3 EXECUTION

3.1 DUST CONTROL

A. Control dust during the Work. Use a mechanical street sweeper as needed or at the request of the Engineer.

B. Prevent dust from becoming a nuisance or hazard. During construction, excavated material and open or stripped areas are to be policed and controlled to prevent spreading of the material.

C. Control dust during the work on-site using calcium chloride and/or water.

D. During the Work on-site, all paved road and driveway surfaces shall be scraped and broomed free of excavated materials on a daily basis. The surfaces shall be hosed down or otherwise treated to eliminate active or potential dust conditions and the natural road or wearing surface shall be exposed.

E. Ensure that the existing equipment, facilities, and occupied space adjacent to or nearby areas of the work do not come in contact with dust or debris as a result of concrete demolition, excavation or surface preparation for coatings.

F. Control dust by the construction of temporary wooden frame/polyethylene sheeting walls and covering enclosures separating adjacent or nearby areas and equipment from the Work site.

3.2 DRAINAGE AND EROSION CONTROL

A. Control erosion and siltation during the construction through mulching, haybales, siltation fencing, diversion and control of storm water run-off, ponding areas and similar methods.

B. Provide and maintain sediment trapping systems.

C. Discharge surface runoff from any disturbances to the site into silt containment basins. Utilize siltation prevention measures including haybale and geotextile fences before discharge to drainage systems.

D. Control surface waters within the construction area through the use of temporary culverts.

E. Install sediment trapping devices in catch basins located in existing paved areas with sediment trapping devices to minimize the transport of sediment through the subsurface stormwater collection system.

3.3 HAYBALES AND SILTATION FENCE

A. Place and maintain both haybales and a staked filter fabric siltation fence along the entire length of the proposed construction between the area of construction and where shown on the Drawings or required by permit.
B. Install haybales by anchoring bales butted together to existing ground with at least 2 stakes per bale. The stake shall be a minimum of 2 inch square cross section and shall be long enough to penetrate 12 inches into the ground. Replace deteriorated haybales. Remove and dispose of the haybales following the successful growth of vegetation in the areas disturbed by the construction. Haybales shall not be removed until their removal is approved by the Engineer.

C. Install a filter fabric siltation fence in addition to the staked haybales, prior to construction and remove after full surface restoration has been achieved. Install the siltation fence parallel and immediately adjacent to the haybales as shown on the Drawings. Install as follows:

1. Hand shovel excavate a small trench on the upstream side of the desired fence line location.
2. Unroll the siltation fence system, position the post in the back of the trench (downhill side), and hammer the post at least 1½ feet into the ground.
3. Lay the bottom 6 inches of the fabric into the trench to prevent undermining by storm water run-off.
4. Backfill the trench and compact.

3.4 RESTORATION

A. Provide erosion control, seed and mulch and netting for surface restoration of areas disturbed during construction activities.

B. Provide temporary stabilization of disturbed areas that remain inactive greater than 14 consecutive days to minimize erosion. Methods to minimize erosion may include but are not limited to:

1. Spreading straw and/or providing temporary planting stabilization.
2. Installing jute netting.
3. Preparing surfaces to increase the runoff flow path, reduce the runoff flow velocity, or create small storage pockets to retain surface flows. Methods of accomplishing this include using mechanical devices such as track equipment or sheep’s foot rollers.

C. Place mulch on seeded areas. Use jute netting on areas having a slope greater than 3 horizontal to 1 vertical, to anchor the mulch until a satisfactory growth is obtained. If seeding is not possible because of the time of the year, apply mulch and netting to stabilize the area until such time as seed can be sown.

D. Provide grading, refertilizing, reseeding, remulching and/or netting to maintain the restored areas until the Work is accepted by the Owner.

E. See Section 329003 – Lawns and Grasses for seed.
3.5 CLEANING

A. Remove any sediment that builds up around the haybales or catchbasins.

B. Clean sediment trapping devices periodically during the Work. Devices shall be cleaned on a weekly basis, or more frequently if the devices become clogged.

C. Clean catchbasins that collect sediment as a result of the Work.

END OF SECTION
PART 1  GENERAL

1.1 SUMMARY

A. The work under this Section shall consist of bituminous concrete placed upon a completed processed aggregate base course or upon the surface of an existing pavement. The work shall be installed in accordance with the line, compacted thickness and details shown on the Contract drawings.

B. Section Includes

1. New Pavement
2. Pavement overlay
3. Permanent pavement repair
4. Bituminous Concrete Curbing

1.2 QUALITY ASSURANCE

A. Codes and standards: Comply with provisions of following, except otherwise indicated:


1.3 SUBMITTALS

A. Submit Material Certificates of Bituminous Mixture (Class) and Tack Coat signed by material producer and Contractor, certifying that each material item complies with or exceeds specified requirements in accordance with Conditions of Contract and Division 1 Specifications Sections.

PART 2  PRODUCTS

2.1 MATERIALS

A. Bituminous Concrete Pavement:

1. Material for Bituminous Concrete Pavement and Bituminous Bases shall comply with Section M.04 of “Form 816”.

2. The class of bituminous and compacted thickness shall be as indicated on the Contract Drawings.
PART 3 – EXECUTION

3.1 CONSTRUCTIONS METHODS

1. Bituminous Concrete for Pavement shall comply with Article 4.06.03 of “Form 816”.

END OF SECTION
PART 1 - GENERAL

SECTION REQUIREMENTS

A. Division 1 – General Requirements is made a part of this section.

B. Submittals: Product Data and concrete mix designs.

C. Ready-Mixed Concrete Producer Qualifications: ASTM C 94/C 94M.


TESTING

A. Sampling and testing for quality assurance during placement of concrete includes the following:
   1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
   2. Slump: ASTM C 143; one test for each concrete load at point of discharge from truck, and one test for each set of compressive strength test specimens.
   3. Air Content: ASTM C 231 pressure for normal weight concrete, ASTM C173 volumetric method for light weight concrete; one for each set of compressive strength test specimens.
   4. Concrete Temperature: Test hourly when air temperature is 40 degrees F. (4 degrees C.) and below, and when 80 degrees F (27 degrees C), and above; and each time a set of compressive test specimens are made.
   5. Compression Test Specimen: ASTM C 31; one set of 4 standard cylinders for each class of concrete; test specimens except when field cure test specimens are required.
   6. Compressive Strength Tests: ASTM C 39; one set for each 50 cu. yds. or fraction thereof, of each concrete class placed in each concrete load of 5,000 sq. ft. of surface area placed; 1 specimen tested at 7 days, 2 specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
      a. When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.
      b. When strength of field-cured cylinders is less than 85% of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
   7. Test results will be reported to Engineer and Contractor on same day that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, name of concrete supplier, concrete type and class, location of concrete batch in structure,
8. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Engineer. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests conducted, and any other additional testing as may be required, when concrete placed does not conform to the specified limits of the Contract Documents or when unacceptable concrete is verified.

B. Mock-ups: Provide samples of smooth formed, rubbed and light broom finishes to demonstrate typical joints, surface finish, color, texture, tolerances and standard of workmanship.

C. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure as directed by the Engineer. Contractor shall pay for such tests conducted, and any other additional testing as may be required, when concrete placed does not conform to the specified limits of the Contract Documents or when unacceptable concrete is verified.

SUBMITTALS

A. Product Data: Submit manufacturer’s product data with application and installation instructions for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, joint systems, curing compounds, moisture barrier and others as requested by the Owner.

B. Shop Drawings; Reinforcement: Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI Detailing Manual - 1988, Publication SP-66, showing bar schedules, stirrup spacing, diagrams of bent bars, placing plans and wall elevations showing arrangement of concrete reinforcement. Reproduction of the Owner’s Contract Drawings are not acceptable for use as shop drawings.

C. Certificates of Compliance: Provide the Special Inspector with Certificates of Compliance for welded wire fabric, cement, air-entraining agent, water-reducing agent, and vapor barrier.

D. In addition provide mill test reports for reinforcement bars used for this project.

E. Batch Tickets: The General Contractor shall furnish to the Special Inspector tester with each batch of concrete and before unloading at the site, a delivery ticket on which is printed, stamped, and or written, information concerning said concrete as follows

- Name of ready-mix batch plant,
- Serial number of ticket,
- Date,
- Truck number,
- Name of purchaser,
- Specific designation of job (name and location),
- Specific class or designation of concrete in conformance with that required by job specifications,
- Amount of concrete in cubic yards,
- Time loaded or of first mixing of cement and aggregates,
- Quantity of water added by receiver of concrete and his initials,
- Type and brand, and amount of cement,
- Type and brand, and amount of admixtures,
- Total water content by producer (or W/C ratio),
- Maximum size of aggregate,
- Weights of fine and coarse aggregate,
- Signature or initials of ready-mix representative.

F. Test Reports: Submit for review laboratory test reports for concrete materials and mix design test as specified.

PART 2 - PRODUCTS

ACCEPTABLE SUPPLIERS:

A. SUZIO
B. TILCON
C. Approved equal

MATERIALS

FORM MATERIALS

A. Forms for Exposed Finish Concrete: Unless otherwise indicated, construct formwork for exposed concrete surfaces with 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. Provide form material with sufficient thickness to withstand pressure of newly-place concrete without bow or deflection.
   1. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.
   2. Provide Class A tolerances for concrete exposed to view.

B. 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.
   1. Unitex Farm Fresh Vegetable Oil Form Release

C. Reinforcing Bars: ASTM A615 Grade 60, deformed.

D. Plain Steel Wire: ASTM A82, plane, cold-drawn steel.
E. Plain-Steel Welded Wire Reinforcement: ASTM A185, fabricated from as-drawn steel wire into flat sheets. Size and weight as noted on the drawings.

F. Joint Dowel Systems at patio entries:
1. Expansion Joints: Diamond Dowel System: ¼” thick stainless steel plate, 4.5” x 4.5” square at 24 inches on center with Diamond Dowel pocket former as manufactured by PNA Construction Technologies.
2. Control Joints: Square Dowel Basket Assemblies: ¾” x 14” stainless steel square dowel at 14” on center. Side frame supports fabricated from ¼” diameter cold drawn wire per ASTM A108 grade 1010-1020. Square dowel clips extend at least 2” past center of the dowel. PNA clip with foam on each side of dowel extending to within +/- 3/16” of 2/3 length of the dowel to allow for horizontal movement. System as manufactured by PNA Construction Technologies.

G. Joint Dowel System at street line sidewalk:
1. #5 epoxy painted rebar dowels shall be cast-in place 12” O.C. with an 18” leg sheath. Expansion joint filler and joint sealant shall be as specified. Concrete joints between expansion joints shall be tooled.

CONCRETE MATERIALS

A. Portland Cement: ASTM C150, Type I unless otherwise acceptable to the Owner. Use one brand of cement throughout project, unless acceptable to Engineer/Owner. Select cement color acceptable to the Owner.

B. Pozzolonic materials which will darken the concrete surface, such as fly-ash and microsilica are not permitted.


FIBER REINFORCEMENT

A. Synthetic Fiber: ASTM C1116, Type III, polypropylene fibers, 1/2 to 1-1/2 inches long.

B. Water: Potable.

C. Water-Reducing Admixture: ASTM C494, Type A and not containing more chloride ions than are present in municipal drinking water.


E. Waterproofing Membrane: Bituthene 3000 self-adhesive rubberized asphalt/polyethylene waterproofing membrane adjacent to the building structure by Grace Construction Products www.graceconstruction.com or approved equal. Contractor shall apply WP 3000 or Primer B2 prior to installing the waterproofing membrane.

F. WaterStop: Continuous bentonite waterstop along the abutting building structures – provide 3” of coverage.
1. Waterstop shall be Volclay RX-101RH and adhered to the building structure with Volclay WB adhesive.
2. Waterstop shall be installed below the expansion joint filler.

G. Vapor Retarder: Clear 12-mil thick polyethylene sheet or reinforced polyethylene sheet, ASTM E 1745, Class C.

H. Expansion joint filler shall be Sealtight® Fibre Expansion Joint by W.R. Meadows, Inc., www.wrmeadows.com – 1-800-342-5976 or approved equal. Thickness shall be ½”. Expansion joint filler shall also be placed against abutting building structures, columns, curbs and at all interrupting objects. Expansion joints shall be set ½” below the concrete surface and filled with the appropriate specified joint sealant.

I. Contractor shall install joint sealant over all expansion joint filler installed. Joint sealant shall be DynaTred® non-sag, traffic-grade polyurethane sealant by Pecora Corporation www.pecora.com – 1-800-523-6688 or approved equal. Submit manufacturer’s standard color options to Owner for review and selection.

CONCRETE REPAIR MATERIALS

A. Bonding Agent / Primer: Ardex Bonding & Anti Corrosion Agent, Silpro C-21 All Acrylic Bonding Agent / Primer or approved equal.

B. Concrete Patch Material: Ardex CP Concrete Patch, Silpro Easy Patch or approved equal.

C. Concrete Resurfacing Material: Ardex CD Concrete, Silpro Fastcrete or approved equal.

CURING AND SEALING COMPOUND

A. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

B. Concrete Color Admixture: Submit color samples for Owner approval.

C. Sidewalks
1. Concrete for sidewalks and aprons shall conform to the requirements of Section 9.21 and M.03.01 Class “F” concrete of the State of Connecticut Department of Transportation “Standard Specifications for Roads, Bridges and Incidental Construction”, Form 814A, including current suplemental. Higher compressive strengths may be required by the Owner.
2. The gravel or crushed stone base shall conform to article M.02.01-1 or M.02.01-2 and shall meet gradation “A” of M.02.06 and be placed in layers not less than 8 inches in depth and to such a depth that after compaction it shall be at the specified depth below
the finished grade of the walk. The base shall be wetted and rolled or tamped after the spreading of each layer.

3. The sidewalk expansion joints at the street line (EJ@SL) shall be at a maximum of 20’-0”. #5 epoxy painted rebar dowels shall be cast-in place 12” O.C. with an 18” leg sheath. Expansion joint filler and joint sealant shall be as specified. Concrete joints between expansion joints shall be tooled.

