SECTION - EARTHWORK

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. The work to be done under this Section consists of furnishing all materials, labor, tools and equipment, and performing all operations necessary to complete excavation of all types of material encountered, placing of excavated material in embankments, or backfill, disposal of unsuitable and/or surplus material, and furnishing and placing borrow materials; necessitated by conditions encountered in the course of the work and as herein specified.

B. The work shall include power and/or hand excavation, stockpiling, rehandling and all incidental work.

C. The work includes, but is not limited to, the following items:

1. Miscellaneous and extra earth excavation and backfilling.
2. Excavation of rock or boulders, existing paving, foundations, or other underground structures, and pipe lines.
3. Control of water by ditching, pumping, well point systems or other methods.
4. Compaction of embankment, fills, and backfills.
5. Furnishing, placing and compacting gravel borrow materials.
6. Disposal of surplus and/or unsuitable materials. Such materials shall be hauled off the site.
7. Excavation below grade as specified when necessitated by type of material encountered, as ordered by the Superintendent of the Somerset Highway Department.
8. Silt and erosion control.
9. Topsoil removal, stockpiling, reuse.

1.02 STANDARDS

A. The following standards form a part of these Specifications:

1. ASTM C 131
   Test Method for Resistance to Degradation of Small Size
   Coarse Aggregate by Abrasion and Impact in the Los Angelas Machine.

2. ASTM C 136
   Method for Sieve Analysis of Fine and Coarse Aggregates.

3. ASTM C 330
   Specification for Lightweight Aggregate for Structural Concrete.

4. ASTM D 1556
   Test for Density of Soil in Place by the Sand-Cone Method.

5. ASTM D 1557
   The Moisture-Density Relations of Soils and Soil Aggregate Mixture Using a 10 lb. (4.5 kg) Rammer and an 18-in. (145 mm) Drop.

6. ASTM D 2922
   Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

7. AASHTO T238-86
   Standard Specifications of Density of Soils and Soils-Aggregate.

8. AASHTO T239-91
   Moisture Control of Soils and Soils Aggregate.

PART 2 PRODUCTS

2.01 MATERIALS

A. Gravel Borrow, Gravel Borrow for backfill, pipe bedding in and/or replacement of unsuitable material in trenches, shall be either graded bank-run gravel or screened gravel consisting of hard, durable particles, practically free from loam or clay.

Gravel borrow shall meet the requirements listed in MDPW Specification Section M1. 03. 0, Type b. and following gradation requirements:

Sieve (Square Openings)	Percent Passing (By Weight)
3”	100
½”	50 - 85
No. 4	40 - 75
No. 50	8 - 28
No. 200	0 – 8

B. Crushed Stone

1. Crushed stone for pipe bedding in rock trench shall consist of durable crushed rock consisting of the angular fragments obtained by breaking and crushing solid or shattered natural rock and shall be reasonably free from thin, flat elongated or other objectional pieces.

2. The crushed stone shall be free from any organic soil or perishable material and not more than 1.0 percent by weight of satisfactory material passing a No. 200 sieve will be allowed to adhere to the crushed stone, and the stone shall meet the following gradation requirements:

Sieve (Square Openings)	Percent Passing (By Weight)
5/8”	100
½”	85 - 100
3/8”	15 - 45
No. 4	0 - 15
No. 8	0 – 5

3. Crushed stone shall satisfy the requirements listed in MDPW Specification Section M2. 01.

C. Common Fill. Material imported or excavated on site which is easily crumbled, natural soils composed of gravel, sand, or silty or clayey gravel and sand; free from debris, concrete or other rubber, organic matter muck, peat, excavated rock or boulders over 4 inches in maximum dimension.

D. Gravel Base for Pavement. Use material conforming to Dense-graded crushed stone for sub-base of Standard Specification for Highways and Bridges, Commonwealth of Massachusetts, meeting following gradation requirements:

Sieve (Square Openings)	Percent Passing (By Weight)
2”	100
1” - ½”	70 - 100
3/4”	50 - 85
No. 4	30 - 55
No. 50	8 - 24
No. 200	3 – 10

E. Sand Borrow. Sand borrow shall satisfy the requirements listed in MDPW Specification Section M1. 04. 0.

F. Controlled Density Fill (CDF). CDF shall satisfy the requirements listed in MDPW Specification Section M4. 08. 0.

2.02 FILTER FABRIC

A. Filter fabric used as a drainage medium and to prevent intrusion of subgrade soils shall consist of a non-woven fabric made from polyethylene, polyester, or polypropylene filaments or yarns. The fabric shall be non-rotting, acid and alkali resistant, and inert to organic chemicals commonly encountered in the soil.

