

SECTION 31 20 00 – EARTH MOVING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. The General Documents, as listed in the Table of Contents, and applicable parts of Division 1, GENERAL REQUIREMENTS, shall be included in and made a part of this Section.
- B. Examine all drawings and all other Sections of the Specifications for the requirements therein affecting the work of this trade. Plans, surveys, measurements, and dimensions, under which the work is to be performed are believed to be correct to the best of the Architect's knowledge, but the Contractor shall have examined them for himself during the bidding period, as no allowance will be made for any errors or inaccuracies that may be found herein. The contractor shall reconcile all drawings.
- C. Where there is a conflict between drawings, the stricter requirement and the interpretation that is most in favor of the owner shall be adopted at no additional cost to the owner.
- D. The Contractor shall become thoroughly familiar with the site, consult records and drawings of adjacent structures and of existing utilities and their connections, and note all conditions which may influence the work of this Section.
- E. By submitting a bid, the Contractor affirms that he has carefully examined the site and all conditions affecting work under this Section. No claim for additional costs will be allowed because of lack of full knowledge of existing conditions.
- F. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure a steady progress of work under this Contract.

1.2 SCOPE OF WORK

- A. Work described in Section 1.2 of these specifications shall be included in the base bid and will not be paid for separately.
- B. The work of this section consists of all excavation, filling and grading and related items as indicated on the Drawings and/or as specified herein and includes, but is not limited to, the following:
 - 1. All materials, equipment, labor, and services required for all Earth Moving work, including all items incidental thereto, as specified herein and as shown on the Drawings.
 - 2. Excavation of all types, including but not limited to excavations for footings, slabs, foundations, retaining walls, temporary support of excavations, dewatering systems, new pavements, ramps, equipment pads, curbs, sidewalks, and utilities, to the lines and grades shown in the Drawings or the limits specified herein, whichever is deeper. The excavation includes rock removal as necessary to allow the construction of foundations, slabs on-grade, and installations of utilities. Excavation shall include removal and legal offsite disposal of all materials that cannot be reused.
 - 3. Excavating, filling, trenching, backfilling, compaction, and concrete encasement of utility conduits, of all description, required for the construction of foundations, walls, building structures, retaining walls, temporary support of excavations, dewatering systems, new pavements, ramps, equipment pads, curbs, sidewalks, utility structures, lawn areas, and site improvements.

Provide all additional fill materials as required and specified herein. Refer to Sections on Heating, Plumbing, Fire Protection, Electrical and Structural for other excavation.

4. Entirely removing topsoil/surficial organic soil, tree stumps, root balls, buried organic soil, subsoil, asphalt, concrete structures, cobbles, boulders, demolition debris, below ground structures, existing fill, existing bedrock as necessary, and other deleterious matter from within the proposed building footprint.
5. Entirely removing topsoil, surficial organic material, tree stumps, root balls, subsoil, asphalt, concrete structures, cobbles, boulders, existing bedrock as necessary, and other deleterious material from within the proposed paved areas. The existing fill should be removed from within the proposed paved areas where it is less than 18 inches from the bottom of the proposed subbase layer.
6. Improving the existing fill under the subbase of paved areas.
7. Screening and stockpiling the topsoil for reuse as directed by the Architect.
8. Performing test pits before start and during construction as required by the Geotechnical Engineer.
9. Removing and disposing of spoiled material not suitable for fill from the site. No burning on the site shall be permitted.
10. Rehandling, hauling, and placing of stockpiled materials for use in refilling, filling, backfilling, grading, and such other operations. Stockpiling shall include protection to maintain materials in a workable condition.
11. Furnishing, placing, and compacting fill materials, including subbase layer under paved areas, ramps, equipment pads, curbs, sidewalks, and other locations required in the drawings.
12. Removing, hauling, stockpiling, rehandling, and placement of materials.
13. Over-excavation to remove unsuitable materials.
14. Proofrolling/proofcompacting of exposed subgrade for fill, footings, foundations, slabs, walks, equipment pads, pavements, lawns and grasses, and exterior plants.
15. Backfilling of excavations for foundations, footings, walls, utilities, pavements, sidewalks, and landscaped areas with specified on-site and imported materials.
16. Installing seismographs and monitoring vibration at the nearby existing buildings during construction. The cost of vibration monitoring shall be included in the base bid.
17. Disposing off-site of excess or unsuitable materials.
18. Placing bedding, sub-base and base course layers.
19. Stabilizing/mitigating of saturated or otherwise disturbed materials.
20. Performing rough and final grading.
21. Filling slopes and site retaining walls.
22. Protecting existing buildings, utilities, roads, pavements, lawns, planting, and other improvements from damage due to construction.
23. Performing coordination of material testing shall be the responsibility of the Contractor. All imported material tested shall be under ASTM D422 and shall be paid for by the Contractor.
24. Performing material testing, and field density testing as needed.
25. Performing dust control and cleanup.
26. Groundwater Control, dewatering, pumping, bailing and control of groundwater and surface water for all work under this contract in accordance with item 1.13 of these specifications.
27. Installing temporary support of excavation as needed in accordance with item 1.12 of these specifications.
28. Installing fencing and safety devices or controls as specified and as necessary.

29. Notifying all affected utility companies and Dig Safe before the start of work.
30. Processing and improving onsite marginal soil, as needed, including by crushing and blending, to meet the specifications herein.

B. The Work of this Section shall include performance of pre and post construction Condition surveys,

1.3 CONTRACT REFERENCE

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections
 1. Section 03 30 00, Cast-In-Place Concrete
 2. Section 22 00 01, Plumbing
 3. Section 31 10 00, Site Clearing and Preparation
 4. Section 31 25 00, Erosion and Sedimentation Controls
 5. Section 32 12 16, Asphalt Paving
 6. Section 32 13 13, Exterior Concrete
 7. Section 32 16 00, Curbing
 8. Section 32 30 00, Site Improvements
 9. Section 32 32 23 Segmental Retaining Wall
 10. Section 33 10 00, Water Utilities
 11. Section 33 30 00, Sanitary Sewage Utilities
 12. Section 33 40 00, Storm Drainage Utilities

1.4 DESCRIPTION

- A. The Contractor shall furnish all labor, material, tools, and equipment necessary to excavate materials; segregate, track, handle, sample, analyze, and test excavated materials, backfill, and re-grade as indicated on the Drawings.
- B. The Contractor shall use suitable on-site soils and fill, and soil from off-site sources, as needed. Please note that most of the on-site existing fill and natural soil will likely not be suitable for reuse. The contractor shall avoid mixing the reusable soils with fine-grained and/or organic soils. Imported materials or amending/blending of onsite materials with imported materials are anticipated for this project.
- C. The Contractor shall make excavations in such a manner and to such widths that will provide suitable room for performing the Work and shall furnish and place all sheeting, bracing, and supports as necessary. Excavation support is anticipated for this project.
- D. The Contractor shall provide labor and material for all pumping and draining, as necessary; and shall render the bottom of excavation firm and dry and in all respects acceptable. The Contractor shall collect and properly dispose of all discharge water from dewatering systems in accordance with local and State requirements and permits.
- E. The Contractor shall raise the Site to final grades and compact the subgrade and intermediate layers to the required criteria set forth within this Section of the Construction Specifications.
- F. The Contractor shall provide routine monitoring of in-place excavation support systems.