4. Expansion joint filler shall be Sealight® Fibre Expansion Joint by W.R. Meadows, Inc., www.wrmeadows.com – 1-800-342-5976 or approved equal. Thickness shall be ½”. Expansion joint filler shall also be placed against abutting building structures, columns, curbs and at all interrupting objects. Expansion joints shall be set ½” below the concrete surface and filled with the appropriate specified joint sealant.

5. Contractor shall install joint sealant over all expansion joint filler installed. Joint sealant shall be DynaTred® non-sag, traffic-grade polyurethane sealant by Pecora Corporation www.pecora.com – 1-800-523-6688 or approved equal. Submit manufacturer’s standard color options to Owner for review and selection.

6. Expansion joint filler shall be installed against the existing concrete curb and sealed with the specified joint sealant.

PROPORTIONING AND DESIGN OF MIXES

Prepare design mixes for each type and strength of concrete in accordance with ACI 318 Section 5.3 "Proportioning on the Basis of Previous Field Experience or Trial Mixtures", as indicated on drawings.

Use an independent testing facility acceptable to Engineer for preparing and reporting proposed mix design. The testing facility shall not be the same as used for field quality assurance testing unless otherwise acceptable to Engineer.

Submit written reports to Engineer for 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 and approved by Engineer.

Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job condition, 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.

Water Cement Ratio: All concrete to have a water to cementitious materials ratio of not more than 0.45.

Strength: All concrete to have a twenty-eight day compressive strength (f’c) of not less than 4000 psi unless otherwise noted.

Slump Limits: The concrete shall be proportioned and produced to have a slump of 2 inches to 4 inches. Concrete of lower slump may be used provided it is properly placed and consolidated.

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, as ac-
accepted by Engineer. Laboratory test data for revised mix design and strength results must be submit-
ted to and accepted by Engineer/Owner before using in Work.

Air Content: Maintain within range permitted by ACI 301. Do not allow air content of floor slabs to
receive troweled finishes to exceed 3 percent.

CONCRETE MIXING

Ready-Mix Concrete: Comply with requirements of ASTM C 94 "Standard Specification for Ready-
Mixed Concrete", and as herein specified.

Delete references for allowing additional water to be added to batch for material with insufficient
slump. Addition of water to the batch will not be permitted.

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.

When outdoor air temperature is between 85 degrees F (30 degrees C) and 90 degrees F (32 degrees
C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is
above 90 degrees F (32 degrees C), reduce mixing and delivery time to 60 minutes. Select strength
from options in subparagraph below or revise to suit Project.

7. PART 3 – EXECUTION

3.1 FORMS

Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might
be applied until such loads can be supported by concrete structures.

Construct formwork so concrete members and structures are of correct size, shape, alignment, eleva-
tion and position. The Contractor is solely responsible for the safe design and installation of form-
work and supports.

Design Formwork to be readily removable without impact, shock or damage to cast-in-place concrete
surfaces and adjacent materials.

Construct forms complying with ACI 347, "Recommended Practice for Concrete Formwork", to siz-
es, 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 select-
ed materials to obtain required finishes.

Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.
Provide Class A tolerances for concrete exposed to view.

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.

Provide temporary openings where interior area of formwork is inaccessible for clean out, 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.

Chamfer exposed corners and edges unless otherwise specified, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal. Unless otherwise indicated, provide ties so portion remaining within concrete after removal is at least 1-1/2” inside concrete. Unless otherwise shown, provide form ties which will not leave holes larger than 1” diameter in concrete surface.

Provisions for Other Trades: Provide openings in concrete formwork 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.

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. Re-tighten forms and bracing after concrete placement if required to eliminate mortar leaks and maintain proper alignment.

3.2 PLACING REINFORCEMENT

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. Clean reinforcement of loose rust and mill scale, old concrete, earth, ice, and other materials which reduce or destroy bond with concrete.

Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolster, spacers, and hangers, as required.

Place reinforcement to obtain at least minimum coverages indicated on the Contract drawings 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. All reinforcement must be completely supported and secured against possible displacement prior to placing concrete in any portion of the scheduled placement.

Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lap splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.
Concrete reinforcement shall be erected from shop drawings displaying the Engineer’s stamp of ac-
ceptance only. In the event a conflict exists between the accepted shop drawing and the Contract Doc-
uments the conflict shall be brought to the immediate attention of the Engineer for resolution.

3.3 JOINTS

A. Construction Joints: Locate and install construction joints, which are not shown on drawings, so
as not to impair strength and appearance of the structure, as acceptable to Engineer/Owner.
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. Place con-
struction joints perpendicular to the main reinforcement. Continue reinforcement across con-
struction joints. Reference design drawings.

B. 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. Joint filler and sealant materials are specified in
Division 7.

C. Control Joints in Slabs-on-Ground: Construct control joints in slabs-on-ground to form panels
or patterns as shown. Use inserts or saw-cut 1/4” wide x 1/5 to 1/4 of the slab depth, unless
otherwise indicated.

3.4 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build into work anchorage devices and other embedded items required for oth-
er work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, dia-
grams, instruction and directions provided by suppliers of items to be attached thereto.

B. 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 sufficiently strong to support types of screed strips by use of strike-off templates or
accepted compacting type screeds.

3.5 PREPARATION OF FORM SURFACES

A. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.

B. Thin form-coating compounds only with thinning agent of type, and in amount, and under con-
ditions of form-coating compound manufacturer’s directions. Do not allow excess form-coating
material to accumulate in forms or to come into contact with concrete surfaces against which
fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

C. Coat steel forms with a non-staining, rust-preventative material. Rust-stained steel formwork is
not acceptable.

3.6 CONCRETE PLACEMENT
A. Pre-placement Inspection: Before placing concrete, inspect and complete formwork 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. Coat forms with sealer as specified in Section 2.01 of these specifications.

B. Notify testing/inspection agency of intent to place concrete at least 48 hours prior to placement. Perform complete pre-placement inspection of formwork, reinforcement and condition of base prior to arrival of inspector. For each placement Contractor will provide the Special Inspector with a written record of the quality control inspection performed by and signed by the Contractor.

C. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.

D. General: Comply with ACI 304, "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete", and as herein specified. Deposit concrete continuously or in layers of such thickness that in 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.

E. 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.

F. 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 recommended practices.

G. 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 without causing segregation of mix.

H. 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.

I. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

J. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

K. Maintain reinforcing in proper position during concrete placement operations. Do not use calcium chloride, salt and other materials containing anti-freeze agents or chemical accelerators, unless otherwise accepted in mix designs.

3.7 FINISH OF SURFACES

A. Rough Form Finish (RfFm-Fn): 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 (SmFm-Fn): For formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to concrete, such as waterproofing, damp-proofing, painting or other similar system. This is as-cast concrete surface obtained with select-
ed 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.

C. Smooth-Rubbed Finish (SmRbd-Fn): Provide smooth rubbed finish (SmRbd-Fn) to scheduled concrete surfaces exposed to-view, which have received smooth form finish (SmFm-Fn) treatment, not later than one day after form removal. Moisten concrete surfaces and rub with Carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.

3.8 MONOLITHIC SLAB FINISHES

A. Scratch Finish (Scr-Fn): Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tiles, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated. After placing slabs, plane surface to a tolerance not exceeding 1/4" in 2'-0" when tested with a 2' straight-edge. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms or rakes.

B. Floated Finish (Flt-Fn): Apply floated finish to monolithic slab surfaces to receive light broom finish 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.

C. After screeding and consolidating 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 a tolerance not exceeding 1/4" in 10" when testing with a 10' straight edge. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, re-float surface to a uniform, smooth granular texture.

D. Light Broom Finish: Apply light broom finish to platforms, steps, landings, and for exterior or interior pedestrian ramps. After completion of float finishing, lightly draw broom over concrete surface and apply chemical-hardener finish at platform as specified above.

3.9 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

B. Curing Methods: Perform curing of concrete by moist curing and curing blankets.
   1. Keep concrete surface continuously wet by covering with water a minimum of 7 days.
   2. Cover concrete surface with non-staining absorbive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorbive cover to provide coverage of concrete surfaces and edges, with 4’ lap over adjacent absorbive covers.
      a. Ultra Care wet curing blankets or approved equal.

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 peri-
3.10 SHORES AND SUPPORTS

A. For shoring and reshoring comply with ACI 347 "Recommended Practice of Concrete Formwork", and as herein specified.
B. Remove shores and restore 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.
C. Keep reshores in place until concrete has attained its required 28-day strength and heavy loads due to construction operations have been removed.

3.11 REMOVAL OF FORMS

A. Formwork such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 degrees for 24 hours after placing concrete, except as noted below, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.
B. Formwork for concrete to receive a rubbed finish shall be removed within 24 hours of placement to allow proper finishing.
C. Formwork supporting weight of concrete, such as beam soffits, joints, slabs and other structural elements, when removed for finishing, must immediately be replaced with shoring. Shoring shall remain in place until concrete has achieved its design strength.

3.12 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 formwork.
B. When forms are extended for successive concrete placement, thoroughly clean surface, 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 Architect.

3.13 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 specified to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete Work.

3.14 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Engineer.
B. Cut out honeycomb, rock pockets, voids over 1/4" in any dimension, and holes left by tie rods and bolts, down to solid concrete, but in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Before placing cement mortar or proprietary agent, brush-coat the area to be patched with neat cement grout or proprietary bonding agent.
C. For exposed-to-view surfaces, blend white Portland cement and standard portland cement so that when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixtures and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surfaces.

D. Repair of formed Surfaces: Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.

E. Repair concealed formed surfaces, where possible, that contain defects that affect the reliability of concrete. If defects cannot be repaired, remove and replace concrete.

F. 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.

G. 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.

H. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.

I. 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.

J. 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 brush with neat cement grout, or apply concrete of same type or class as original concrete. Place, compact and finish to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.

K. 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 brush with neat cement grout, or apply concrete bonding agent. 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. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

L. Use epoxy-based mortar, approved by the Engineer, for structural repairs. Structural repairs include, but are not limited to, areas of unsound (honeycombed or spalled) concrete with a surface area greater than 9 square inches and/or with a depth greater than 1.5 inches, areas where reinforcement is exposed or areas with cracks greater than 1/16 inch in width. All areas requiring a structural patch shall be approved by the Engineer prior to commencing patching operations.

M. Concrete Sealer: Contractor shall apply low gloss, surface sealer at after concrete has cured for 28 days. Surface sealer shall be applied to patio entry surfaces, sidewalks and stamped concrete.

N. Patio Sidewalk: Contractor shall apply a compatible sealer over the concrete 28-days after concrete placement.

O. Street Line Sidewalks: Contractor shall apply a compatible sealer over the concrete 28-days after concrete placement.

END OF SECTION 03300
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Integrally colored Portland cement concrete paving with imprinted pattern, stain and
cure/sealer.

B. Integrally colored and color-hardened Portland cement concrete paving with imprinted
pattern and stain/sealer treatments.

1.2 RELATED SECTIONS

A. Section 312300 - Earthwork: Preparation of site for paving.

B. Section 321216 – Bituminous Concrete Pavement.

C. Section 07920 - Joint Sealants: Sealant for joints.

1.3 REFERENCES

A. ACI 301 - Specifications for Structural Concrete for Buildings.

B. ACI 302 - Guide for Concrete Floor and Slab Construction.

C. ACI 303 - Guide to Cast-in-Place Architectural Concrete Practice.

D. ACI 305R - Hot Weather Concreting.

E. ACI 306R - Cold Weather Concreting.

F. ACI 308 - Standard Practice for Curing Concrete.

G. ACI 309 - Standard Practice for Consolidation of Concrete.

H. ACI 347 - Guide to Formwork for Concrete.
I. ACI 503 - Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive.

J. ASTM C33 - Standard Specifications for Concrete Aggregates.


N. ASTM C494 - Standard Specifications for Chemical Admixtures for Concrete.

O. ASTM C618 - Standard Specifications for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.


R. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.


X. ASTM C1059 - Standard Specification for Latex Agents for Bonding Fresh To Hardened Concrete.


1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer’s data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Testing:
   1. Perform testing and analysis under provisions of Section 01400.
   2. Submit proposed mix design for each class of concrete for review prior to commencement of work.
   3. Testing firm will take cylinders and perform slump and air entrainment tests in accordance with ACI 301.
   4. Four concrete test cylinders will be taken for each class of concrete placed each day.
   5. One slump test will be taken for each set of test cylinders taken.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:

B. Installer Qualifications:
   1. The Installer shall provide a qualified foreman or supervisor who has a minimum of three years experience with imprinted and textured concrete, and who has successfully completed at least five Bomanite imprinted concrete installations of high quality and similar in scope to that required.
   2. The concrete is cast in place, on the job site, by trained and experienced workmen who shall be employed by a firm that is a licensed and certified Bomanite Imprint Licensed Contractor
   3. Perform work in accordance with ACI 301, 302, 303.
   4. Obtain materials from same source throughout.
   5. Conform to applicable codes and regulations for paving work performed within the public right of way.

C. Ready-Mixed Supplier Qualifications: Supplier of ready-mixed concrete products shall comply with ASTM C 94 requirements for production facilities and equipment. Supplier shall be certified according to NCRMA’s “Certification of Ready Mixed Concrete Production Facilities Quality Control Manuals.”

D. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
E. Mock-Up: Provide field samples of surface colors, textures, and patterns specified for architect approval prior to beginning work, 48 inches by 48 inches (1219 mm by 1219 mm) in size illustrating paving finishes.
   1. Finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer’s unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 PROJECT CONDITIONS

A. Do not place pavement when base surface or ambient temperature is less than 40 degrees F (4 degrees C) or if base surface is wet or frozen.

B. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer’s absolute limits.

1.8 WARRANTY

A. All materials manufactured by The Bomanite Company are warranted to be of uniform quality within manufacturing tolerances.

B. Since control is not exercised over their use, no warranty, expressed or implied, is made as to the effects of such use. The Bomanite Company's obligation under this warranty shall be limited to refunding the purchase price of that portion of the material proven to be defective.