1. The geotextile fabric for pipe bedding drainage media shall be a nonwoven fabric having sufficient strength and permeability for the purpose intended and shall meet the following minimum standards:

Property	ASTM Std.	Requirements
Puncture Strength	ASTM D4833	40 lbs.
Mullen Burst Strength	ASTM D3786	140 psi
Trapezoid Tear Strength	ASTM D4533	150 lbs.
Grab Strength	ASTM D4632	50 lbs.
Apparent Opening Size (AOS)	ASTM D4751	70 lbs.

B. All fabric shall be free of any flaws or defects which will alter its physical properties. Torn or punctured fabric will not be used. Only commercially available fabric which is certified in writing by the manufacturer for the purpose intended shall be used. The Contractor shall submit a two foot square sample of fabric to be used along with technical data, certified test reports, materials certificates, and certificates of compliance. The Town reserves the right to reject any which he deems unsatisfactory for the specific use. The brand name shall be labeled on the fabric or the fabric container. Fabrics which are susceptible to damage from sunlight or heat shall be so identified by suitable warning information on the packaging material. Fabrics susceptible to sunlight damage shall not be used in any installation where exposure to light will exceed 30 days, unless specifically authorized in writing by the Authority.

C. Materials incidental to installation of the filter fabric shall conform to the manufacturer of the filter fabric.

D. The filter fabric shall be placed in accordance with the manufacturer's recommendations and as specified herein.

PART 3 EXECUTION

3.01 GENERAL

A. All equipment and methods for excavation shall be submitted to the Somerset Highway Department for review, particularly as to adequacy and suitability to accomplish the work in a safe and satisfactory manner.

B. Grade line for pipes and masonry is 6 inches below the pipe or masonry except as otherwise specified or shown on the Drawings.

C. No pipeline or structures shall be constructed in areas to be filled until the fill has been placed and compacted to at least 2 feet above the grade line of the pipe or bottom of the slab of the structure.

D. Subgrade at the bottom of excavation shall be undisturbed, or restored at the Contractor's expense. Unauthorized over excavation shall be replaced with compacted gravel borrow as approved by the Superintendent of the Somerset Highway Department.

E. All suitable excavated material shall be used for topsoil, fill or embankment to the extend needed. Suitability of materials shall be determined by the Superintendent of Somerset Highway Department. Such use of excavated materials may include stock-piling until needed.

F. All unsuitable or surplus excavated material shall be removed from the site. The Contractor shall be wholly responsible for the disposal of such excavated material. Such disposal shall be in strict compliance with all State rules, regulations, ordinances and laws which regulate and control the dumping on and filling of land.

G. All disposal of excavated material is included in the prices for the various categories of excavation.

H. Except when otherwise specifically approved, all excavation shall be performed in the dry.

I. On paved surfaces the Contractor shall not use or operate tractors, bulldozers, or other power-operated equipment with treads or wheels which are shaped so as to cut or otherwise damage such surfaces. The Contractor shall replace or repair any paved surfaces damaged by such equipment at his own expense.

3.02 EARTH EXCAVATION BELOW GRADE

Wherever, in the opinion of the Superintendent of Somerset Highway Department, the material at or below grade line is unsuitable for pipe bedding, it shall be excavated to such additional depths as authorized in writing by the Superintendent of the Somerset Highway Department, and shall be refilled with gravel borrow. This material shall be compacted to not less than 95 percent of maximum dry density determined by ASTM Standard D1557, Method C.

3.03 MISCELLANEOUS AND EXTRA EARTH EXCAVATION

Wherever authorized by the Superintendent of Somerset Highway Department, the Contractor shall do excavation and backfilling in addition to the excavation and backfilling needed to perform the work. Miscellaneous earth excavation and backfilling may be authorized for test pits or for other unforeseen purposes. It may include hand excavation. Miscellaneous and extra earth excavation shall be subject to all requirements for other excavation previously stated herein.