- G. The Contractor shall protect and moisture condition all onsite and imported materials for proper installation, compaction and use. This includes covering, drying, and adding moisture in order to maintain suitable workability of the soil materials. Failure by the Contractor to follow this requirement shall not be cause for additional cost to the Owner.

1.5 INFORMATION

- A. Information on the Drawings, Reference Drawings, Geotechnical Reports, and in the Specifications relating to subsurface conditions, natural phenomena, and existing utilities and structures is from the best sources presently available. Such information is furnished only for information and is not guaranteed.
- B. Site Information – Data on indicated subsurface conditions are not intended as representations or warrants of continuity of such conditions between soil borings and test pits. It is expressly understood that the Owner will not be responsible for interpretations or conclusions drawn there by the Contractor. Data is made available for the convenience of the Contractor. The Owner, Architect and Engineer assume no responsibility for the accuracy of the data other than at the particular locations and at the time the explorations were made.
- C. The Contractor, at his/her own expense, may conduct additional subsurface testing for his/her own information after approval by the Owner. The Owner assumes no responsibility for the Contractor's failure to make his own site investigation and makes no representation other than the soils reports regarding the character of the soil or subsurface conditions which may be encountered during the performance of the work. The Contractor shall refer to the Geotechnical Report. Failure by the Contractor to be aware of existing site conditions shall not be cause for additional cost to the Owner.

1.6 SUBSURFACE CONDITIONS AND SPECIAL SITE CONSIDERATIONS

- A. Lahlaf Geotechnical Consulting, Inc. of 100 Chelmsford Road, Suite 2, Billerica, MA 01862 prepared a geotechnical report titled: "Geotechnical Report, Proposed Crocker Elementary School, Fitchburg, Massachusetts, dated June 6, 2022. The Owner, the Architect, and the Geotechnical Engineer assume no responsibility for the accuracy of the data and for the Contractor's failure to make his own site investigation and make no representation other than the soils reports regarding the character of the soil or subsurface conditions which may be encountered during the performance of the work. Failure by the Contractor to be aware of existing site conditions shall not be cause for additional cost to the Owner.
- B. Information on subsurface conditions is made available for the convenience of the Bidders. The Owner does not represent to the Contractor that the information is either an accurate or a comprehensive indication of subsurface conditions. Bidders are invited to review the information to apprise themselves of the information available, and also to make additional investigations at their own expense.
- C. Interpretation of this data for purposes of construction is the responsibility of the Contractor. It is the Contractor's responsibility to make interpretations and draw conclusions with respect to the character of materials to be encountered and groundwater conditions at the site and their impact upon Contractor's work based on his expert knowledge of the area, construction dewatering methods, and support of excavation methods. Contractor may, at his own expense, conduct additional subsurface testing as required for his own information after approval by the Owner.
- D. The Geotechnical Report indicates that the majority of the materials present at the site contain quantities of fines beyond the limit deemed acceptable for reuse by the specification. The contractor is made aware of this condition and will not be eligible to receive additional compensation exceeding the Contractor's initial bid for imported material.

- E. The Contractor shall visit the site prior to submitting a bid to become familiar with the extent of the work to be done under this Contract. The Contractor shall be responsible for determining the quantities of earth materials necessary to complete the work under this Section. All earth materials shall be included in the Contractor's base bid.
- F. Test boring and test pit locations as depicted on the Drawings are located by tape measurements from existing site features and structures and shall only be considered as accurate as the procedure utilized.
- G. The Contractor shall be aware that the ground surface elevations shown in the boring logs were interpolated to the nearest foot and are approximate.
- H. No claim for extra cost or extension of time resulting from reliance by the Contractor on information presented herein shall be allowed, except as provided in the Contract Documents.

1.7 QUALITY CONTROL

- A. Costs related to retesting due to unacceptable quality of work and failures discovered by testing shall be paid for by the Contractor at no additional expense to Owner, and the costs thereof will be deducted by the Owner from the Contract Sum.

1.8 COORDINATION

- A. Prior to start of earthwork, the Contractor shall arrange an onsite meeting with the Architect, Engineer, the Geotechnical Engineer, and the site testing agency for the purpose of establishing the Contractor's schedule of operations, and scheduling observation and testing procedures and requirements.
- B. As construction proceeds, the Contractor shall be responsible for notifying the Geotechnical Engineer at least 2 days and the site testing agency at least 24 hours prior to the start of earthwork operations requiring observation and/or testing. This section also applies to instances when the General Contractor resumes earthwork operations after a period of pause in earthwork operations that require observations by the Geotechnical Engineer.
- C. The work of this Section shall be coordinated with that of other trades affecting, or affected by, this work, as necessary to ensure the steady progress of all work of the Contract.

1.9 PERMITS, CODES AND SAFETY REQUIREMENTS

- A. This project is subject to the Safety and Health regulations of the U.S. Department of Labor set forth in 29 CFR, Part 1926. Contractors shall be familiar with the requirements of these regulations.
- B. The Contractor is responsible for the adequacy of the excavation support system and shall retain the services of a Professional Engineer registered in Massachusetts to design any required excavation support systems. The Contractor's Professional Engineer shall practice in a discipline applicable to excavation work, shall have experience in the design of excavation support systems and shall design in conformance with OSHA requirements. The Contractor's Professional Engineer shall provide sufficient on-site inspection and supervision to assure that the excavation support system is installed and functions in accordance with his design. Criteria listed herein defining the responsibilities of the Contractor's Professional Engineer are minimum requirements.

- C. All work shall conform to the Drawings and Specifications and shall comply with applicable codes and regulations.
- D. Comply with the rules, regulations, laws, and ordinances of the City of Fitchburg, of the State of Massachusetts, appropriate agencies of the State of Massachusetts and all other authorities having jurisdiction. Coordinate all work done within City and State rights of way with the appropriate agencies. Provide all required traffic control and safety measures, including uniformed police officers per City and State requirements. All labor, materials, equipment, and services necessary to make the work comply with such requirements shall be provided without additional cost to the Owner.
- E. Comply with the provisions of the Manual of Accident Prevention in Construction of the Associated General Contractors of America, Inc., and the requirements of the Occupational Safety and Health Administration (OSHA), United States Department of Labor whichever is more stringent.
- F. The Contractor shall procure and pay for all permits and licenses required for the complete work specified herein and shown on the Drawings.
- G. The Contractor shall not close or obstruct any street, sidewalk, or passageway unless authorized in writing by the Architect. The Contractor shall so conduct his operations as to interfere as little as possible with the use ordinarily made of roads, driveways, sidewalks or other facilities near enough to the work to be affected hereby. The Contractor shall comply with the time limits established by the terms for trucking onto and off the site.
- H. Any apparent conflict between the Drawings and Specifications and the applicable codes and regulations shall be referred to the Architect in writing, for resolution before the work is started.
- I. The Contractor shall comply with all excavation, trenching, and related sheeting and bracing requirements of Occupational Safety and Health Administration (OSHA) excavation safety standards, 29 CFR Part 1926.650 through 1926.652.