PART 2 PRODUCTS

2.1 MANUFACTURERS


B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01600.
2.2 SYSTEM

A. Supporting Structure:
   1. Mix Design:
      a. Mix and deliver concrete in accordance with ASTM C94, Alternate 2. Refer to Drawings for concrete strength requirements.
      b. Use accelerating admixtures containing no calcium chloride in cold weather only when approved by testing laboratory. Use of admixtures will not relax cold weather placement requirements.
      c. Use set retarding admixtures during hot weather only when approved by testing laboratory.
      d. Add air entraining agent to concrete mix for concrete work exposed to exterior, in amounts of 4 to 7 percent of total concrete volume or as otherwise recommended by testing laboratory.
      e. Add coloring admixture where scheduled in quantities recommended by coloring admixture manufacturer to achieve selected color.
      f. Add polypropylene fiber reinforcement at point of concrete batching at rate scheduled.
      g. Maintain water cement ratio to produce a minimum of 3 to maximum of 5 inch slump.
      h. Use of calcium chloride is strictly prohibited.
   2. Subgrade:
      a. Refer to Section 02300 for subgrade preparation.
      b. Refer to drawings for scope of subgrade preparation.
   3. Reinforcement:
      a. Fiber Reinforcement: ASTM C948, collated, fibrillated, 3/4 inch (19 mm) long virgin polypropylene fibers, equal to BOMANITE Fibers by The Bomanite Company.
      b. Reinforcing Steel: ASTM A615; Grade 60; deformed billet steel bars, uncoated finish.
      c. Welded Steel Wire Fabric: Plain type, ANSI/ASTM A185; in flat sheets; uncoated finish.

B. Color:
   1. Integral Color:
         1) Type A, cement dispersing/water reducing.
         2) Type D, set retarding/water reducing.
         3) Color to match Architect’s sample.
   2. Color Hardener:
      a. Bomanite Color Hardener: The concrete shall be colored with Bomanite Color Hardener. Color(s) as scheduled. Refer to Drawings.

C. Tools Selection:
   1. Imprinting Tools:
      a. Mat type imprinting tools for texturing freshly placed concrete, in pattern/texture as selected by Architect or as scheduled.
b. Imprinting tools used in the execution of this project shall be manufactured by The Bomanite Company.

2. Bomanite Patterns: Design(s) as scheduled. Refer to Drawings.

3. Bomacron Textures and Patterns: Design(s) as scheduled. Refer to Drawings.

D. Release Agent Selection:
   1. Powdered Release Agent. Color(s) as scheduled. Refer to Drawings.
      a. Bomanite Release Agent.

E. Secondary Antique or Coloration:
   1. Topical Stain: Color(s) as scheduled. Refer to Drawings.
      a. Bomanite Topical Stain.
   2. Chemical Stain: Color(s) as scheduled. Refer to Drawings.
      a. Bomanite Chemical Stain.

F. Cure Agent:
   1. Membrane Color Cure: Color(s) as scheduled. Refer to Drawings.
         1) BOMANITE Color Cure by The Bomanite Company.
         2) BOMANITE Clear Cure by The Bomanite Company.
         3) BOMANITE Clear Cure Matte Finish by The Bomanite Company.
   2. Silicate Cure & Densifier:
      a. The concrete shall receive a cure treatment utilizing Bomanite Con Shield.

G. Sealing and Finish Coatings:
   1. Colorwax by The Bomanite Company.
   2. Hydrolock by The Bomanite Company.
   3. VOC II by The Bomanite Company.

2.3 RELATED MATERIALS

A. Cement: ASTM C150, type 1, Portland cement, gray color.


C. Water: Clean and not detrimental to concrete.

D. Form Material: Conform to ACI 301. If using metal, material shall be free from deformities. If using wood, use construction grade lumber, sound and free of warp, minimum 2 inches (51 mm) nominal thickness, except where short radii of curves require thinner forms.

E. Contraction Joint Devices: Galvanized sheet metal, keyed profile, with knock-outs for reinforcing and dowel steel.

F. Tie Wire: Annealed steel, minimum 16 gage (1.519 mm) size.
G. Dowels: ASTM A615; Grade 40, plain steel, uncoated finish.

H. Miscellaneous Reinforcing Accessories: Spacers, chairs, ties, and other devices necessary for properly placing, spacing, supporting, and fastening reinforcement in place.

I. Form release agent: As acceptable to concrete colorant manufacturer, non-staining, dissipative type.

J. Vapor Retarding Membrane: 10 mil (.2540 mm) reinforced polyethylene.

K. Air-Entraining Admixture: ASTM C 206. Air Entrained Concrete shall be used wherever concrete is exposed to the freezing weather. Proportions of entrained air, as determined by ASTM C233, and C260, shall be as follows:
   1. Aggregate: 3/8 inch (9.5 mm) maximum size aggregate 6-8 percent entrained air.
   2. Aggregate: 3/4 inch (19 mm) maximum size aggregate 5-7 percent entrained air.

L. Joint Fillers:
   1. Redwood Boards: Construction heart grade redwood, sound and free of checks, splits or other defects, 3/4 inch (19 mm) thick.
   2. Asphaltic Joint Filler: Asphalt impregnated fiberboard, ASTM D1751, 1/2 inch (12 mm) thick.
   3. Non-Asphaltic Joint Fillers: ASTM D1752, Type I.

M. Sealants: Two part polyurethane sealants, of grade as required to suit application, meeting ASTM C920, in manufacturer’s custom colors.
   1. Urethane, SL grade, as specified in Section 07920.
   2. Urethane, SL-TB grade as specified in Section 07920.

N. Bonding-Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene rubber.

O. Epoxy-Bonding Adhesive: ASTM C 881, two component epoxy resin, capable of humid curing and bonding to damp surface, of class and grade to suit requirements if required, and as follows: Types I and II, non-load bearing, for bonding hardened of freshly mixed concrete to hardened concrete.

PART 3  EXECUTION

3.1 INSPECTION

A. Verify compacted subgrade is ready to support paving and imposed loads, free of frost, smooth and properly compacted.

B. Verify gradients and elevations of base are correct, and proper drainage has been provided so water does not stand in the area to receive paving.

C. Beginning of installation means acceptance of existing conditions.
3.2 PREPARATION

A. If vapor retarding membrane is not used, moisten base to minimize absorption of water from fresh concrete.

B. Notify Architect and testing laboratory, minimum 24 hours prior to commencement of concreting operations.

3.3 FORMING

A. Construct and remove forms in accordance with ACI 347.

B. Place and secure forms to correct location, dimension, and profile. Adequately brace to withstand loads applied during concrete placement.

C. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

D. Place joint fillers vertical in position, in straight lines. Secure to formwork during concrete placement.

3.4 INSERTS AND ACCESSORIES

A. Make provisions for installation of inserts, accessories, anchors, and sleeves.

B. Place vapor retarder continuously over subgrade. Overlap joints a minimum of 12 inches (305 mm) and seal with a joint tape of same permeance as sheeting material.

3.5 REINFORCEMENT

A. Accurately place reinforcement in middle of slabs-on-grade.

B. Discontinue every other bar of reinforcement at control and expansion joints.

C. Place reinforcement to achieve slab and curb alignment as detailed.

D. Steel shall be free of rust, mill scale, dirt and oil.

E. Provide doweled joints at interruptions of concrete with one end of dowel set in capped sleeve to allow longitudinal movement. Provide support at both ends of dowels.

F. Support reinforcing on bar chairs. Securely saddle tie at intersections. Rigidly secure in place to minimize displacement during concrete pour.

3.6 JOINTS

A. Intentional stoppage of concrete placing shall be at planned location of either an expansion joint or contraction joint.
B. When stoppage occurs at an expansion joint, install joint assembly with a bulkhead of sufficient section drilled to accommodate required dowels. Provide expansion joints at maximum 40 feet (12 m) o.c.e.w. in parking lots, 40 feet (12 m) o.c. for curbs and maximum 20 feet (6 m) o.c.e.w. at pedestrian paving.

C. When stoppage occurs at a contraction joint, install sheet metal joint assembly of sufficient section to prevent deflection, shaped to concrete section. Drill bulkhead to permit continuation of longitudinal reinforcing steel through construction joint.

D. Stoppage at Unintentional Location:
   1. Immediately upon unintended stoppage of concrete placing, place available concrete to a line and install bulkhead perpendicular to surface of pavement and at required elevation. Place and finish concrete to this bulkhead. Remove and dispose of concrete remaining on subgrade ahead of bulkhead.
   2. When placing of concrete is resumed before concrete has set to extent that concrete will stand on removal of bulkhead, new concrete shall be rodded with the first; otherwise, carefully preserve joint face.
   3. Provide a joint seal space at edges created by a construction joint of this type shall have a joint seal space as detailed on Drawings.

E. Provide sawed contraction joints in vehicular paving and curbs spaced as detailed on Drawings, but in no case greater than 20 feet (6 m) o.c. spacing.
   1. Saw joints after completion of finishing operations as soon as concrete has hardened to extent necessary to prevent revealing of joint or damage to adjacent concrete surfaces.
   2. Saw joints same day that concrete is placed except that sawing of joints in concrete placed late in day may be delayed until morning of following day.
   3. In any event, saw joints within 18 hours after placing concrete.
   4. Use a power-driven concrete saw made especially for sawing concrete and maintain in good operating condition.
   5. Saw cut shall be to a depth equal to 1/4 of slab thickness, minimum one inch (25 mm) depth.
   6. Align joints in vehicular paving with joints in adjacent pedestrian paving.
   7. Cut joints through curbs at right angles to back of curb.

F. Place joint filler between paving components and building or other appurtenances.

G. Provide scored joints in sidewalks and plazas to a depth of 1/4 the slab thickness, and at intervals as indicated, but in no case spaced greater than width of walk.

3.7 PLACING CONCRETE

A. Place concrete in accordance with ACI 301, 302, and 304. Deposit concrete so that specified slab thickness will be obtained after vibrating and finishing operations. Minimize handling to prevent segregation. Consolidate concrete by suitable means to prevent formation of voids or honeycombs. Exercise care to prevent disturbance of forms and reinforcing and damage to vapor retarder. Place concrete to lines and levels shown, properly sloped to drain as designed.
3. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.
4. Place concrete continuously between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

B. After consolidating and screeding, float concrete to gradients indicated. Use a straight edge to level and test surface in longitudinal direction to required grade. Finish edges to provide a smooth dense surface with 1/8 inch (3 mm) radius.

C. Apply Bomanite Color Hardener prior to application of pattern. Apply at rate recommended by manufacturer, evenly to the surface of the fresh concrete by the dry-shake method. Applied in two or more shakes, floated after each shake and troweled only after the final floating.

D. While concrete is still in its plastic state, apply the tool/texture pattern to the surface of the concrete. Properly tamp tools into the surface to achieve the required texture, with uniformity of pattern and depth of stamping. Utilize bond breaker to keep tools from sticking to fresh concrete.
   1. Release material shall be applied to the troweled surface prior to imprinting.

E. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer’s instructions.

F. Apply secondary stain treatment per approved mock-up or as scheduled to achieve design.

G. Apply finish sealer per approved mock-up or as specified to achieve design required.

3.8 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01400.

B. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.9 PROTECTION

A. Immediately after placement, protect concrete under provisions of Section 01500 from premature drying, excessive hot or cold temperatures, and mechanical injury.

END OF SECTION
PART 1  GENERAL

1.1  SUMMARY

A.  Section Includes

1.  New painted pavement markings

2.  Replacement of pavement markings disturbed as part of construction activities.

3.  The work of this Section shall also consist of furnishing and installing sheet aluminum/reflective sheeting signs and galvanized steel support posts as indicated on the plans

B.  Related Sections

1.  Section 321216 - Bituminous Concrete Pavement

1.2  REFERENCES


B.  State of Connecticut Department of Transportation – Standard Specifications for Roads, Bridges and Incidental Construction, Form 816, 2004 (CT-DOT Form 816).

C.  State of Connecticut Department of Transportation, “2004 Traffic Catalog of Signs”.

1.3  SUBMITTALS

A.  Submit material specifications and shop drawings for all materials furnished under this Section including, but not limited to the following:

1.  Pavement marking paint

PART 2  PRODUCTS

2.1  MATERIALS

A.  Waterborne Pavement Marking Paint

1.  In accordance with Connecticut Department of Transportation – Standards for Roads, Bridges and Incidental Construction, Form 816, 2004, as amended, pavement marking paint shall conform to the requirements of Article M.07.20 for waterborne pavement marking paint.

2.  The paint shall be capable of being applied to bituminous and portland cement concrete pavements with striping equipment that does not require heating above ambient temperatures.
3. The following additional pavement marking paint requirements shall be met:
   a. The total nonvolatile content shall not be less than 70% by weight.
   b. Pigment shall be 45-55% by weight.
   c. Weight per gallon shall not be less than 12.5 pounds.
   d. Drying time to no pickup shall be 15 minutes.

B. Application Requirements
   1. Marking paint shall be applied at a rate of 100 to 115 square feet per gallon.
   2. Material application temperature shall be from 40°F to 120°F.
   3. No thinners shall be used for the above listed pavement marking applications except in accordance with the manufacturer's specifications and at the direction of the Engineer.
   4. Minimum finished paint thickness shall be 15 mils.

C. Signs and support posts shall conform to the requirements of Article 12.08.02 of "Form 816".

PART 3 EXECUTION

3.1 PREPARATION
   A. All surface dirt within the areas to be painted shall be removed. Large areas of tar, grease or foreign materials may require sand blasting, steam cleaning or power brooming to accomplish complete removal.
   B. Application of markings shall not proceed until final authorization is received from Engineer.
   C. Bituminous concrete pavements shall have been in place for at least 48 hours prior to the application of pavement markings.

3.2 INSTALLATION
   A. All permanent pavement repair areas shall be repainted to match the original pavement markings.
   B. New pavement markings shall be as shown on the Drawings and as specified herein.
   C. Painting shall be in accordance with Connecticut Department of Transportation – Standards for Roads, Bridges and Incidental Construction, Form 816, 2004, as amended.
D. No paint or pavement marking material shall be heated above the temperature marked on the container.