3.04 TOPSOIL

Topsoil shall be stripped from all areas to be occupied by buildings, structures, roadways, and all areas to be excavated or filled. Care shall be taken to avoid mixing topsoil with subsoil. Topsoil shall be stockpiled in areas on the site designated or approved by the Superintendent of the Somerset Highway Department, free from brush, trash, large stones and other extraneous material and protected until placed as specified under Section – TOPSOILING AND SEEDING. Any surplus topsoil remaining shall be disposed of by the Contractor offsite.

3.05 TRENCH EXCAVATION

A. Trenches in pavement shall have the travelled way surface cut in a straight line by a concrete saw or equivalent method, to the full depth of pavement. Excavation shall only be between these lines. Cutting operations shall not be done by backhoe, gradall, or other ripping equipment.

B. Trenches and related excavations shall be of sufficient width and depth at all points to allow pipes to be laid, joints to be formed, and appurtenant structures to be built in a workmanlike manner, and when needed, to allow for sheeting and shoring, pumping and draining, and/or for removing and replacing any materials unsuitable for foundations.

C. Trenches shall be at least 12 inches wider than the outside dimension of the pipe or structures they are to contain.

D. Trenches shall not be unnecessarily wide, so as to increase excessively the load on the pipe resulting from backfill.

E. Bottoms of trenches shall be carried to lines and shapes approved by the Superintendent of the Somerset Highway Department. Bottoms of trenches shall be shaped to conform to the outside of pipes insofar as the material will admit, so that pipes shall have a continuous and even bearing. Bottoms of trenches shall be shaped so that bells of pipes will not bear on the ground.

F. No tunneling shall be permitted in place of open trench construction, unless specifically authorized by the Superintendent of the Somerset Highway Department.

G. Excavations adjacent to existing underground utility lines and other underground structures shall be done by hand to insure against possible damage.

H. Excavation just above the bottom of structures in trenches shall be done by hand so that foundations will rest on undisturbed earth, or disturbed subgrade re-compacted to the 95 percent of maximum dry density as determined by ASTM D 1557, Method C.

I. Side slopes of excavation shall be less than the angle of repose of the material excavated, and flat enough to prevent slides or cave-ins.

J. Any extra excavation required as a result of slides or cave-ins shall be done by the Contractor.

K. Final trimming excavation at bottom of trenches shall not be done until the ground has been dewatered and the Contractor is ready to install pipe or construct foundations of the appurtenant structures.

L. Trenches shall only be opened at such times and to such extent as approved by the Superintendent of the Somerset Highway Department.

3.06 SHEETING, SHORING AND BRACING

A. Sheeting, shoring, bracing or parts thereof, shall be left in place after the completion of the work. The Superintendent of the Somerset Highway Department may permit sheeting to be left at the Contractor's option.

B. All sheeting left in place, for whatever reason, shall be cut off at least 2 feet below the finished ground surface, unless otherwise approved by the Superintendent of the Somerset Highway Department.

3.07 DEWATERING

A. All water pumped or drained from the work shall be disposed of in a manner which will not result in undue interference with other work or damage to adjacent properties, pavements and other surfaces, buildings, structures and utilities. Suitable temporary pipes, flumes or channels shall be provided for water that may flow along or across the site of the work.

3.08 LENGTH OF TRENCH

A. The length of trench allowed to be open shall be per Somerset Highway Permit requirements and/or determined by the Superintendent of the Somerset Highway Department. The total running length of all work in each section shall be kept as short as is practicable.

B. The Contractor shall provide and maintain flashing barricades around all open or soft trenches, parked equipment within all Public Right of Way, in areas where personal injury could result, or as required by Somerset Highway Permit and/or the Superintendent of the Somerset Highway Department.

3.09 PROTECTING EXISTING UNDERGROUND STRUCTURES

A. Wherever culverts, sewers, drains, manholes, catch basin connections, water mains, valve chambers, gas mains, electric conduits, telephone conduits, or any other underground constructions are encountered in excavating, they shall be protected and firmly supported by the Contractor, at his own expense, until the excavation is backfilled and the existing structures are made secure. Injury to any such structures caused by or resulting from the Contractor's operations shall be repaired at the Contractor's expense. The Authority having charge of any particular underground structure shall be notified promptly of injury to its structure.