1.10 LAYOUTS AND GRADES

- A. All line and grade work not presently established at the site shall be laid out by a survey team under the supervision of a Land Surveyor or Professional Engineer registered in the Commonwealth of Massachusetts and employed by the Contractor in accordance with Drawings and Specifications. Basic layout for the project is shown on the drawings. The Contractor shall supply all additional layout and grade control as necessary to properly implement and construct the work. The Contractor shall establish permanent benchmarks and replace as directed any which are destroyed or disturbed. The Contractor shall employ and pay all costs for a registered Civil Engineer or Surveyor who is licensed within the jurisdiction of the project site to lay out all lines and grades in accordance with the Drawings and Specifications, and as necessary or required for the construction. The Contractor shall submit building layout drawings for approval, stamped by a Registered Surveyor.
- B. The words “finished grades” as used herein shall mean final grade elevations indicated on the Drawings. Spot elevations shall govern over proposed contours. Where not otherwise indicated, project site areas outside of the building shall be given uniform slopes between points for which finished grades are indicated or between such points and existing established grades.
- C. The word “subgrade” as used herein, means the surface or elevation remaining after completing excavation or top surface of a fill, borrow fill or compacted fill. This surface is immediately beneath the site improvements, fill materials as dimensioned on the Drawings, or other proposed surface material.

- D. The words “rough grading” shall mean excavating or filling to elevations indicated, and to the required depths herein. The permissible tolerance of rough grading within an area of 100 sq. ft. shall not exceed plus or minus 2 in. The cost of placing fill material to refill areas having rough grades lower than designed shall be borne by the Contractor.

1.11 DISPOSITION OF EXISTING UTILITIES

- A. All work shall be executed in such a manner as to prevent any damage to existing buildings, streets, curbs, paving, service utility lines, structures, and adjoining property. Existing streets, sidewalks and curbs damaged during the project work shall be repaired or replaced to their condition prior to commencement of Earth Moving operations.
- B. Locate and mark underground utilities to remain in service before beginning the work. Active utilities existing on the site and work areas shall be carefully protected from damage and relocated or removed as necessitated by the work. When an active utility line is exposed during construction, its location and elevation shall be plotted on the record drawings as described in this Section and both Architect and Utility Owner notified in writing.
- C. Inactive or abandoned utilities encountered during construction operations shall be removed and suitably backfilled if within the building area. Abandoned utilities outside the building area shall be removed, grouted, plugged, or capped. The location of such utilities shall be noted on the record drawings and reported in writing to the Architect.
- D. The Contractor shall notify “Dig Safe” and local utility companies prior to the start of construction. The “Dig Safe” number shall be submitted by the Contractor in writing to the Architect prior to construction.
- E. Acceptance of any of the Contractor’s plans, design calculations and methods of construction by the Designer and /or design team shall not relieve the Contractor of the responsibility for the adequacy of the excavation lateral support system; preventing damage to existing or new structures, utilities, and streets adjacent to excavations; the safety of persons working within excavated areas and the public at large; and excavation dewatering.

1.12 SUPPORT OF EXCAVATION

- A. Provide support of excavation (SOE) system, as necessary, in order to meet the requirements of OSHA and to assure complete safety against collapse of earth at sides of excavations. The contractor shall design and submit for review and upon approval install a temporary support of excavation (SOE) as necessary to protect the existing structures and utilities during construction and as necessary to perform the excavations during utility excavations and during the removal of the unsuitable materials.
- B. In selecting the type of SOE system, the Contractor shall take into consideration the presence of cobbles and boulders, and abandoned buried structures in the existing fill and in the natural soil.
- C. If sufficient or proper supports have not been provided, additional supports shall be placed at the expense of the Contractor. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed.
- D. All components of SOE system not ordered left in place shall be carefully removed in such a manner as not to endanger the construction of other structures, utilities, or property whether public or private. All voids left after withdrawal of sheeting shall be immediately refilled with sand and

rammed with tools especially adapted to that purpose or otherwise compacted as directed to achieve the required density.

- E. The design and installation of SOE systems shall not constitute a condition for which an increase may be made in the contract price with the exception that if the Architect directs with writing that certain shoring or sheeting shall be left in place, the contract price will be adjusted in accordance with General Conditions.
- F. SOE systems shall be designed to support the earth pressures, surcharge loads from stored material and construction equipment.
- G. Shoring and bracing of trenches and other excavations shall, at a minimum, be in accordance with the latest requirements of the Department of Labor and Industries Bulletin No. 12, Section 10, and all subsequent amendments, and OSHA excavation safety standards.
- H. SOE systems shall be designed by a Professional Engineer registered in the Commonwealth of Massachusetts and hired by and paid for by the Contractor.

1.13 DRAINAGE AND GROUNDWATER CONTROL

- A. The Contractor shall control the grading in areas under construction at the site so that the surface of the ground will properly slope to prevent accumulation of groundwater and surface water in excavated areas and adjacent properties.
- B. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
- C. The Contractor shall provide, at his own expense, adequate pumping and drainage facilities 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. The flows of all water resulting from pumping shall be managed so as not to cause erosion, siltation of drainage systems, or damage to adjacent property.
- D. Before excavation below groundwater level, place system into operation to lower groundwater level to specified levels and then operate it continuously until drains, sewers, and structures have been constructed and fill materials have been placed, or until dewatering is no longer required. The groundwater level shall be maintained at 12 inches beneath the bottom of excavation or deeper until the excavation is backfilled to at least 2 feet above the groundwater level. The Contractor shall be prepared to install multiple sump pumps as needed to achieve the requirements of these specifications.
- E. The Contractor shall submit a groundwater control plan in accordance with the requirements of Section 1.19. The plan shall include locations of deep and shallow (moveable) sump pumps.
- F. Sump pumps shall be installed in crushed stone wrapped in a geotextile fabric for filtration and separation.
- G. Deep stationary sump pumps shall be at least 7 feet beneath the bottom of the deepest excavation, and shallow, moveable sump pumps shall be at least 3 feet beneath the bottom of the excavation.
- H. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.