E. All painting shall be performed in a neat and workmanlike manner.

F. Lines shall sharp and clear with no feathered edging or fogging.

If for any reason material is spilled or tracked on the pavement or any markings applied by Contractor, in Engineer's judgment, are not acceptable, then the Contractor shall remove such material by a method that shall not damage the roadway surface and is acceptable to Engineer, clean and prepare the surface for a reapplication of markings, and reapply the markings as directed without additional compensation for the corrective work.

G. Signs and support posts shall be installed in accordance with Article 12.08.03 of "Form 816".

3.3 PROTECTION

A. Markings shall remain protected until sufficiently dry to bear traffic on roadways that are open to traffic.

B. Precautions shall be taken to prevent tracking by tires of the striping equipment.

C. Markings shall be protected by traffic cones of not less than 28 inches in height.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Work includes furnishing and installing concrete retaining wall units and wall caps to the lines and grades designated on the construction drawings and as specified herein.

B. Furnishing and installing railing along the top of the retaining wall as shown on the Contract Drawings per the manufacturer’s requirements and in accordance with State and Local Building Code requirements.

1.2 REFERENCED STANDARDS

ASTM C94 READY-MIXED CONCRETE

ASTM C1372 Segmental Retaining Wall Units

1.3 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall check the materials upon delivery to assure proper material has been received.

B. Contractor shall prevent excessive mud, wet cement and like materials from coming in contact with the SRW units.

C. Contractor shall protect the materials from damage. Damaged material shall not be incorporated in the project.

D. Employ a qualified professional engineer licensed to practice in the State of Connecticut to design all segmental block retaining walls in accordance with wall Manufacturer’s specifications and based upon information, including, but not limited to, soil properties, bearing capacities, and existing and proposed construction provided in the project Geotechnical Engineering report and shown on the Contract Drawings, plans, profiles, details and notes. Review and request clarification of any information provided prior to submittal of bid to ensure that all Work costs are included in the Contractor’s bid.

E. Design and construct segmental block retaining walls to withstand and resist applied soil, hydrostatic, or other pressures. Provide wall construction, wall materials, backfill materials, geo-grid and/or other soil/wall reinforcement materials required to accomplish this task.

F. Design and construct all segmental block retaining walls to lines and grades indicated on the Contract Drawings and to other dimensions and depths required so as to not to destabilize or to be de-stabilized, or undermine or be undermined by, adjacent construction.

G. Install segmental block retaining walls without damaging existing buildings, pavements, and other adjacent site improvements.
H. Obtain all required permits for segmental block retaining walls from the authorities having jurisdiction.

1.4 SUBMITTALS:

A. Product Data: Include data for proposed materials, method of installation, and list of materials proposed for use.
   
   1. Include location of product manufacturer.

B. Shop Drawings, System Designs and Calculations: Prepared by a qualified professional engineer licensed in the State of Connecticut, who is experienced in design of proposed segmental block retaining wall systems. Include drawings and comprehensive engineering analysis that shows system’s compliance with specified requirements. Systems designs, materials, calculations and shop drawings must be signed and sealed by a qualified professional engineer responsible for their preparation and must be submitted to, reviewed by, the Architect, Project Engineer and/or Owner.

C. Samples for Initial Selection: manufacturer’s color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of concrete units required shall be submitted to the Architect and Owner for review and approval.

D. Samples and verification: Full size units of each type of concrete unit for each color, texture, and pattern specified, showing the full range of variations expected in the characteristics.

E. Qualification Data: For firms and persons specified in “Quality Assurance” Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed segmental retaining wall installations similar in material, design, and extent to that indicated on this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations: Obtain each type of concrete unit from one source with resources to provide materials and products of consistent quality in appearance and physical properties.

C. Engineering Responsibility: Contractor shall engage a qualified professional engineer who will be responsible for preparation of designs and data for segmental block retaining walls including drawings and comprehensive engineering analysis that shows system’s compliance with specified requirements.

D. Professional Engineer Qualifications: A professional engineer, in good standing, who is legally qualified and currently licensed to practice in the State of Connecticut and who is
experienced in providing engineering services for designing segmental block retaining walls that are similar to those indicated for this Project in material, design, and extent.

E. Provide as-built information as required by the Contract.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

A. Available manufactures: Subject to compliance with requirements, Manufactures offering products that may be incorporated into Work include, but are not limited to, the following:

1. Available manufacturers
   a. Redi Rock International
   b. Versa-Lok Retaining Wall systems
   c. Keystone Retaining Wall systems

2.2 COLORS AND TEXTURES:

A. Colors and Textures

1. Modular Block Retaining Wall Units: As selected by Architect and approved by Owner from manufacturer’s full range.

2.3 MODULAR CONCRETE RETAINING WALL SYSTEM

A. Modular Concrete Retaining Wall System: Use wall system materials and construct in accordance with wall engineer’s design and wall Manufacturer’s specifications to meet performance requirements set forth in this specification.

2.4 WALL UNITS

A. Concrete Units: Comply with ASTM C1372 and following requirements:

1. Face Finish: Sculptured rock face in angular tri-planar configuration or as otherwise approved by Owner.

2. Strength: Minimum 28-day compressive strength of 4000 psi.


4. Concrete Units: Provide concrete units, mini, cap and end units provided by wall Manufacturer for use with selected wall system and as required to meet performance requirements set forth in this specification.
B. Base Leveling Pad Material: Provide and install continuous footing or base material required by wall Manufacturer and wall engineer for use with selected wall system to meet performance requirements set forth in this specification. Do not exceed soil bearing limitations.

C. Unit Fill: Provide and install unit fill material required by wall Manufacturer and wall engineer for use with selected wall system to meet performance requirements set forth in this specification.

D. Backfill Material: Provide and install backfill material required by wall Manufacturer and wall engineer for use with selected wall system to meet performance requirements set forth in this specification. Do not use unsuitable soil for backfill, such as heavy clays or organic soils.

E. Soil and Wall Reinforcement/Stabilization: Provide and install temporary and/or permanent soil and wall reinforcement and stabilization materials required by wall Manufacturer and wall engineer for use with selected wall system to meet performance requirements set forth in this specification. Such materials include, but are not limited to, high density polyethylene expanded sheet, polyester woven fiber materials, mechanical anchors, sheeting, shoring and bracing specifically fabricated for use as soil reinforcement.

F. Non-Corrosive Connectors: Provide pins, clips, or bars to connect successive horizontal rows of concrete blocks, possessing a verifiable strength and durability consistent with design calculations of wall as a whole and required by wall Manufacturer and wall engineer for use with selected wall system to meet performance requirements set forth in this specification.

G. Adhesive: Construction adhesive complying with ASTM 2339 or other material required by wall Manufacturer and wall engineer for use with selected wall system to meet performance requirements set forth in this specification.
2.5 PRECAST CONCRETE RETAINING WALL CAPS

A. Except as otherwise required or recommended by wall Manufacturer and Contractor’s wall engineer for use with selected wall system and to meet performance requirements set forth in this specification, retaining wall caps will meet following minimum specifications:

1. Structural Performance:
   a. Provide precast concrete wall cap units and connections capable of withstanding design loads within limits and under conditions indicated.
   b. Provide cap block capable of accepting fence. see paragraph 2.5 below.
   c. Where cap block extends above grade and is exposed on both sides both sides must be finished and cap must cover entire section of concrete wall units.
   d. Where asphalt paving abuts segmental retaining wall, wall face is to be continuous flat surface.
   e. Provide ½ inch premolded expansion joint filler between wall and any abutting concrete.

2. Materials: comply with pci mnl 117 and following:
   a. molds: provide molds and, where required, form-facing materials of metal, plastic, wood or another material that is nonreactive with concrete and dimensionally stable to produce continuous and true precast concrete surfaces within fabrication tolerances and suitable for required finishes.
   b. Reinforcing bars: ASTM a 615/a 615m, grade 60, deformed.
   c. Portland cement: ASTM c 150, type i or iii.
   d. Normal-weight aggregates: washed, inert, natural sand, or well graded crushed stone or gravel complying with ASTM a 33 and matching aggregate used in cast-in-place retaining wall.
   e. Lightweight aggregates: ASTM C330.
   f. Air-entraining admixture: ASTM C260, certified by manufacture to be compatible with other required admixtures.

3. Accessories:
a. Dowels: round stainless steel bars complying with ASTM A276, type 304, ½-inch diameter.

b. Concrete mix: prepare design mixes for each type of concrete required. Design mixes may be prepared by a qualified independent testing agency or by qualified precast plant personnel.

c. Compressive strength (28 days): 5000 psi.

d. Maximum water-cement materials ratio: 0.45.

2.6 RETAINING WALL FENCE:

A. Fence shall be placed directly into cap of retaining wall as indicated on drawings. Engineer will be responsible for designing wall to account for loading onto fence that will be mounted into cap. Placing fence outside of cap will not be accepted or approved.

PART 3 EXECUTION

3.1 PREPARATION:

A. Place leveling materials upon approved foundation to a minimum thickness of 6 inches. Compact material to provide a level surface. Compaction shall be 95 percent of standard proctor for sand or gravel type materials. Prepare leveling pad to ensure complete contact of retaining wall unit with base.

3.2 SEGMENTAL RETAINING WALL INSTALLATION:

A. Install segmental retaining walls according to modular concrete unit Manufacturer’s written instructions and approved shop drawings. Use wall system materials and construct in accordance with wall engineer’s design and wall Manufacturer’s specifications to meet performance requirements set forth in this specification.

B. Except as otherwise required or recommended by wall Manufacturer and Contractor’s wall engineer for construction of selected wall system to meet performance requirements set forth in this specification, retaining wall construction will meet following minimum specifications:

1. Place first course of concrete wall units on base leveling pad. Check units for levelness and alignment. Ensure that units are in full contact with base.

2. Place units side by side for full length of wall alignment. Install non-corrosive connectors and fill voids at units with unit fill material as required by Manufacturer. Tamp fill.

3. Sweep excess material from top of units and install next course. Ensure each course is complete unit filled and compacted prior to proceeding to next course.
4. Install Soil and Wall Reinforcement/Stabilization system, backfill and continue to lay up wall according to modular concrete unit Manufacturer's written instructions and approved shop drawings. When using geogrid, lay geogrid soil reinforcement horizontally on compacted backfill and connect to concrete wall units as indicated on Manufacturer’s shop drawings. Pull geogrid taut and anchor before backfill is placed on it.

3.3 PRECAST CONCRETE WALL CAP INSTALLATION:

A. Except as otherwise required or recommended by wall Manufacturer and Contractor’s wall engineer for construction of selected wall system to meet performance requirements set forth in this specification, installation of precise wall cap will meet following minimum specifications:

1. Install precast concrete wall caps as indicated. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.

2. Anchor precast units in position as indicated. Remove temporary shims, wedges, and spacers as soon as possible after anchoring and grouting are completed.

3.4 CONSTRUCTION TOLERANCES:

A. Except as otherwise required or recommended by wall Manufacturer and Contractor’s wall engineer for construction of selected wall system to meet performance requirements set forth in this specification, the installation of precise wall cap will comply with following as-built construction tolerances:

B. Vertical Alignment: Do not vary from plumb by more than 1-1/2 inches over any 10-ft distance.

1. Wall Batter: Do not vary more than 1 degrees of design batter.

2. Horizontal Alignment: Do not vary more than 1-1/2 inches over any 10-ft distance.

3. Corners, Bends and Curves: Do not vary 1-ft to theoretical location.


3.5 FIELD QUALITY CONTROL:

A. Testing Agency: Engage a qualified independent testing and inspecting agency to provide quality assurance and testing services during construction. Quality testing shall include foundation soil inspection, soil and backfill testing, and observation of construction.

END OF SECTION
PART 1    GENERAL

1.1 SUMMARY

A. Section includes:

1. Planting of trees, shrubs and bushes.

B. Related Sections:

1. Section 329210– Vegetative Support Material

1.2 REFERENCES


B. American Association of Nurserymen (AAN) Specifications.

1.3 SUBMITTALS

A. Planting Soil Analysis: Furnish a planting soil analysis prepared by a commercial or government agency approved by the Engineer to show that all amendments necessary for good plant growth have been added.

B. Bark Mulch: Furnish one cubic foot with name and address of the supplier.

C. Instructions to the Owner: Furnish complete written instructions for maintenance of the plant materials to the Owner at least ten days prior to the end of the maintenance period in order to familiarize the Owner with the proper care and development of the plantings.

D. Furnish certifications from plant suppliers indicating the botanical name, quantity, and size of plants to be delivered to the project.

E. Inspection and Acceptance: Submit inspection notice and planting plan per Section 3.11.

1.4 QUALITY ASSURANCE

A. Perform Work with experienced personnel under the direction of a skilled foreman with a minimum of three years experience with similar type and size projects.

B. Plants are subject to inspection and approval by the Engineer before delivery for conformity to Specification requirements as to quality, size and variety.
1.5 DELIVERY, STORAGE AND HANDLING

A. Only deliver plant materials immediately prior to installation.

B. Deliver plant materials to the site in accordance with the best horticultural practices to prevent damage.

C. Move and handle plant materials so as to prevent damage to roots and crowns.

D. "Heal-in" plants that cannot immediately be installed with bark mulch or wood chips in a location that protects the plants from sun and wind. Rootballs and containers shall be completely covered and kept consistently moist until installation.

E. Replace damaged and unhealthy plant materials prior to installation as directed by the Engineer.

1.6 WARRANTY

A. Plants shall be true to botanical name and size, and in vigorous healthy growing condition.

B. Plants shall be guaranteed for 1 year from date of original or replacement installation.

PART 2 PRODUCTS

2.1 PLANT MATERIALS

A. Plant material requirements:

1. Nursery grown, conforming to the American Association of Nurserymen Standards.

2. Hardy under climatic conditions similar to those in the locality of the project.

3. Typical of their species or variety, with a normal habit of growth.

4. Sound, healthy and vigorous.

5. Well branched and densely foliated when in leaf.

6. Free of disease, insect pests, eggs or larvae, and with healthy, well-developed root systems.

B. Substitutions shall be permitted only upon written approval of the Engineer.

C. Dimensions shall conform to specifications in the current edition of Horticultural Standards of the American Association of Nurserymen.