B. Whenever approved by the Superintendent of the Somerset Highway Department pipes or other underground structures encountered in excavating or trenching shall be supported permanently with supports across the excavation or trench.

C. If underground utility structures are encountered they shall be reported to the appropriate authority, if known. The appropriate authority shall deem if any change in the work to be done is required to deal with such unforeseen obstructions.

3.10 ROCK EXCAVATION

A. Rock excavation shall mean boulders exceeding 1 cubic yard in volume or solid rock which requires drilling and blasting for its removal. No hard pan, no soft or disintegrated rock, no loose or previously blasted rock or broken stone smaller

than one cubic yard, and no rocks exterior to the maximum limits of excavation which may fall into the excavation.

B. Rock in Trenches. Wherever the bottom of a trench consists of boulders or solid rock, it shall be excavated to 8" below grade and refilled to a depth of 12-inches over the pipe with crushed stone compacted to the satisfaction of the Superintendent of the Somerset Highway Department. Compaction operations shall be continued until stones are firmly interlocked and the surface is unyielding.

3.11 BACKFILLING TRENCHES

A. After pipe lines and appurtenant structures have been built, the trenches and other areas shall be backfilled with suitable excavated material to the extent available or with gravel borrow when excavated material is not available. All material for backfilling shall be free of roots, stumps, frost and stone weighing over 100 pounds. Backfill shall be placed to meet the Mass Highway Requirements and following requirements:

1. Backfill around pipe or over pipe cradle shall be deposited in layers not over 6 inches deep, placed evenly on both sides of pipe and each layer firmly compacted by hand tools and/or mechanical compactors to the satisfaction of the Superintendent of the Somerset Highway Department. (See Sub-paragraph 4). Joints may be left uncovered for inspection or testing, then backfilled as previously specified. Pipe shall be backfilled to a depth of at least ¾ of the pipe diameter before testing and thereafter to a depth of at least one foot above the top of pipe by the same methods.

2. For trenches in streets, walks, paved areas, or locations to be paved or landscaped upon completion of trench backfill, the entire depth of trench shall be backfilled and compacted in the same manner as the portion around the pipe.

3. For trenches in open areas where no future paving or landscaping/seeding is indicated, backfill shall be placed and compacted by spreading equipment, mechanical compactors, or puddling, to suit the material, and width and depth of trench, and to the approval of the Superintendent of the Somerset Highway Department.

4. Unless stated, the above described compaction of trench backfill around pipes and under paved areas will be deemed satisfactory when field density

tests show at least 95 percent of maximum dry densities of the same materials, as determined by ASTM D 1157, except that 2 feet of depth below finished grade shall have 100 percent of maximum density. Where an envelope of selected material is provided around the pipe for which density tests are not feasible the material shall be well-compacted as hereinbefore specified.

5. Backfill around manholes, pits and other structures in trenches shall be placed and compacted as specified for backfill in trenches. Backfill around concrete or masonry structures shall not be placed until approved by the Superintendent of the Somerset Highway Department and shall be brought up evenly on all sides to prevent excessive pressure or displacement.

6. Unless otherwise specifically required, all topsoil, sods, shrubs, and other surface material shall be replaced in good condition.

7. Puddling or jetting of the backfill materials are not allowed.

8. Where hardened surfaces or roadways, driveways, or walls are dug up or interfered with, special attention shall be given to the backfilling operations before resurfacing.

9. The Contractor shall continually provide street sweeping on roadways, used by his vehicles, in order to reduce dust, siltation, nuisance problems, and to provide safe passage for vehicular and pedestrian traffic.

B. State Highway Trench Backfill: When required by permit, Controlled Density Fill (CDF) shall be used to backfill trenches. The CDF shall satisfy the requirements listed in MDPW Specification Section M4. 08. 0

3.12 GRADING

All areas covered by the project, including excavated and filled sections and adjacent transition areas, shall be uniformly smooth-graded to the elevations shown. The finished surface shall be reasonably smooth, compacted, and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from blade-grader operations.