- I. Damage resulting from the failure of the dewatering operations of the Contractor, and damage resulting from the failure of the Contractor to maintain all the areas of work in a suitable dry condition, shall be repaired by the Contractor, as directed by the Engineer, at no additional expense to the Owner. The Contractor's pumping and dewatering operations shall be carried out in such a manner as to prevent damage to the Contract work and so that no loss of ground will result from these operations. Precautions shall be taken to protect new work from flooding during storms or from other causes. Pumping shall be continuous to protect the work and/or to maintain satisfactory progress.
- J. All pipelines or structures not stable against uplift during construction or prior to completion shall be thoroughly braced or otherwise protected. Water from the trenches, excavations, and stormwater management operations shall be disposed of 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.
- K. The Contractor shall excavate interceptor swales and ditches, as necessary, prior to the start of major earthmoving operations to reduce the potential for erosion and to keep areas as free from surface and ponded water as possible.
- L. All piping exposed above ground surface for this use, shall be properly covered to allow foot traffic and vehicles to pass without obstruction.
- M. Should surface, rain or groundwater be encountered during the operations, the Contractor shall furnish and operate pumps or other equipment and provide all necessary piping to keep all excavations clear of water at all times and shall be responsible for any damage to work or adjacent properties for such water. Protect subgrades and foundation soils from softening and damage by rain or water accumulation. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
- N. The presence of groundwater or stormwater in soil will not constitute a condition for which an increase in the contract price may be made. Under no circumstances place concrete fill, lay piping, or install appurtenances in excavation containing free water. Keep utility trenches free of water until pipe joint material has hardened and backfilled to prevent flotation.
- O. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on a continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense.
- P. For further information refer to paragraphs on SPECIAL REQUIREMENTS FOR SEQUENCE OF CONSTRUCTION OPERATIONS AND DRAINAGE AND EROSION CONTROL as specified herein.
- Q. Remove groundwater control components at end of dewatering operations. Backfill sump pump excavation and plug well hole as applicable using suitable materials as specified herein.

1.14 FROST PROTECTION/WORK IN FREEZING WEATHER

- A. Protect excavation bottoms and sides against freezing. Provide protective insulating materials as necessary, including by means of heat blankets, and heating plant.
- B. A layer of fill shall not be left in an uncompacted state at the close of a day's operation when there is the potential for that layer to freeze.

- C. The Contractor shall not place any material on snow, ice, frozen soil, or soil that was permitted to freeze prior to compaction. Removal of these unsatisfactory materials will be at the Contractor's expense.
- D. Do not excavate to full indicated depth when freezing temperatures may be expected, unless work can be completed to subgrade, the materials installed, and the excavation backfilled the same day. Protect the excavation from frost if placing of materials or backfilling is delayed.
- E. The Contractor shall keep the operations under this Contract clear and free of accumulation of snow within the limits of Contract Lines as necessary to carry out the work.
- F. No materials shall be installed on frozen ground. Fill materials shall be free of frost.
- G. The subgrade of footings and slabs shall be protected from frost before placing concrete. The subgrade on the sides of the footings shall be protected from frost after the footings are constructed until sufficient fill is placed to protect the bottom of footings from frost induced heave. Uninsulated slabs shall be covered with heat blankets until the slab areas are heated. The cover shall extend at least 4 feet beyond the limits of the slabs.

1.15 DISTURBANCE OF EXCAVATED AND FILLED AREAS DURING CONSTRUCTION

- A. The Contractor shall take the necessary steps to avoid disturbance of subgrade and underlying natural soils/compacted fill during excavation and filling operations. Methods of excavation and filling operations shall be revised as necessary to avoid disturbance of the subgrade and underlying natural soils/compacted fill, including restricting the use of certain types of construction equipment and their movement over sensitive or unstable materials. The Contractor shall coordinate with the Architect or Soils Representative to modify his operations as necessary to minimize disturbance and protect bearing soils, based on the Architect's or Soils Representative's observations.
- B. All excavated or filled areas disturbed during construction, all loose or saturated soil, and other areas that will not meet compaction requirements as specified herein shall be removed and replaced with compacted approved material in accordance with this Specifications. Fill that cannot be compacted within 48 hours because of its saturated or wet condition shall be removed and replaced with compacted approved material in accordance with this Specifications. Costs of removal of disturbed material and replacement with approved material shall be borne by the Contractor.
- C. The Contractor shall place a six-inch layer of Crushed Stone or 6-inch layer of Granular Fill/Structural Fill over natural soil to stabilize areas disturbed during construction.
 - 1. The placement of the Crushed Stone layer or Granular Fill/Structural Fill as well as material costs shall be borne by the Contractor. A geotextile fabric shall be used to separate the crushed stone from the natural soil when the natural soil is below the groundwater table, and from the overlying fill when directed by the Geotechnical Engineer at no additional cost to the owner.

1.16 SPECIAL REQUIREMENTS FOR SEQUENCE OF CONSTRUCTION OPERATIONS AND DRAINAGE AND EROSION CONTROL

- A. The sequencing of construction operations as specified under Section 31 25 00, Erosion and Sedimentation Controls shall be extended through earthwork operations as follows:
 - 1. Perform initial procedures as specified under Section 31 25 00, Erosion and Sedimentation Controls – Initial Sequence of Construction Activities and Preliminary Drainage Control.
 - 2. Repair any broken or damaged Sections of the haybales or siltation fencing installed during site preparation and install any additional Sections necessary for proper erosion control.

3. Throughout earthwork operations, in addition to drainage swales, check dams, siltation sumps, and other items shown on the Drawings, the Contractor shall take other necessary precautions, including installation of temporary drainage swales, siltation sumps, check dams, haybales, silt fencing and temporary pipe to direct and control drainage from disturbed areas on the site so that erosion and siltation is minimal. In addition, no erosion or discharge of silt or larger particles shall occur in water bodies or wetland areas to remain undisturbed or onto adjacent properties.
4. Damaged or loose haybales and siltation fence shall be replaced as necessary to maintain their function of controlled erosion and siltation. Damaged or broken down check dams and filtration dams shall be replaced immediately.
5. Throughout construction, remove accumulation of silt or soil build-up behind haybales, silt fences, check dams and filtration dams as it occurs. Remove accumulations of silt and build-up from the siltation pumps and silt traps when it is approximately 18 inches deep, or when it adversely affects the performance of the system. Remove silt sacks in catch basins when they have become clogged and replace to maintain their function.
6. Replace the crushed stone on the inside of all siltation sumps as necessary to permit adequate flow through the media and to maintain their function as a filter of silt and larger particles. Excavate silt and other material from the basins of all siltation sumps as it accumulates.
7. Remove temporary drainage swales, check dams, siltation sumps, haybales and other temporary drainage, erosion and siltation control measures when permanent drainage control measures have been installed, and grass is established in drainage areas and lawn areas. Do not remove the above items without approval of the Architect. If, in the Architect's opinion, these measures are still necessary, they shall stay in place.

1.17 DEFINITIONS

- A. Backfill: Soil material used to fill an excavation.
 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Course placed between the grade and hot-mix asphalt paving.
- C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill. Imported fill shall meet the gradation requirements set forth in PART 2 - PRODUCTS.
- E. Building Area: The area defined by the projection of a line from two foot outside of the edge of the footing extending downward and outward at a slope of 1.5H: 1V. (If over-excavation is required below the footing the building area will be redefined from the bottom of over-excavation).
- F. Compaction: The tamping and rolling of all backfill placed in uniform horizontal layers not exceeding a defined uncompacted lift thickness.
- G. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- H. Deleterious Material: Trash, debris, clay, topsoil, roots, organic material friable material, glass, material that has become soft and saturated, even if previously compacted, material defined in section 1.17.X, or otherwise degradable materials that compromise the strength and properties of soils.