D. Types and sizes of deciduous and evergreen plants for this project shall be as shown on the project drawings.
E.  Plant sizes shall conform to measurements specified in the Contract Documents. Use of plants larger than specified will be acceptable if approved by the Engineer, and at no increase to the contract price.

2.2 MISCELLANEOUS MATERIALS

A.  Planting soil shall be prepared based on the following proportions.

   1.  One part dehydrated sterilized manure.

   2.  One part peat moss.

   3.  Three parts vegetative support material with a pH of 6.0 to 6.5.

B.  The following amendments shall be incorporated into the prepared planting soil prior to backfilling of planting pits in accordance with the planting soil analysis.

   1.  Fertilizer: Complete with 70% of the nitrogen derived from organic sources.

   2.  Lime: Ground dolomite limestone; 95% passing through a 100-mesh sieve.

   3.  Super Phosphate: Finely ground phosphate rock as commonly used for agricultural purposes containing not less than 18% available phosphoric acid.

   4.  Bone Meal: Commercial raw bone meal, finely ground, minimum analysis of 1% nitrogen and 18% phosphoric acid.

   5.  Peat Moss: Shall be domestic brown sphagnum peat; natural, shredded or granulated with a pH of 4.0 to 5.0; low in woody material content; free from mineral matter such as sulfuric and iron harmful to plant life; water absorbing capacity of 1100% to 2000%; and moisture content of 30%.

C.  Anti-Desiccant shall be "Wilt-Pruf" or equal approved by Engineer, delivered in manufacturer's containers and used according to manufacturer's instruction.

D.  Bark Mulch shall be 100% fine shredded pine or hardwood bark, free of foreign matter size ranging from ¼ inch to 2 inch.
PART 3 EXECUTION

3.1 PLANTINGS

A. Plant trees and shrubs in pits 12 inches greater in width than the diameter of the root ball. Pit depth shall be sufficient to ensure a minimum of 6 inches of planting soil mixture under plant root system.

B. Set plants in center of pits, plumb and straight and at level that top of root ball is 1 inch lower than surrounding finished grade after settlement.

C. Compact topsoil mixture thoroughly around base of root ball to fill all voids, when plant material is set. Cut all burlap and lacing and remove from top of root ball. Do not pull burlap from under any root ball. Backfill pits halfway with planting soil mixture and thoroughly puddle before backfilling pit. Water planting, again, when each backfill operation is complete.

D. Thoroughly compact topsoil planting mixture around root balls and water. Immediately after plant pit is backfilled, form a shallow saucer slightly larger than pit with ridge of soil to facilitate and contain watering. Grub out sod or other growth and remove from bed area. Rake bed area smooth and neat.

E. Pine bark mulch is to be placed in a 3 inch thickness around the planting. The area to be mulched shall be circular with a diameter of 12 inches greater than the plantings root ball.

F. Mulch is to be contained around the circumference of the planting by means of installing a metal edge strip. Metal edge strips shall be fastened securely in place with tapered metal stakes at 30 inch intervals along the strip. Set edge strips to finished grade.

G. All plantings 10 feet or higher shall be supported by a minimum of 2 wooden stakes driven into the ground within the mulch area. Guide wires with garden hose protection shall be attached.

H. Prune each shrub in accordance with American Association of Nurserymen standards to preserve natural form and character of plant. All pruning is to be done with clean, sharp tools and carried out only by workmen thoroughly familiar with this type of work.

I. Apply antidessicant to all evergreen trees and shrubs and to all deciduous plant materials which are leafed out at time of planting. Rate and method of application in accordance with manufacturer’s recommendations.

J. All plantings shall be in accordance with American Association of Nurserymen standards.
3.2 TIME OF PLANTING

A. The time of planting shall be guided by the schedule below unless otherwise approved by the Engineer based on plant types, weather conditions or other factors that may be detrimental to plant growth.

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Spring</th>
<th>Fall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deciduous</td>
<td>March 15th to June 1st</td>
<td>October 15th to November 1st</td>
</tr>
<tr>
<td>Evergreen</td>
<td>March 15th to June 1st</td>
<td>August 15th to October 1st</td>
</tr>
</tbody>
</table>

3.3 EXISTING CONDITIONS

A. Refer to Drawings showing finish grades. No installation of plants shall take place until all subgrade elevations have been completed.

B. Prior to planting, verify locations and depth of underground utilities. Exercise care when digging in these areas. Assume responsibility for any damage and replace or repair any damage at the Contractor’s expense to the satisfaction of the Engineer.

3.4 FIELD MEASUREMENTS

A. Make all necessary measurements to properly locate the plants as shown on the Drawings. Location and arrangement of plants shall be approved by the Engineer prior to installation.

B. Plants installed prior to approval by the Engineer shall be relocated, if necessary, at no additional cost to the Owner.

3.5 PLANTING PITS

A. Excavate to the depths and widths necessary to achieve the dimensions indicated on the Drawings.

B. Excavated soil and material may be used as a portion of the backfill and planting soil provided it meets the requirements of Section 329003 Section 2.1A and Section 2.2 herein.

3.6 INSTALLING DECIDUOUS AND EVERGREEN PLANTS

A. Place sand or stone drainage layer in the bottom of the pit if required due to wet conditions. Place prepared planting soil and tamp firmly until the required depth is achieved. Place the plant in the center of the pit or spaced in beds as indicated on the Drawings. Set the plant plumb and adjust its height to achieve the elevation shown on the Drawings by placing prepared planting soil beneath the rootball. Burlap, rope, wires or other material shall be cut and removed from the top 1/2 of the rootball and not left in the
planting pit. Backfill around the rootball with prepared planting soil. Uniformly compact and water the prepared planting soil to fill all voids and to firmly secure the rootball.

B. Form a shallow "saucer" at the surface of the planting pit or bed with topsoil. Blend the perimeter of the saucers and beds to form a smooth and uniform transition to the finish grade.

C. Immediately after planting neatly spiral wrap tree trunks from the bottom to the height of the second set of branches. Secure wrapping using suitable methods.

3.7 MULCHING DECIDUOUS AND EVERGREEN PLANTS

A. Cover all tree pits and shrub beds with bark mulch. Neatly outline the edges of the saucer at a uniform radius from the tree trunk.

3.8 PRUNING

A. Prune plants in accordance with American Association of Nurserymen Standards to preserve the natural character of the plant.

B. Remove all dead wood or suckers and all broken or badly bruised branches. Paint cuts over 1 inch in diameter with a tree paint especially manufactured for this purpose. Cover all exposed cambium as well as other exposed living tissue.

3.9 PLANT MAINTENANCE

A. Begin maintenance immediately after planting and continue for 1 year from date all plantings have been installed. Plantings done in late fall after November 1st shall be maintained until the second spring leafing.

B. Continue the maintenance period at no additional cost to the Owner until all previously noted deficiencies have been corrected, at which time the final inspection will be made.

C. All plant materials shall be watered, fertilized, pruned, weeded, and sprayed as required to keep plant material in a healthy growing condition, and to keep planted areas neat and attractive.

D. Provide all equipment and means for proper application of water to plants.

E. Fertilize plants in spring and fall.

F. Protect all planted areas against damage, including erosion and trespassing by providing and maintaining proper safeguards.

G. Reset settled plants to proper grade and position.
3.10 REPLACEMENT OF DECIDUOUS AND EVERGREEN PLANTS

A. Dead or declining plant material shall be removed immediately and replaced as soon as possible with a new, healthy plant of the same type and size as specified, at no additional cost to the Owner. Replacement plants shall be maintained and guaranteed for 1 year from time of replacement.

B. All plant material required under this contact, deemed by the Engineer to be unsightly, unhealthy, or excessively pruned, during and at the end of the guarantee period, shall be replaced as soon as conditions permit.

C. At the end of the maintenance period all plant material shall be in a healthy growing condition.

3.11 INSPECTION AND ACCEPTANCE

A. The Engineer shall be the sole judge of acceptance.

B. All materials and workmanship will be subject to inspection and examination by the Engineer, and he/she shall have the right to reject defective materials and workmanship or require corrections.

C. Submit written notice requesting inspection by the Engineer at least 10 days prior to the end of the maintenance period.

D. Submit planting plans indicating the dates plants were installed for purposes of establishing warranty and replacement dates.

END OF SECTION
PART 1  GENERAL
1.1 SUMMARY
A. Section Includes
   1. Restoration of all vegetated areas disturbed during construction including:
      a. Lawn areas
      b. Grass surfaces
   2. New loam and seed areas
   3. Loam, starter fertilizer, lime, lawn seed
   4. Mulch
B. Related Sections
   1. Section 02 40 00 – Site Preparation
1.2 REFERENCES
A. ASTM D5539 – Standard Specification for Seed Starter Mix
1.3 QUALITY ASSURANCE
A. Place seed only between the periods from April 15th to June 1st, and from August 15th to October 1st, unless otherwise approved by the Engineer.
B. A Certificate of Clean Fill must be provided to Engineer and Owner for approval prior to delivery of any and all fill material including but not limited to, mineral soil, borrow material, structural fill, processed fill material, loam, or top soil to be placed on site during the course of the Work. The Certificate must include laboratory analytical reports for all material to be used at the site on a basis of one sample per every 500 cubic yards or lesser portions thereof. Analytical reports must demonstrate that the proposed material does not contain detectable concentrations of contaminants including but not limited to; petroleum hydrocarbons, semi volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), pesticides, and/or herbicides and that metals listed in the Connecticut Remediation Standard Regulations do not exceed minimal concentrations deemed allowable by Engineer and Owner. No fill material shall be placed on site until Contractor has received approval from Engineer and/or Owner. Engineer and Owner reserves the right to collect and analyze samples from any proposed fill material prior to or after delivery to the site and to allow use of off-specification material at their sole discretion.
The Certificate must clearly state the following and be signed by an authorized signatory employed by the Contractor:

1. Volume of material to be used
2. Process by which the material was obtained
3. Location of origin and summary of current and past site uses of the location of origin
4. Statement from Contractor that the analytical reports included with the Certificate represent the specific material to be used at the site
5. Statement that the Contractor does not know or have reason to believe that the proposed fill material contains foreign materials or contaminants.

1.4 SUBMITTALS

A. Submit the following for approval:

1. Lawn seed mixture including percent by weight of each seed type, and manufacturer/supplier name.

2. Suitable laboratory analysis of the soil to determine the quantity of fertilizer and lime to be applied.

3. Lime and starter fertilizer application rates based on laboratory soil tests.
PART 2  PRODUCTS

2.1  MATERIALS

A.  Loam

1.  Loam shall consist of fertile, friable, natural topsoil typical of the locality without admixture of subsoil, refuse or other foreign materials and shall be obtained from a well-drained arable site. It shall be such a mixture of sand, silt and clay particles as to exhibit sandy and clayey properties in and about equal proportions. It shall be reasonably free of stumps, roots, heavy or stiff clay, stones larger than 1-inch in diameter, lumps, coarse sand, noxious weeds, sticks, brush or other litter. Topsoil as delivered to the site or stockpiled shall have pH between 6.0 and 7.0 and shall contain not less than 5 percent or more than 8 percent organic matter as determined by loss of ignition of moisture-free samples dried at 100 degrees Celsius. The topsoil shall meet the following mechanical analysis:

**PERCENTAGE FINER**

<table>
<thead>
<tr>
<th>Screen Opening</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-in screen opening</td>
<td>100</td>
</tr>
<tr>
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<td>95 to 100</td>
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<td>35 to 75</td>
</tr>
<tr>
<td>0.002 mm*</td>
<td>5 to 25</td>
</tr>
</tbody>
</table>

* Clay size fraction determined by pipette or hydrometer analysis.

2.  Place a minimum of 4 inches of loam.

B.  Starter Fertilizer

1.  Starter fertilizer shall bear the manufacturer’s name and guaranteed statement of analysis, and shall be applied in accordance with the manufacturer’s directions.

2.  Starter fertilizer shall be Scott’s Starter Fertilizer, or equal, with timed nitrogen release to prevent burning.

C.  Lime

1.  Lime shall be an agricultural type ground limestone.

2.  Lime shall be pelletized type for prolonged time release to soil.

D.  Lawn Seed

1.  Seed shall be of the previous year’s crop.

2.  Required ranges:
   a.  Purity > 90%
3. The standard seed mixture shall be applied at a minimum rate of 175 lbs./acre, 4 lbs./1,000 sf.

<table>
<thead>
<tr>
<th>OPEN FIELD MIX</th>
<th>% WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Fescue (Creeping)</td>
<td>60%</td>
</tr>
<tr>
<td>Red Top</td>
<td>10%</td>
</tr>
<tr>
<td>Crown Vetch</td>
<td>30%</td>
</tr>
</tbody>
</table>

4. All seed shall comply with State and Federal seed laws.

5. A sworn certificate indicating each variety of seed, weed content, germination of seed, net weight, date of shipment and manufacturer’s name shall accompany each seed shipment. Responsibility for satisfactory results rests entirely on the Contractor.

E. Mulch

1. Shall be a specially processed 100 percent Virgin wood fiber mulch containing no growth or germination-inhibiting factors. Wood fiber mulch shall be Second Nature Regenerated wood fiber as by Central Fiber Corporation, Wellsville, KS or equal. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogenous slurry. When sprayed on the ground, the material shall allow absorption and percolation of moisture. Each package of the wood fiber shall be marked by the manufacturer to show the air dry weight content and not contain in excess of 10 percent moisture.

PART 3 EXECUTION

3.1 PREPARATION

A. In accordance with Section 024000, salvage all existing loam and stockpile at an acceptable on-site location. Under no circumstances shall existing topsoil be removed from the Project site.

B. The ground surface shall be fine graded and raked to prepare the surface of the loam for lime, fertilizer and seed.

C. Perform a laboratory soil test on the proposed loam before placing any lime, fertilizer, or seed. This work shall be in accordance with ASTM D5539.
D. Loam surface that has been raked smooth and prepared for sod installation shall be watered as directed by grower for plant species supplied.

3.2 LAWN AREAS

A. Apply fertilizer and lime to the surface of the ground in accordance with the manufacturers’ instructions, and based on the results of the certified soils test.

B. Place the seed using a drop or rotary spreader at the rate recommended by the seed manufacturer for the intended use of the lawn or grass area being restored.