- I. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions.
 - 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- J. Fill: Soil materials used to raise existing grades or meet proposed grades.
- K. Frost Zone: The area within 4 feet of finished grade.
- L. Influence Zone/Area: The area below a footing defined by the projection of a line from two feet outside of either edge of the footing extending downward and outward at a slope of 1V:1.5H.
- M. "In-the-dry": In-situ soil moisture content of no more than two percentage points above the optimum moisture content for that soil.
- N. Optimum Moisture Content: Determined by the ASTM standard specified to determine the maximum dry density for relative compaction.
- O. Prepared Ground Surface: The ground surface after clearing, grubbing, stripping, excavation, and scarification and/or compaction.
- P. Proof-rolling/proofcompacting: The tamping and rolling of all subgrades including running a loaded rubber tire truck over the subgrade when requested by the Geotechnical Engineer.
- Q. Relative Density: As defined by ASTM D4253 or D4254.
- R. Relative Compaction: The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by ASTM D1557. Corrections for oversized material shall be applied to maximum dry density.
- S. State Standards: Massachusetts Highway Department Standard Specifications for Highways and Bridges.
- T. Structures: Buildings, footings, foundations of any type, retaining walls, buildings and equipment slabs, ramps, stairs, tanks, curbs, sidewalks, mechanical and electrical appurtenances, retaining walls, or other man-made stationary features constructed above or below the ground surface.
- U. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- V. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below structures, subbase, drainage fill, or topsoil materials.
- W. Unclassified Excavation: The nature of materials to be encountered has not been identified or described herein.
- X. Unsuitable material shall be material having at least one of the following properties:
 - 1. Material with a maximum unit dry weight per cubic foot less than 110 lbs., as determined by ASTM D1557.

2. Material containing greater than 3% organic matter by weight, topsoil, organic silt, peat, construction debris, roots and stumps.
 3. Material which has a Liquid Limit greater than 55 when tested in accordance with ASTM D 4318.
 4. Materials that do not meet one of the gradation specifications in this section.
 5. Wet material which cannot be compacted due to moisture contents outside of the limits of ± 2 percentage points of optimum moisture content.
 6. Material classified as unsuitable by the Geotechnical Engineer.
 7. Unsuitable material shall be disposed of off-site as directed by the Architect.
 8. Material processed onsite that is not well graded or contains excess stones and exhibits honeycombing when placed in lifts.
 9. Materials that are unstable as a result of inadequate construction dewatering, excessive subgrade disturbance, or other means and methods used by the Contractor are not considered unsuitable materials. This includes materials that were stable and that have become unstable.
- Y. Utilities: On-site underground and aboveground pipes, conduits, ducts, and cables, as well as underground services within buildings.
- Z. Trench: An excavation of any length where the width is less than twice the depth and where the shortest distance between payment lines does not exceed ten (10') feet. All other excavations shall be defined as open excavations.
- AA. Architect: Where architect is referenced it shall mean the Architect or the Architect's representative.
- BB. Geotechnical Engineer: Where Geotechnical Engineer is referenced it shall mean the Geotechnical Engineer or its representative.

1.18 REFERENCES

- A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements or requirements of other specification sections, the most restrictive requirements that are most favorable to the Owner shall govern.
- B. American Society for Testing and Materials (ASTM):
1. ASTM D1556, Density of Soil In Place by the Sand-Cone Method.
 2. ASTM D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 3. ASTM D6938, Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
 4. ASTM D422, Particle Size Analysis of Soils.
- C. Commonwealth of Massachusetts:
1. Massachusetts Highway Department Standard Specifications for Highways and Bridges.
 2. The Commonwealth of Massachusetts State Building Code 780 CMR, Ninth Edition (MSBC 9th Edition)
- D. American Association of State Highway and Transportation Officials (AASHTO):
1. AASHTO T-11, Standard Method of Test for Amount of Material Finer than 0.075 mm sieve in aggregate.
 2. AASHTO T-27, Standard Method of test for sieve analysis of fine and coarse aggregates.
- E. Occupational Safety and Health Act of 1970 (Public Law 91-596 of the United States, 29 USC Section 651 et seq.).

1.19 SUBMITTALS

- A. Product Data: For the following:
 - 1. Each type of plastic warning tape.
 - 2. Geotextile – The contractor shall submit a 12" by 12" sample of geotextiles.
 - 3. Controlled low-strength material, including design mixture.
- B. Submit a detailed construction sequence plan for project excavation indicating temporary stockpile areas, side slopes of excavations, limits of required temporary excavation support and sequence and procedures for subgrade protection, excavation, concrete placement, moisture conditioning of on-site excavated soils used as fill, filling, backfill, and compaction.
- C. The Contractor shall submit, the name of imported material suppliers. Change of source suppliers shall require approval from the Architect.
- D. Grain-size distribution analysis test data shall be delivered with the samples. The analysis shall be performed in accordance with ASTM D 422 and shall at the minimum include the sieve sizes listed for the respective material in Part 2. The data shall include a plot of the gradation and the envelope of the specified material. A material shall be considered meeting the specifications when its gradation curve fits entirely within the specified envelope. Borrow soil materials with grain-size distribution curves that do not fall entirely within the specified envelope shall be deemed unacceptable.
- E. The Contractor shall submit to the Architect, manufacturer's literature and data on proposed compaction equipment.
- F. The Contractor shall provide to the Architect, on a daily basis, copies of field records documenting the location of stockpiled material, and stockpile identification data.
- G. The Contractor shall submit a scale plan daily that defines the location, limits, and depths of the area excavated.
- H. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
 - 1. Classification according to ASTM D 2487 of each onsite and borrow soil material proposed for fill and backfill.
 - 2. Recent (less than one month old) Gradation Curve (ASTM-D422) and Laboratory compaction curve according to ASTM D 1557 for each on-site and borrow soil material proposed for fill and backfill.
- I. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins.
- J. Excavation and Excavation Support Plan: Submit at least 10 calendar days prior to the start of the work a detailed plan for the sequence of excavation, and methods to be used for excavation support and dewatering of excavations. Submit engineering calculation stamped by a Massachusetts Registered Professional Engineer and shop drawings for earth support systems to be used.
- K. Dewatering plan shall be submitted at least 10 days before the start of construction. Dewatering and groundwater control systems shall be designed to keep excavations free of water and to avoid disturbance of the subgrade in accordance with Section 1.13 of these Specifications. The dewatering

submittal shall include a plan clearly showing locations, depth, and size of deep stationary sump pumps.