C. After spreading the seed, lightly rake the surface to work the seed in. The surface shall then be rolled.

D. All seed on banks and slopes of three to one (3:1) and greater shall be netted and staked.

E. As sodding is completed in any one section, roll the entire section by making four passes with a hand roller weighing not more than 100 lbs/ft of width.

3.3 MAINTENANCE

A. Maintain loamed and seeded areas by mulching, covering, netting, watering and fencing until an acceptable stand of vegetation is approved by the Engineer.

B. The dressed and seeded areas shall be sprinkled with water as necessary from time to time. Signs and barricades should be placed to protect the seeded areas. After the grass has started to grow, all areas and parts of areas that fail to show a uniform stand of grass shall be seeded repeatedly until all areas are covered with a satisfactory growth of grass.

3.4 SPECIAL CONSIDERATIONS

A. Following the final top course of paving, all pavement edges, waterways, sidewalks and berms shall be brought to grade with loam, fine graded, raked, seeded, and rolled to the satisfaction of the Engineer. The final surface of the loam backup shall slope away from the surface edge to allow proper sheeting of runoff. The Contractor shall protect, maintain, and repair seeded areas until a satisfactory start of healthy grass is established.

3.5 RESTORATION

A. In locations where the Work passes through existing grass, weed brush or tree-surfaced areas that are not covered by a specific lawn repair item, surface restoration shall be as follows:

1. After completion of backfilling, the existing loam and organic ground cover materials that were salvaged during excavation shall be returned to the top of the trench.

2. After natural settlement and compaction has taken place, the trench surface shall be harrowed, dragged and raked as necessary to produce a smooth and level surface.
3. The area is then to be sowed with “orchard grass” or “rye grass” or other such materials to hold the soil and produce a growth similar to that existing prior to construction.

3.6 GUARANTEE PERIOD AND FINAL ACCEPTANCE

A. At the end of the guaranteed period, inspection will be made by the Engineer upon written request submitted at least 10 days before the anticipated date. Seeded areas not demonstrating satisfactory stands as outlined above, as determined by the Engineer, shall be renovated, reseeded and maintained meeting all requirements as specified herein.

B. After all necessary corrective work has been completed, the Engineer shall certify in writing the final acceptance of the seeded areas.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

   1. Topsoil

1.2 SUBMITTALS

A. Provide representative samples of borrow materials taken from the source. Tag, label, and package the samples as requested by the Engineer. Provide access to the borrow site for field evaluation and inspection.

B. Provide analytical test results at the rate specified. Results shall indicate whether sample was taken from the upper or lower 6 inches of the vegetative support materials. All samples shall be representative and analyzed for the following:

   pH
   Nitrogen
   Phosphorus
   Potash
   Grain size
   Organic content

PART 2 PRODUCTS

2.1 MATERIALS

A. Vegetative Support Material

   1. Vegetative support material shall consist of fertile, friable, natural topsoil typical of the locality without admixture of subsoil, refuse or other foreign materials and shall be obtained from a well-drained arable site. It shall be such a mixture of sand, silt and clay particles as to exhibit sandy and clayey properties in and about equal proportions. It shall be reasonably free of stumps, roots, heavy or stiff clay, stones larger than 1-inch in diameter, lumps, coarse sand, noxious weeds, sticks, brush or other litter. Topsoil as delivered to the site or stockpiled shall have pH between 6.0 and 7.0 and shall contain not less than 5 percent or more than 8 percent organic matter as determined by loss of ignition of moisture-free samples dried at 100 degrees Celsius. The topsoil shall meet the following mechanical analysis:
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</tbody>
</table>

* Clay size fraction determined by pipette or hydrometer analysis.

2. Prior to stripping, the topsoil shall have demonstrated; by the occurrence upon it of healthy crops, grass or other vegetative growth; that it is reasonably well drained and that it does not contain toxic amounts of either acid or alkaline elements.

A. A Certificate of Clean Fill must be provided to Engineer and Owner for approval prior to delivery of any and all fill material including but not limited to, mineral soil, borrow material, structural fill, processed fill material, loam, or top soil to be placed on site during the course of the Work. The Certificate must include laboratory analytical reports for all material to be used at the site on a basis of one sample per every 500 cubic yards or lesser portions thereof. Analytical reports must demonstrate that the proposed material does not contain detectable concentrations of contaminants including but not limited to; petroleum hydrocarbons, semi volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), pesticides, and/or herbicides and that metals listed in the Connecticut Remediation Standard Regulations do not exceed minimal concentrations deemed allowable by Engineer and Owner. No fill material shall be placed on site until Contractor has received approval from Engineer and/or Owner. Engineer and Owner reserves the right to collect and analyze samples from any proposed fill material prior to or after delivery to the site and to allow use of off-specification material at their sole discretion.

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1. Volume of material to be used
2. Process by which the material was obtained
3. Location of origin and summary of current and past site uses of the location of origin
4. Statement from Contractor that the analytical reports included with the Certificate represent the specific material to be used at the site
5. Statement that the Contractor does not know or have reason to believe that the proposed fill material contains foreign materials or contaminants.

2.2 EQUIPMENT

A. Earth Moving Equipment
B. Adequate types and number of equipment shall be used to ensure that the vegetative support material is spread evenly and at the proper depth to all areas intended to be covered without damaging underlying soil layers or structures.

PART 3 EXECUTION

3.1 INSTALLATION

A. Vegetative support material shall be placed over approved areas to a depth sufficiently greater than required so that after natural settlement and light rolling, the complete work will conform to the lines, grades and elevations indicated. No loam shall be spread in water or while frozen or muddy.

B. The vegetative support material shall be hauled, deposited, spread, compacted, tracked and raked to the lines and grades shown on the Plans or as directed by the Engineer. After the vegetative support material has been spread, it shall be carefully prepared for seeding by spading or harrowing, and raking. All large, stiff clods, lumps, stones, brush, roots, stumps, litter, and other foreign material shall be removed.

C. The compaction shall be equivalent to that produced by a hand roller weighing from 75 to 100 pounds per foot of width. The compaction may be obtained by rolling, dragging or any method that produces satisfactory results. All depressions caused by settlement or rolling shall be filled with additional materials and the surfaces shall be regraded and rolled until it presents a reasonably smooth and even finish and is up to the required grade.

D. During hauling operations, all public and private roadway surfaces shall be kept clean and any topsoil or other dirt which may be brought upon the surface shall be removed promptly and thoroughly before it becomes compacted by traffic. If necessary, the wheels of all vehicles used for hauling shall be cleaned frequently and kept clean to avoid bringing any dirt upon the surface.

3.2 QUALITY CONTROL

A. The responsibility for satisfactory results on work carried out under this item rests entirely on the Contractor regardless of the prior approval of the materials and methods on the part of the Engineer.

B. The Contractor shall provide laboratory test results for the vegetative support material intended for use as specified herein, at a frequency of 1 round per 1,000 cy of material.

C. The Engineer shall randomly sample the borrow material and have a certified analytical laboratory perform testing as described herein. The testing shall be a verification of the results submitted by the Contractor and shall be entirely at the Contractor’s expense.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Precast concrete manholes
2. Precast concrete catch basins
3. Cast iron manhole frames and covers
4. Cast iron catch basin frames and grates

B. Related Sections


1.2 REFERENCES

A. AASHTO – American Association of State Highway and Transportation Officials, Standard Specifications for Highways and Bridges, most recent edition.

B. ASTM C32 - Standard Specification for Sewer and Manhole Brick (made from clay or shale).


1.3 SUBMITTALS

A. Submit Shop Drawings, showing details of construction, reinforcing, joints, pipe connections to structures, manhole rungs, manhole frames and covers, damp proofing coating, catch basin frames and grates.

B. Submit weights of manhole frames and covers and catch basin frames and grates.
C. Submit design calculations including verification of adequate anti-flotation features and lateral earth pressures. Calculations shall verify that the manhole structure has been designed to withstand the burial depth, submergence due to flooding, flotation, and dead and live loads.

D. The Contractor shall record the locations of all underground utilities installed or found during construction. The utilities shall be measured from permanent surface features and compiled by the Contractor on Record Drawings. An as-built survey shall be prepared by a surveyor licensed in the State of Connecticut and in accordance to Wesleyan University Project Close-Out requirements, and submitted to the Owner and Project Engineer for review and approval 2 weeks prior to applying for certificate of occupancy or completion of the project.

1.4 QUALITY ASSURANCE

A. The quality of materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the Engineer, or other representative of the Owner. Such inspection may be made at the place of manufacture, or at the Site after delivery, or at both places, and the materials shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though samples may have been accepted as satisfactory at the place of manufacture. Material rejected after delivery to the job shall be marked for identification and shall be removed from the job at once. Materials which have been damaged after delivery will be rejected, and if already installed, shall be acceptably repaired, if permitted, or removed and replaced, at no additional cost to the Owner.

B. At the time of inspection, the materials will be carefully examined for compliance with the latest ASTM designation specified and these Specifications, and with the approved manufacturer's drawings. Manhole sections will be inspected for general appearance, dimension, "scratch-strength," blisters, cracks, roughness, and soundness. The surface shall be dense and close-textured.

C. Imperfections in manhole sections may be repaired, subject to the approval of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs will be carefully inspected before final approval. Cement mortar used for repairs shall have a minimum compressive strength of 4,000 psi at 7 days and 5,000 psi at 28 days, when tested in 3 inch by 6 inch cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the Engineer.

D. Personnel shall have confined space entry training as appropriate for the work to be performed.

E. Manholes and catch basins shall be designed for lateral earth pressures and to resist flotation.

PART 2 PRODUCTS

2.1 PRECAST CONCRETE MANHOLE AND CATCH BASIN SECTIONS

A. Precast concrete barrel sections and transition top sections, shall conform to ASTM C478 and the following requirements:
1. The wall thickness shall not be less than 5 inches for 48 inch diameter reinforced barrel sections, 6 inches for 60 inch diameter reinforced barrel sections and 7 inches for 72 inch diameter reinforced barrel sections.

2. Top sections shall be eccentric except that flat top sections shall be used where shallow cover requires a top section less than 4 feet as shown on the Drawings.

3. Barrel sections shall have tongue and groove joints.

4. All sections shall be cured by an approved method and shall not be shipped nor subjected to loading until the concrete compressive strength has attained 3,000 psi and not before 5 days after fabrication and/or repair, whichever is longer.

5. Precast concrete barrel sections with precast top slabs and precast concrete transition sections shall be designed for a minimum of AASHTO HS20-44 loading plus the weight of the soil above at 120 pcf.

6. The date of manufacture and the name and trademark of the manufacturer shall be clearly marked on each precast section.

7. Precast concrete bases shall be monolithically constructed. The thickness of the bottom slab of the precast bases shall not be less than the barrel sections or top slab whichever is greater. Precast concrete bases shall be constructed with a 6 inch extended base, unless otherwise shown on the Drawings.

8. Knock out panels for piping shall be provided in precast sections at the locations shown on the Drawings. They shall be integrally cast with the section, 2½ inches thick and shall be sized as shown on the Drawings. There shall be no steel reinforcing in knock out panels.

9. The side wall height of the base section shall be a minimum of 12 inches above the top of the pipe coming into the manholes and catch basins.

10. A 2’-0” deep sump shall be provided below catch basin outlet pipes.

11. Coordinates are provided on the project drawings for the center of structure. Final location of catch basins, yard drains, trench drains, and manhole frames and grates requires coordination with the proposed surface treatments and patterns designed by the Project Landscape Architect. The Contractor shall coordinate the final frames, grates, and covers location and elevation with the Project Landscape Architect.

2.2 BRICK MASONRY

A. Bricks shall be good, sound, hard and uniformly burned, regular and uniform in shape and size, of compact texture. Underburned or salmon brick will not be acceptable and only whole brick shall be used unless otherwise permitted. In case bricks are rejected by the Engineer, they shall be immediately removed from the site of the work and satisfactory bricks substituted, at no additional cost to the Owner.
1. Bricks for the channels and shelves shall comply with the latest specifications of ASTM C32 for Sewer Brick, Grade SM.

2. Bricks for building up and leveling manhole frames shall conform to ASTM C32 Grade MS.

3. Poured concrete inverts will not be allowed.

B. Mortar used in the brickwork shall be composed of one part Type II portland cement conforming to ASTM C150 to two parts sand to which a small amount of hydrated lime not to exceed 10 lbs. to each bag of cement shall be added.

C. Sand used shall be washed, cleaned, screened, sharp and well graded as to different sizes and with no grain larger than will pass a No. 4 sieve. Sand shall be free from vegetable matter, loam, organic or other materials of such nature or of such quantity as to render it unsatisfactory.

D. Hydrated lime shall conform to ASTM C207, Type S.

2.3 MANHOLE FRAMES AND COVERS

A. Manhole frames and covers shall be of good quality, strong, tough, even grained cast iron, smooth, free from scale, lumps, blisters, sand holes and defects of any kind. Manhole covers and frame seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer inspection. Cast iron shall conform to ASTM A48, Class 30B.

B. Manhole covers installed on-site shall have a diamond pattern, pick holes and the word "SANITARY SEWER" or “STORM SEWER”, as appropriate, cast in 3 inch letters. Manhole frame and covers shall be manufactured by LeBaron Foundry; Mechanics Iron Foundry; Neenah Foundry or approved equal. Manhole covers installed in City right-of-way shall conform to applicable City or Water & Sewer requirements.

C. Manhole frames and covers shall comply with the detail shown on the Drawings and their final locations and elevations shall be coordinated with the Project Landscape Architect.

2.4 CATCH BASIN FRAMES AND GRATES

A. On-site catch basin frames and grates shall be of good quality, strong, tough, even grained cast iron, smooth, free from scale, lumps, blisters, sand holes and defects of any kind which render them unfit for the service for which they are intended. Grate and frame seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer inspection. Cast iron shall conform to ASTM A48, Class 30B.

B. The catch basin frames and grates shall comply with the details shown on the Drawings and the landscape drawings and their final locations and elevations shall be coordinated with the Project Landscape Architect.
2.5 JOINTING PRECAST MANHOLE SECTIONS
   A. Tongue and groove joints of precast manhole sections shall be sealed with a preformed flexible joint sealant. The preformed flexible joint sealant shall conform to ASTM C990.

2.6 MANHOLE RUNGS
   A. Manhole rungs shall be drop front design, 14 inches wide with an abrasive step surface, steel reinforced, copolymer, polypropylene, plastic. Manhole rungs shall conform to OSHA requirements.

2.7 FLEXIBLE PIPE-TO-STRUCTURE CONNECTORS
   A. The flexible pipe-to-structure connectors shall be designed to provide a positive seal between the connector and the structure wall and between the connector and the pipe.
   B. The flexible boot shall be manufactured of EPDM synthetic rubber in accordance with ASTM C443 and C923 and shall be 3/8 inch thick or greater.
   C. The external bands shall be made entirely of 304 series non-magnetic stainless steel.
   D. The flexible connectors shall be provided with a wedge-type or toggle-type expander to secure the pipe in the structure opening.
   E. The flexible connectors shall meet the following criteria, in accordance with ASTM C923:
      1. Shall not leak when subjected to a head pressure of 10 psi for 10 minutes.
      2. Shall have the ability to deflect 7 degrees in any direction without leakage under the head pressure conditions described above.
      3. Shall not leak when subject to a load of 150 lbs./in. pipe diameter and the head pressure conditions described above.

2.8 DAMPPROOFING
   A. Provide two coats of bituminous dampproofing on outer surfaces of precast manholes at the rate of 20-25 square feet per gallon in accordance with manufacturer’s instructions.
   B. Dampproofing coating shall be a factory-applied asphalt compound specially made to adhere to below grade concrete structures.
   C. The dampproofing shall be Sonoshield semi-mastic, as manufactured by BASF; Dehydratine 4 by Euclid Chemical; RIW Marine Liquid by Toch Brothers; or approved equal.

2.9 NON-SHRINK, WATER-PROOF GROUT
   A. Non-shrink, water-proof grout shall be Hallemite; Waterplug; Embeco; or equal.
PART 3 EXECUTION

3.1 INSTALLATION

A. Installation

1. Construct manholes and catch basins to the dimensions shown on the Drawings and as specified. Protect all work against flooding and flotation.

2. Set precast concrete barrel sections so as to be plumb and with sections in true alignment with a ¼ inch maximum tolerance to be allowed.

3. Install the precast sections in a manner that will result in a watertight joint. Seal the joints of precast concrete barrel sections with the preformed flexible joint sealant used in sufficient quantity to fill 75% of the joint cavity. Fill the outside and inside precast section joints with non-shrink grout and finish flush with the adjoining surfaces. Plug holes in the concrete barrel sections required for handling or other purposes with a non-shrink, water-proof grout or concrete and rubber plugs, and finish flush on the inside.

4. Backfilling shall be done in a careful manner, bringing the fill up evenly on all sides.

B. Pipe Connections

1. Stubs

   a. Connect pipe stubs for future extensions to the structures as shown on the Drawings and close the stub end by a suitable watertight plug.

2. For pipes with smooth exterior surfaces (PVC, ductile iron, HDPE pressure pipe, steel, etc), use flexible pipe-to-structure connectors.

3. Where flexible pipe-to-structure connectors cannot be used, such as pipes with rough, irregular or corrugated exterior surfaces (concrete, corrugated metal, HDPE drainage pipe, etc):

   a. After the new pipe has been set in place, completely fill the hole around the new pipe and structure with non-shrink, water-proof grout.

   b. Place a 6 inch thick concrete encasement a total of 12 inches in length around the pipe stub adjacent to the exterior wall of the structure. Concrete shall have a 28 day compressive strength of 3,000 psi.

C. Manhole Rung Installation

1. Steel reinforced copolymer polypropylene plastic steps shall be press fitted by hand driven hammer into preformed holes in cured precast sections, on 12 inch centers, by the precast concrete manufacturer.
D. Brickwork

1. Mix mortar only in such quantity as may be required for immediate use and use before the initial set has taken place. Do not retain mortar for more than one and one-half hours and constantly work over with a hoe or shovel until used. Anti-freeze mixtures will not be allowed in the mortar. No masonry shall be laid when the outside temperature is below 40°F unless provisions are made to protect the mortar, bricks, and finished work from frost by heating and enclosing the work with tarpaulins or other suitable material. The Engineer’s decision as to the adequacy of protection against freezing shall be final.

2. Construct channels and shelves of brick as shown on the Drawings. The brick channels shall correspond in shape with the lower half of the pipe. The top of the shelf shall be set at the elevation of the crown of the highest pipe and shall be sloped 1 inch per foot to drain toward the flow through channel. Construct brick surfaces exposed to sewage flow with the nominal 2 inch by 8 inch face exposed (i.e., bricks on edge).

3. Set manhole covers and frames and catch basin frames and grates in a full mortar bed and bricks, a maximum of 12 inches thick for conical tops and 6 inches thick for flat top sections, utilized to assure frame and cover are set to the existing grade. Reset the manhole frames and covers and catch basin frames and grates to final grade prior to placement of final paving.

3.2 LEAKAGE TEST

A. Leak test sewer manholes in conjunction with the pipeline in accordance with Section 333114 – Testing of Sanitary Sewer and Storm Drainage Systems.

3.3 CLEANING

A. Clean new manholes and catch basins of silt, debris and foreign matter of any kind, prior to final inspection.

END OF SECTION
PART 1  GENERAL

1.1  SUMMARY

A. Section Includes

1. Breaking through the walls and inverts of existing manholes and catch basins.

2. Connecting new pipes to existing structures.

3. Ancillary work associated with making the new connections to the existing structures.

1.2  REFERENCES


1.3  SUBMITTALS

A. Submit shop drawings showing pipe connection details.

1.4  QUALITY ASSURANCE

A. Personnel shall have confined space entry training as appropriate for the work to be performed.

PART 2  PRODUCTS

2.1  MATERIALS

A. Flexible Pipe-to-Structure Connectors

1. The flexible connectors shall be designed to provide a positive seal between the connector and the structure wall and between the connector and the pipe.

2. The flexible boot shall be manufactured of EPDM synthetic rubber in accordance with ASTM C443 and C923 and shall be 3/8 inch thick or greater.

3. The external bands shall be made entirely of 304 series non-magnetic stainless steel.

4. The flexible connectors shall be provided with a wedge-type or toggle-type expander to secure the pipe in the structure opening.

5. The flexible connectors shall meet the following criteria, in accordance with ASTM C923:
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a. Shall not leak when subjected to a head pressure of 10 psi for 10 minutes.

b. Shall have the ability to deflect 7 degrees in any direction without leakage under the head pressure conditions described above.

c. Shall not leak when subject to a load of 150 lbs./in. pipe diameter and the head pressure conditions described above.

B. Non-shrink, water-proof grout

1. Non-shrink, water-proof grout shall be Hallemite; Waterplug; Embeco; or equal.

C. Piping

Install additional piping segments as required to make the final tie-in. Match existing piping materials unless otherwise noted on the plans. Replace clay tile pipe or asbestos cement pipe with HDPE, RCP, DIP, or PVC pipe as shown on the Contract Drawings or as required by the Engineer.

PART 3  EXECUTION

3.1 INSTALLATION

A. General

1. Core drill into existing structures in such a fashion as to make an opening of suitable size to accommodate the connecting pipe without excessive damage to the existing structure.

B. Manholes

1. For manholes, break out and rebuild existing inverts as required to provide an adequate base under the new channels being installed, and shaped to provide smooth continuous hydraulic flow through the manhole.

2. Control existing flows as required during the period of construction. No sewage or drainage will be permitted to flow directly against concrete or other masonry work until it is at least 48 hours old.

a. Temporary handling of sewage or drainage flows may be accomplished by inserting pipes from the inlet to the outlet of the manhole and by using temporary plugs, where appropriate, provided that such pipes do not interfere with satisfactory completion of the work and shaping of the inverts, nor cause excessive backing-up in the existing system upstream of the diversion. In cases where this type of temporary handling of flows is not possible, provide the necessary dams, plugs, etc., as required in upstream manholes, and pump the flow around the structure under construction.
b. When sewage is pumped or otherwise diverted around a particular structure, it shall be discharged back into the sewage system through existing downstream manholes. Under no circumstances shall sewage be permitted to run onto the surface of the ground.

C. Catch basins

1. All catch basin openings, created as a result of the removal and replacement of the existing drains connected to the catch basins with new drain pipes, shall be sealed. This work shall be performed using masonry to match existing construction, where applicable, and non-shrink grout to provide a neat patch.

D. Pipe Connections

1. Rebuild and tightly close existing manhole walls and inverts and catch basin walls to provide an integral, water-tight structure around the new pipes.

2. For pipes with smooth exterior surfaces (PVC, ductile iron, HDPE, steel, etc), use flexible pipe-to-structure connectors.

3. Where flexible pipe-to-structure connectors cannot be used, such as pipes with rough, irregular or corrugated exterior surfaces (concrete, corrugated metal or HDPE, etc):
   a. After the new pipe has been set in place, completely fill the hole around the new pipe and structure with non-shrink, water-proof grout.
   b. Place a 6 inch thick concrete encasement a total of 12 inches in length around the pipe stub adjacent to the exterior wall of the structure. Concrete shall have a 28 day compressive strength of 3,000 psi.

END OF SECTION
PART 1  GENERAL

1.1  SUMMARY

A.  Section Includes

1.  Testing of Storm Drainage Systems

2.  Testing of Gravity Sewer Systems

PART 2  PRODUCTS

NOT USED

PART 3  EXECUTION

3.1  TESTING OF STORM DRAINAGE SYSTEMS

A.  Storm drainage pipes shall be sighted to insure that pipes are straight between structures, correctly sloped, clean of debris and sediment and generally free flowing.  Alignment shall meet the requirements of Paragraph 3.2.G.

B.  Storm drainage structures shall be sighted to insure that all structures are clean of debris and sediment, have frames, covers, grates, inverts, sumps, and other specified appurtenances installed.

C.  All PVC or HDPE drainage pipe shall be tested for deflection in accordance with Paragraph 3.2.E after forty five (45) days from completion of backfill operations.

3.2  TESTING OF GRAVITY SANITARY SEWER SYSTEMS

A.  All gravity sewers shall be tested for allowable leakage by low pressure air test or by an infiltration/exfiltration water test as described herein.

B.  Low Pressure Air Test

1.  After completing backfill of a section of pipe including laterals, conduct a line acceptance test using low-pressure air.  The test shall be performed according to the specified procedures and under the supervision of the Engineer.  Follow the testing procedures outlined below.

2.  Seal test pneumatic plugs before use in the actual test installation.  Lay one length of pipe on the ground and seal at both ends with the pneumatic plugs to be checked.  Introduce air into the plugs to 25 psig.  Pressurize the sealed pipe to 5 psig.  The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.

3.  After a manhole reach of pipe has been backfilled and cleaned, and the pneumatic plugs have been checked, place the plugs in the line at each manhole and inflate to
25 psig. Introduce low pressure air into this sealed line until the internal air pressure reaches 4 psig greater than the average back pressure of any groundwater that may be over the pipe. Allow a minimum of two minutes for the air pressure to stabilize. After the stabilization period (3.5 psig minimum pressure in the pipe), disconnect the air hose from the control panel to the air supply. The portion of the line being tested has passed the test if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig (greater than the average back pressure of any groundwater that may be over the pipe) is not be less than the time shown for the given diameters and lengths in Table 1 at the end of this section.

4. Air tests shall cover a 1.0 psig pressure drop; 0.5 psig pressure drop tests are not acceptable.

5. In areas where groundwater is known to exist, install a one-half inch diameter capped pipe nipple, approximately 10 inches long, through the manhole wall on top of one of the sewer lines entering the manhole. The nipple shall be installed at the time the sewer line is installed. Immediately prior to the line acceptance test, determine the elevation of the groundwater by removing the pipe cap, blowing air through the pipe nipple to remove any obstructions, and then connecting clear plastic tube to the nipple. Hold the hose vertically and measure the height after the water has stopped rising in this plastic tube. Divide the height in feet by 2.3 to establish the pressure in pounds per square inch (psig) that will be added to all readings. (For example, if the height of water is 11-1/2 feet, then the added pressure will be 5 psig. This increases the 3.5 psig to 8.5 psig, and the 2.5 psig to 7.5 psig. The allowable drop of one pound per square inch and the timing remain the same.)

6. The maximum starting test pressure should not exceed 9 psig, regardless of groundwater level above the pipe. If the groundwater level is such that the added pressure would be greater than 5.5 psig (12.7 feet), the pipe section may be tested using a starting pressure of 9 psig.

7. Each pipe nipple installed to measure groundwater levels should be recapped subsequent to the air testing procedure to prevent future infiltration.

8. As an alternative to installing a pipe nipple in a manhole to measure the height of groundwater, excavate a test pit over the pipe to determine the height of groundwater.

C. Vacuum Test for Manholes - Gravity Sewer Lines

1. After a manhole has been constructed, conduct a manhole acceptance test using the following vacuum test procedure:
   a. Plug all lift holes with an approved non-shrink grout.
   b. Plug all pipes entering the manhole, taking care to securely brace the plug from being drawn into the manhole.
   c. Place the test head at the inside of the top of the precast concrete cone section and inflate the seal in accordance with the manufacturers' recommendations.
d. Draw a vacuum of 10 inches of mercury and shut off the vacuum pump. With the valves closed, measure the time for the vacuum to drop to 9 inches. The manhole shall pass if the time is greater than:

1 min. 0 sec. for 0-ft. to 10-ft. deep manholes

1 min. 15 sec. for 10-ft. to 15-ft. deep manholes

1 min. 30 sec. for 15-ft. to 25-ft. deep manholes

e. If the manhole fails the initial test, make repairs with a non-shrink grout. Retest until a satisfactory test is obtained.

D. Infiltration/Exfiltration Test

1. All gravity type sewers shall be subjected to either an infiltration or an exfiltration test unless otherwise specified. The type of test required will be contingent upon groundwater conditions in the area where lines are to be tested. These tests shall include losses or gains through manholes as well as through pipe walls and joints, as well as through house connection fittings and pipe. No building shall be connected to a newly installed sewer until the sewer has been satisfactorily tested.