- L. Rock blasting plan shall be submitted at least 10 days before the start of blasting operations. This submittal shall include description of blasting operations, handling procedure and storage of explosives, blasting limits and depths, blasting sequence, measures to limit vibrations, as needed, and measures to limit overblast and rock heave to less than 2 feet.

1.20 SAMPLING AND TESTING

- A. The contractor shall submit two (2) 50-lbs samples of each type of fill material, in air-tight containers, proposed for use on-site in accordance with PART 2 - PRODUCTS, to the Owner's Geotechnical Engineer (Geotechnical Consultant) for preliminary compliance testing at least two (2) weeks prior to use. No fill material shall be delivered to the site or placed until the material has been preliminarily approved. The final review of the material will be based on a sample tested by the owner's testing agency upon delivery of the material to the site. The gradation curves shall fit entirely within the envelopes defined by the limits specified herein for the material to be approved for use at the site.
 - 1. Samples shall be delivered to the office of the Architect or as directed.
 - 2. Samples required in connection with compaction tests will be taken and transported by the Soils Representative.
 - 3. Additional tests, including grain-size analyses and laboratory compaction tests shall be performed on the material after it is delivered to the site.
 - 4. For on-site materials, submit representative samples, collected from each stockpile of excavated on-site material to be used, directly to the Owner's Geotechnical Consultant's office or as directed at least two (2) weeks in advance of use of these materials.
 - 5. Grain-size analyses shall be performed using a sieve stacks containing at least the sieve listed in the geotechnical report under Structural Fill.
- B. Product Data: Submit location of pits for borrow material. Samples shall include name of source, name of material, sampling date, and intended use.
- C. Samples shall be representative of the source pit. If materials are found to vary once construction begins, the Contractor will be required to submit additional representative samples, for compliance testing, at his own cost.
- D. Compaction tests:
 - 1. Compaction tests shall be performed at all bench and other site fixture pads.
 - 2. Compaction tests shall be performed on each lift of placed and compacted material. Accordingly, it is the responsibility of the Contractor to provide ample notice to the testing agency to provide a field representative to perform field density tests.
- E. Materials imported to the site by the Contractor for on-site use shall not contain oil, hazardous waste, or deleterious materials.
 - 1. The Contractor shall be responsible for all costs incurred by the Owner as a result of the Contractor's action to import materials containing concentrations of oil and/or hazardous materials to the site, including the cost of removing the contaminated soil, the cost of remediation of onsite soils affected by the contamination, and the cost of replacement.
 - 2. In the event that site characterization of off-site borrow sources indicates that soils are acceptable to the Architect or Engineer for use, then chemical testing will not be required. It is anticipated that chemical testing would not normally be required for material from customarily utilized commercial borrow sources.

No fill material from “urban areas” will be accepted for fill at the site, even if chemical testing indicates no exceedances of “Reportable Concentrations”.

If requested by the Owner or Engineer, based on review of the borrow site characterization, the Contractor shall conduct testing on proposed fill material and submit results prior to delivery to the site, at no additional cost to the Owner. Testing shall be conducted by a DEP-certified testing laboratory and shall include, at a minimum, the following analytical test data.

- a. Total Petroleum Hydrocarbons (EPA Method 418.1) every 100 yards
 - b. Volatile Organic Compounds (EPA Method 8420) every 500 yards
 - c. PCB and Pesticides (EPA Method 8080) every 500 yards
 - d. Total RCRA Metals (EPA Method 6000-7000 series) every 500 yards
 - e. Polynuclear Aromatic Hydrocarbons (EPA Method 8270) every 500 yards
 - f. TCLP for those total parameters which exceed twenty times the TCP criteria every 500 yards.
 - g. Total cyanide (EPA 9020)
3. All off-site material submitted for use on the project site shall conform to the S-1 Soils Standards contained in the Massachusetts Contingency Plan, dated October 1, 1993, Section 310 CMR 40.0975 or site soil background levels, whichever is lower. Samples will be chemically tested to determine their conformance with the S-1 Soils Standards and site soil background levels.
 4. Testing parameters and testing frequencies may be reduced, as directed by the Soils Representative.
 5. All sieve analyses for conformance of on-site and off-site fill materials to be used in the work shall be done by means of a mechanical wet sieve analysis and in accordance with ASTM D 422.

1.21 QUALITY ASSURANCE

- A. The Owner may retain and pay for the services of an independent testing agency (Soils Representative) to monitor and observe the backfill operations, perform laboratory tests on soil samples, and to perform field density tests; and a Geotechnical Engineer to periodically observe the earthwork operations, observe the preparation of the subgrade for footings, slabs, and if requested by the Owner paved areas, and to review laboratory and field test data. The geotechnical engineer may from time to time request that the contractor excavate test pits ahead of excavation to confirm subsurface conditions. Test pits shall be performed at no additional cost to the Owner.
- B. The Geotechnical Engineer’s duties do not include the supervision or direction of the actual work by the Contractor, his employees, or agents. Neither the presence of the Geotechnical Engineer nor any observation and testing by the Engineer shall excuse the contractor from defects discovered in his Work at that time or subsequent to the testing.
- C. The services of the Soils representative may include but are not limited to monitoring and performing observations of the backfill operations and testing during placement of fills and backfills within the proposed building, parking area, underneath structures in general, and controlled fill areas.
- D. Neither the presence of the Soils Representative and/or the Geotechnical Engineer, nor any observations and testing performed by them, nor failure to give notice of defects shall excuse the Contractor from defects discovered in his work.
- E. Subgrades of footings and slabs, and if requested by the Owner subgrades of paved areas, shall be observed by the geotechnical engineer before placing fill. The compaction and material composition shall be approved by the geotechnical engineer before placement. If inspections indicate subgrade

does not meet specified requirements, the unsuitable subgrade shall be excavated, the unsuitable material shall be removed, and replaced with approved backfill material and compacted at no additional cost to the owner or architect. The work shall be done in accordance with this specification.

1. Testing frequency shall be as follows:

Material	Responsible Party	Situation	Test	Minimum Frequency
Structural Ordinary Processed Gravel for Sub-base/	Fill/ Contractor	Source Investi- gation	Grain Size Moisture Density Relationship	1 per source
	Fill/ Owner			1 per source
Common Borrow/ Bedding Material/ Crushed Stone / Pea Gravel	Owner	As-Placed	Dry Density and As-Placed Moisture	1 per source
				1 per 100 tons
Loam Borrow	Contractor	During Place- ment	PH, Nitrogen, Phosphorous, Potas- sium, and USDA Classification	2 per lift per location or activity and no less than 1 every 500 sf
Riprap	Contractor	Source Investi- gation	Source Material Certification Specific Gravity	2 per Acre
	Contractor	During Place- ment	Source Material Certification Specific Gravity	1 per source 1 per source 1 per 500 tons 1 per 500 tons

- a. The Owner reserves the right to modify the services of the Soils Representative or Geotechnical engineer.
- E. The contractor shall make provisions for allowing safe and timely observations and testing of Contractor’s Work by the Geotechnical Engineer and by the Soils Representative.
- F. Pre-excavation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
 - 1. Before commencing earthwork, meet with representatives of the governing authorities, Owner, Architect, Engineer, consultants, Soils Representative, and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least 3 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.
- G. Testing: Compaction tests will be required by the Owner and will be paid for by the owner. No specific testing schedule has been established at this time. If tests indicate that density requirement have not been achieved, the contractor shall continue compacting the tested material. All retesting in these areas shall be paid for by the contractor.
- H. The Owner’s Testing Agency will perform water content, and gradation tests on onsite and processed materials, and compaction tests at a frequency and at locations as required. The results of these tests will be submitted to the Architect, and a copy submitted to the Contractor, on a timely basis so that the Contractor can take such action as is required to remedy the indicated deficiencies.
- I. Contractor shall notify Architect when excavations have reached required subgrade and provide a minimum notice of 24 hours prior to placement of backfill on exposed subgrade. Density and Compaction Testing: The contractor is responsible to schedule compaction tests and allow adequate

time for the proper execution of said tests. This section also applies to instances when the General Contractor resumes earthwork operations after a period of pause in earthwork operations that require observations by the Geotechnical Engineer.

- J. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:
1. Prepare plan report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
 2. Seismographic monitoring services during blasting operations.
 3. Prepare a preblast survey of all adjacent properties, including a structural inspection of the buildings and properties and shall include a written and photographic record of existing conditions.
 4. Blast operations shall not commence until all reports and plans are received and approved by the Owner and the Architect.

1.22 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by the owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.
1. Notify Architect not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Architect's written permission.
 3. Contact a utility-locator service for the area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies and City of Fitchburg to shut off services if lines are active.
- C. Subsurface investigations indicated the presence of fill material which contains organic matter. This material has limited reuse applications at the site.
- D. Subsurface investigations indicated the presence of sand and gravel materials which will likely be easily disturbed due to construction activities. This material is also likely to require regular moisture conditioning to obtain required compaction requirements.

1.23 MEASUREMENT

- A. Measurement of Unsuitable Soil overexcavation:
1. Strip vegetation, topsoil, buried organic material and fill to a minimum depth of 1 foot below the existing grades in accordance with the Contract Documents or in accordance with drawings. Remove existing asphalt, curbing, cobbles, boulders, concrete, metal, and wood above and below ground structures.
 2. Remove unsuitable soils to top of natural soil as shown on the Contract Documents or as directed in the field by the Owner's Geotechnical Consultant in accordance with the Section 3.1-B, 3.3, 3.6, 3.7, 3.9, and 3.10 of these Specifications.
 3. Employ a Registered Land Surveyor to survey to bottom of the excavation for unsuitable soils throughout the building footprint. Excavations shall be surveyed at the corners, high and low points, and a maximum spacing for survey points of 20 feet in each direction on a grid.

4. Quantities shall be measured in their original position to the limits of clearly defined vertical construction lines and to the depth required for the defined construction. Payment will be at the Contract Unit Rates.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Segregate excavated material based upon material type to enable reuse in appropriate locations based upon material type as described in Section 3.5.
- B. Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

2.2 SOIL MATERIALS

- A. Use of materials shall be as described below and as shown in the Drawings.
- B. Fill material will not be accepted from off-site borrow sources that are Massachusetts DEP MCP disposal sites. Common borrow material obtained from off-site borrow sources that have no known releases or disposal of oil and/or hazardous material shall be acceptable for use only when accompanied by documentation stating there has been no known releases or disposal of oil and/or hazardous materials at the off-site borrow site.
- C. Fill material shall be free from frost/ice and snow, rocks with a diameter greater than 2/3 of the loose lift thickness as specified herein, and foreign matter, such as construction debris, asphalt, trash, wood, roots, leaves, sod, and organic matter. All fill material shall be maintained by the contractor at suitable moisture contents for proper placement and compaction as specified herein.
- D. Offsite pulverized pavement and crushed concrete are not acceptable for fill material except as specified herein.

2.3 STRUCTURAL FILL

- A. Structural Fill shall have a plasticity index of less than 6 and shall meet the gradation requirements shown below. Structural Fill shall be compacted in maximum 9-inch loose lifts to at least 95 percent of the Modified Proctor maximum dry density (ASTM D1557), with moisture contents within ± 2 percentage points of optimum moisture content.

Sieve Size	Percent Passing by Weight
3 inches	100
1 ½ inch	80 – 100
½ inch	50 – 100
No. 4	30 – 85
No. 20	15 – 60
No. 60	5 – 35
No. 200*	0 - 10

*0 – 5 In top 12 inches under sidewalks, walkways, rubber surface in play areas, equipment pads, and unheated and exterior slabs (Select Fill).

Use structural fill within building areas beneath floor footings and slabs, retaining wall foundations, and in other soil-bearing situations.

Crushed concrete may be used as Structural Fill provided it meets the requirements of these specifications. If used, the crushed concrete shall be used up to 6 inches below the bottom of footings and 12 inches below the bottom of slabs. Crushed concrete shall be free of debris, wood, and organic material, and shall meet the environmental requirements set forth in these specifications.

Use Structural Fill with less than 5 percent fines in top 12 inches under exterior slabs-on-grade including under sidewalks, walkways, rubber surface in play areas, equipment pads, and unheated and exterior slabs.

2.4 ORDINARY FILL

- A. Ordinary Fill shall have a plasticity index of less than 6 and shall meet the gradation requirements shown below. Ordinary Fill shall be compacted in maximum 9-inch loose lifts to at least 95 percent of the Modified Proctor maximum dry density (ASTM D1557), with moisture contents within ± 2 percentage points of optimum moisture content.

Sieve Size	Percent Passing by Weight
6 inches	100
1 inch	50 – 100
No. 4	20 - 100
No. 20	10 - 70
No. 60	5 – 45
No. 200	0 - 20

Use Ordinary Fill for general grading; as backfill for embankments, behind the free draining backfill behind retaining walls, beneath the base layer of landscape areas; and beneath the subbase layer in paved areas outside the building footprint.

Crushed concrete can be used as Ordinary Fill provided it meets the requirements set forth by this specification.

2.5 COMMON BORROW

- C. Common Borrow material shall be soil containing no stone larger than 8 inches and shall be substantially free of organic loam, wood, trash, or other objectionable materials which may be decomposable, compressible or which cannot be properly compacted. Onsite and offsite Common Borrow materials shall not contain more than 30 and 20 percent by weight of silt and clay, respectively.
 - 1. No Common Borrow shall be imported until available onsite Ordinary Fill has been utilized or with prior written approval from the Architect.
 - 2. Common Borrow material from off-site borrow sources shall contain no detectable concentrations of asbestos.
 - 3. Crushed concrete can be used as Common Borrow provided it meets the requirements of these specifications.
 - 4. Common Borrow can be used beneath the topsoil in landscaped areas, and at depths greater than 3 feet in paved areas.