2. Where lines are installed in areas having a high groundwater level, conduct an infiltration test of a minimum four hour duration under the supervision of the Engineer. Isolate various sections of the sewer using watertight plugs and measure the quantity of water entering the pipe during a predetermined time. If the conditions are such that groundwater table varies depending on surrounding influence and time of the year or if the table elevation is unknown at the time of testing, excavate test holes as directed by the Engineer.

3. Where lines are installed in relatively dry areas, conduct an exfiltration test. Conduct this test by isolating various sections of the line using watertight plugs and filling the line with water to a predetermined level. Determine the loss of water in a predetermined time by measuring the quantity of water required to refill the line to the original level.

4. The Engineer will determine the length of line to be tested at one time, depending on the grade of the sewer.

5. Include losses through manholes in determining the loss in a line. For exfiltration test, fill manholes to the bottom of the cone or flat top section and allow to stabilize before beginning test. Refilling to reference line may be required before commencing test.

6. The maximum acceptable loss, through either infiltration or exfiltration, shall not exceed 100 gallons per mile per 24 hours per inch of diameter of the pipe tested. When two or more pipeline sections are tested at the same time, the allowable leakage for the shortest section shall be used as the acceptable loss for the entire length being tested.
E. Allowable Deflection Test for PVC or HDPE Pipe (Sewer or Drain Pipe) - Unless otherwise specified, all gravity and drain PVC or HDPE pipe shall be tested for allowable deflection in accordance with the procedure noted below.

1. Pipe deflection measured not less than 45 days after the backfill has been completed as specified shall not exceed 5 percent. Deflection shall be computed by multiplying the amount of deflection (average outside diameter less twice the average wall thickness diameter when measured) by 100 and dividing by the nominal diameter of the pipe.

2. Deflection shall be measured with a rigid mandrel (Go-No-Go) device cylindrical in shape and constructed with a minimum of nine or ten evenly spaced arms or prongs. Submit drawings of the mandrel with complete dimensions for each diameter of pipe to be tested. Hand pull the mandrel through all sewer and drain lines.

3. Uncover any section of pipe not passing the mandrel and replace the bedding and backfill to prevent excessive deflection. Retest repaired pipe immediately upon backfilling of trench until acceptable.

4. Retest the repaired section of pipeline from manhole to manhole again after the 45 day backfill period until acceptable.

F. Test Failures

1. In case leakage or deflection exceeds the above specified amount, locate the failure and repair them at no additional cost to the Owner.

2. Pipelines with shear-type breaks, fishmouths or damaged gaskets, cracked bells or couplings, hairline fractures, or structural damage shall be replaced in kind. Mechanical sleeve couplings, poured concrete collars or similar repairs are not permitted. The use of pressure grouting repair techniques will not be allowed without the written consent of the Engineer.

3. After repairs have been made, re-test the line and repeat the process of repairing and re-testing until results within the above specified limits are obtained.

G. Alignment of Gravity Sewers and Drains

1. Lay gravity sewers and drains accurately to line and grade.

2. After the pipe is laid and backfill complete, visually inspect the interior of the pipe from manhole to manhole. If it is not possible to sight from manhole to manhole through the pipe, the alignment is considered unacceptable.

3. If the alignment is unacceptable due to horizontal displacement, the Contractor will be allowed to construct intermediate manholes at his own expense. If the alignment is unacceptable due to vertical displacement, remove and replace the pipe to the proper grade.
3.3 PAYMENT FOR TESTS

A. No separate payment will be made for preparing or carrying out tests of pipelines or structures. Furnish all materials, equipment, gauges, pumps, specials, temporary tappings in line, and water or other things required for making the tests. Test all manholes and pipe installed as part of the Work.
<table>
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<th>Pipe Diameter (in.)</th>
<th>2 Minimum Time (min:sec)</th>
<th>3 Length for Minimum Time (ft)</th>
<th>4 Time for Longer Length (sec)</th>
<th>Specification Time for Length (L) Shown (min:sec)</th>
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END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. High density polyethylene (HDPE) pipe for:
   a. Storm drainage lines.

2. Types of HDPE piping specified in this section include:
   a. Corrugated exterior, smooth interior, solid wall HDPE pipe.
   b. Corrugated exterior, smooth interior, perforated HDPE pipe

B. Related Sections

1. Section 312333 – Trenching and Backfilling

2. Section 333114 – Testing of Sanitary Sewer and Storm Drainage Systems

1.2 REFERENCES

A. AASHTO M252 – Corrugated Polyethylene Drainage Pipe

B. ASSHTO M294 – Corrugated Polyethylene Pipe, 300- to 1200-mm Diameter

C. AASHTO MP7 – Corrugated Polyethylene Pipe, 1300- to 1500-mm Diameter

D. ASTM D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials For Wire and Cable

E. ASTM D2239 – Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

F. ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications


H. ASTM D2683 – Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing

J. ASTM D2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping


O. ASTM F405 – Standard Specification for Corrugated Polyethylene (PE) Tubing and Fittings

P. ASTM F667 – Standard Specification for Large Diameter Corrugated Polyethylene Pipe and Fittings


1.3 SUBMITTALS

A. Submit product data on the pipe, fittings, and accessories.

B. Prior to first shipment of pipe, submit certified test reports that the pipe for this Contract was manufactured and tested in accordance with the appropriate ASTM standards specified herein.

C. Submit layout of pipe, fittings, cleanouts, horizontal and vertical bends, flexible couplings, inverts, etc. of all exterior roof leader drainage distribution systems.

D. The Contractor shall record the locations of all underground utilities installed or found during construction. The utilities shall be measured from permanent surface features and compiled by the Contractor on Record Drawings. An as-built survey shall be prepared by a surveyor licensed in the State of Connecticut and in accordance to Yale University Project Close-Out requirements, and submitted to the Owner and Project Engineer for review and approval 2 weeks prior to applying for certificate of occupancy.

1.4 DELIVERY, STORAGE AND HANDLING

A. When lifting with slings, only wide fabric choker slings capable of safely carrying the load shall be used. Wire rope or chain shall not be used to handle pipe.

PART 2 PRODUCTS

2.1 MANUFACTURER – GENERAL

334113-2 High Density Polyethylene Pipe
A. The manufacturer shall have manufacturing and quality assurance facilities capable of producing and assuring the quality of the pipe and fittings required by these specifications.

B. Pipe and fittings from different manufacturers shall not be interchanged for the same type of pipe and application.

2.2 PIPE IDENTIFICATION

A. The following shall be continuously indent printed on the pipe or spaced at intervals not exceeding five-feet:

1. Name and/or trademark of the pipe manufacturer.

2. Nominal pipe size.

3. Dimension ratio.

4. The letters “PE” followed by the polyethylene grade in accordance with the ASTM designation, followed by the hydrostatic design basis in PSI.

5. A production code from which the date and place of manufacture can be determined.

2.3 CORRUGATED EXTERIOR / SMOOTH INTERIOR HDPE PIPE AND FITTINGS

A. General

1. The polyethylene pipe and fittings shall comply with AASHTO M294, Type S (smooth wall interior).

2. Piping shall be manufactured by Advanced Drainage Systems, Inc., or approved equal.

3. Pipe material and fittings shall be high density polyethylene meeting ASTM D3350 minimum cell classification 324420C (4”-10”) or 325420C (12”-60”).

4. Installation shall be in accordance with ASTM D2321.

5. Pipe shall be joined with the bell-and-spigot joint. Gaskets and joint lubricant shall be utilized.

6. Minimum parallel plate pipe stiffness shall be as recommended for each specified diameter pipe per ASTM Test Method D2412.

7. The pipe and fittings shall be free of foreign inclusions and visible defects. The ends of the pipe shall be cut squarely and cleanly so as not to adversely effect joining.

8. The nominal size of the pipe and fittings is based on the nominal inside diameter of the pipe. Corrugated fittings may be either molded or fabricated by the manufacturer.
Fittings and gaskets supplied by manufacturers other than the supplier of the pipe shall not be permitted without the approval of the Engineer.

2.4 JOINTS FOR CORRUGATED PIPING

A. General

1. Joints of smooth interior, corrugated pipe sections shall be as per manufacturer’s instructions utilizing gasketed PVC or HDPE joints meeting ASTM D-3212 and ASTM C969 watertight field test.

2. Installation shall be in accordance with ASTM Recommended Practice D-2321 or as specified by the Engineer or local approving agency.

B. Watertight Pipe – ADS N12 WT

1. Provides superior watertight performance.

2. Meets ASTM D3212 requirements of 10.8 PSI for 10 minutes with no leakage.

3. Shall be ADS, N-12 IB WT (watertight joint type) piping, or approved equal.

C. Manhole Boot Connection

1. Watertight seal made with rubber manhole boot as manufactured by Press Seal, or equal.

2. Alternatively, watertight seal made by Alok, or approved equal, in which case maximum insertion angle is 7 degrees.

D. Watertight Seals for Corrugated HDPE Pipe - Shall be NPC Corrugated Pipe Adapter compatible with Kor-N-Seal manhole connector.
2.5 CORRUGATED INTERIOR/SMOOTH EXTERIOR SLOTTED HDPE PIPE

A. Corrugated, slotted, HDPE tubing shall meet AASHTO M-252. Slotted tubing shall be supplied factory wrapped in a polyester geotextile filter sock. The filter sock shall have a minimum weight of 3.0 oz/square yard, a minimum burst strength of 100 psi, and an apparent opening size of 35.

B. A manufacturers’ certification that the product was manufactured, tested, and supplied in accordance with this specification shall be furnished to the Engineer upon request.

C. There shall be a minimum soil cover of 12 inches, as measured from the top of the pipe, for H-20 loading conditions.

D. Filter Fabric Wraps

1. Extra strong synthetic materials are to be used with perforated drainage pipe to prevent infiltration of fine soil particles while allowing water to flow freely.

2. Material shall be ADS Sock, as manufactured by Advanced Drainage Systems.

PART 3 EXECUTION

3.1 PREPARATION

A. The Contractor shall verify that the surface has been prepared to the proper line and grade by shooting invert elevation grades.

3.2 INSTALLATION

A. Open-Cut Installations

1. Polyethylene pipe and fittings shall be installed in accordance with ASTM Standards, and the manufacturer’s recommendations.

2. Pipe is to be lifted or rolled into position, not dragged over the prepared bedding.

3. The pipe is to be set at the slope and grades indicated on the plans. Ensure pipe remains at proper grades by shoring it.

4. All HDPE piping shall be bedded in 6” of crushed stone unless noted otherwise.

5. Crushed stone shall be used as backfill to a point of 6” above the top of the pipe unless noted otherwise.

6. Clay dams shall be installed in the stone backfill as directed by the Engineer to prevent groundwater migration. Spacing shall be 50 ft. maximum. Clay borrow shall be in

334113-5 High Density Polyethylene Pipe
accordance with Section 311100 – Site Utility Borrow Material requirements for low permeability borrow.

7. Open-Trench Installations - Prepare the area in accordance with Section 312333 – Trenching and Backfilling.

8. No single piece of pipe shall be laid unless it is generally straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16 inch per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site. Laying instructions of the manufacturer shall be explicitly followed.

9. Install piping and fittings true to alignment and grade. If necessary, each length of pipe shall be cleaned out before installation.

B. Joint Couplings

1. Joint couplings shall be installed in accordance with manufacturer’s recommendations.

2. Remove the protective paper and wrap the collar around the pipe with the mastic side to the pipe. The overlap shall be at the top of the pipe.

3. Secure the steel straps.

4. The closing flap shall cover the exposed straps.

5. Encase the entire joint with a minimum of 8 inches of concrete on all sides. The concrete encasement shall extend along the pipe 12 inches on each side of the joint.

3.3 TESTING

A. Pressure Testing

1. All sections of polyethylene drain and sewer pipe shall be tested in accordance with Section 333114.

END OF SECTION
PART 1  GENERAL

1.1 SUMMARY

A. Section Includes

1. Underground Warning Tape

1.2 SUBMITTALS

A. Shop Drawing Submittals

1. Product Data

PART 2  PRODUCTS

2.1 MATERIALS

A. Metallic warning tape for underground piping shall be polyethylene tape with metallic core for easy detection and location of piping with a metal detector.

B. Tape shall be 6 inches wide.

C. Tape shall be as manufactured by Seton Name Plate Corp., New Haven, CT; Presco Detectable Underground Warning tape, Sherman, Texas; Blackburn Manufacturing, Neligh, NE; Mercotape, Hachensach, NJ; or approved equal. The warning tape shall be heavy gauge 0.004 inch polyethylene and shall be resistant to acids, alkalis and other soil components. It shall be highly visible in the following colors with the associated phrases stamped in black letters and repeated at a maximum interval of 40 inches.

<table>
<thead>
<tr>
<th>Type of Utility</th>
<th>Color</th>
<th>Warning Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sanitary Sewer</td>
<td>Green</td>
<td>CAUTION - SANITARY SEWER BURIED BELOW</td>
</tr>
<tr>
<td>Storm Drain</td>
<td>Green</td>
<td>CAUTION - STORM DRAIN BURIED BELOW</td>
</tr>
<tr>
<td>Water</td>
<td>Blue</td>
<td>CAUTION – WATER LINE BURIED BELOW</td>
</tr>
<tr>
<td>Electric</td>
<td>Red</td>
<td>CAUTION – ELECTRIC LINE BURIED BELOW</td>
</tr>
<tr>
<td>Telephone / Communications</td>
<td>Orange</td>
<td>CAUTION – TELEPHONE LINE BURIED BELOW</td>
</tr>
<tr>
<td>Gas</td>
<td>Yellow</td>
<td>CAUTION – GAS LINE BURIED BELOW</td>
</tr>
</tbody>
</table>

D. The tape shall be of the type specifically manufactured for marking and locating utilities.
PART 3  EXECUTION

3.1  INSTALLATION

A.  All buried pipe and fittings shall be installed with metallic-lined underground warning tape located approximately 18 inches below grade to allow detection by a metal detector.

END OF SECTION