2.6 PROCESSED GRAVEL FOR SUBBASE

- A. Processed Gravel for Subbase shall be onsite or imported material conforming to Item M1.03.1 of the State Standards. This material can be used as subbase in the top 12 inches beneath paved areas.

- B. Processed Gravel for Subbase may be anticipated to be onsite in limited quantities.
- C. Crushed concrete shall not be used as Processed Gravel for Subbase.

2.7 BEDDING MATERIAL

- A. Crushed Stone Bedding Material shall be imported material conforming to Item M2.01.3 of the State Standards.
- B. Coarse Sand Bedding Material shall be imported material conforming to Item M1.04.0 type A of the State Standards.

2.8 SAND FILL

- A. Sand Fill: To be used as utility bedding and backfill. It shall be hard, durable sand free from ice, snow, roots, sod, and other deleterious matter conforming to the material and gradation requirements for Type B Sand Borrow, MassDOT Item M1.04.0. The Sand Fill shall be used as backfilling material around banks of pipes. The Sand Fill shall be graded within the following limits:

<u>Sieve Size</u>	<u>% Passing by Weight</u>
3/8-inch	100
No.200	0-10

2.9 DENSE GRADED CRUSHED STONE FOR SUBBASE

- A. Dense graded Crushed Stone for subbase shall be imported material conforming to Item M2.01.7 of the State Standards. This material shall be used as an alternate to Processed Gravel for Subbase in the top 12 inches immediately beneath paved areas.
- B. Crushed concrete cannot be used as Dense Graded Crushed Stone for Subbase.
- C. Dense graded Crushed Stone for subbase are not anticipated to be present onsite.

2.10 CRUSHED STONE

- A. Crushed Stone shall be impacted durable material with maximum of 1 ½ " or 2" as specified in the Drawings. Stone used for drainage components shall be double washed. For all other applications fines shall be <1% unless otherwise noted. Crushed stone shall meet the following gradation:

Size (inches)	Percent Finer
1 ½" – 2"	100%
1 ¼"	85% - 100%
¾"	10% - 40%
½"	0% - 8%
#200	< 1%

- B. ¾" Crushed Stone shall comply with State Standards M2.01.4.
- C. 1/4" to 3/8" Crushed Stone shall comply with State Standards M2.01.6.

2.11 PEA GRAVEL

- A. Clean naturally rounded aggregate with particle sizes no larger than 3/4 of an inch with no more than 5% passing the #8 sieve. The dry density shall be a minimum of 95 pounds per cubic foot.

2.12 WASHED STONE

- A. Washed stone shall be free from shale, clay, organic materials, and debris with stone sizes conforming to No. 4 stone as specified by ASTM D448. Not more than 0.5 percent of satisfactory material passing a No. 200 sieve shall be allowed to adhere to the stone. Laboratory testing shall be completed in compliance with ASTM D6913, and results shall be submitted to the Civil Engineer for approval.

2.13 FILTER FABRIC

- A. Filter fabric shall be nonwoven, needle-punched geotextile, manufactured for subsurface drainage applications, made from polypropylene fibers with elongation greater than 50 percent and complying with AASHTO M288. Filter fabric shall consist of Mirafi 140N, US120NW, GeoTex 401, or approved equal.
- B. High Visibility Filter Fabric shall consist of US 160NW-HVO non-woven orange filter fabric, GeoTex 601OR, or Mirafi 160N/O, or approved equal.

2.14 GEOTEXTILE FABRIC

- A. Geotextile No. 1: Geotextile Fabric for erosion control/slope protection/separation/filtration shall conform to Item M9.50.0 type IV of the State Standards. Geotextile No. 1 is a nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that fibers retain their relative position. The product is inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids.

Mechanical Properties	Test Method	Unit	Minimum Average Roll Value
Grab Tensile Strength	ASTM D 4632-91	lbs	120
Grab Tensile Elongation	ASTM D 4632-91	%	50
Trapezoid Tear Strength	ASTM D 4533-91	lbs	50
Mullen Burst Strength	ASTM D 3786-87	psi	225
Puncture Strength	ASTM D 4833-00	lbs	65
Apparent Opening Size (AOS)	ASTM D 4751-99A	U.S. Sieve	70
Permittivity	ASTM D 4491-99A	sec ⁻¹	1.8
Permeability	ASTM D 4491-99A	sec	0.21
Flow Rate	ASTM D 4491-99A	gal/min/ft	135
UV Resistance (at 500 hours)	ASTM D 4355-02	% strength retained	70
Physical Properties	Test Method	Unit	Typical Value
Weight	ASTM D 5261-92	oz/yd	4.8
Thickness	ASTM D 5199-01	mils	55

Roll Dimensions (width x length)	--	ft	12.5 x 360 / 15 x 360
Roll Area	--	yd	500 / 600
Estimated Roll Weight	--	lb	164 / 197

- B. Geotextile No. 2: Geotextile No. 2 is a nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that fibers retain their relative position. The product is inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids. Geotextile No. 2 shall be used where the project Civil Engineer required it.

Mechanical Properties	Test Method	Unit	Minimum Average Roll Value
Grab Tensile Strength	ASTM D 4632	lbs	160
Grab Tensile Elongation	ASTM D 4632	%	50
Trapezoid Tear Strength	ASTM D 4533	lbs	60
Mullen Burst Strength	ASTM D 3786	psi	305
Puncture Strength	ASTM D 4833	lbs	95
Apparent Opening Size (AOS)	ASTM D 4751	U.S. Sieve	70
Permittivity	ASTM D 4491	sec ⁻¹	1.4
Permeability	ASTM D 4491	sec	0.22
Flow Rate	ASTM D 4491	gal/min/ft	110
UV Resistance (at 500 hours)	ASTM D 4355	% strength retained	70

Physical Properties	Test Method	Unit	Typical Value
Weight	ASTM D 5261	oz/yd	6.4
Thickness	ASTM D 5199	mils	75
Roll Dimensions (width x length)	--	ft	15 x 300
Roll Area	--	yd	500
Estimated Roll Weight	--	lb	217

- C. Geotextile No. 3: Geotextile for the installation of underground tank
1. Woven geotextile fabric with a minimum grab tensile strength of 120 lbs/inch and a maximum apparent opening size of #50 US sieve (0.300 mm)

- D. A geotextile fabric shall not be used between crushed stone and soil fill material at the base of retaining walls. Where separation between crushed stone and soil fill material is required, the crushed stone shall be choked by means of a soil filter.
- E. A geotextile fabric shall be used to separate crushed stone used as a drain within or behind MSE and modular retaining walls and the backfill/natural soil.

2.15 OTHER SOIL MATERIAL

- A. Drainage Aggregate: Narrowly graded mixture of washed crushed stone or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.
- B. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural soil; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and 0 to 5 percent passing a No. 4 (4.75-mm) sieve.
- C. Fine Aggregate: ASTM C 33; fine aggregate, natural, or manufactured sand.
- D. River Stone: River stone shall be 1 ½" to 3" rounded and 3" to 6" rounded and oval, smooth stone, color range shall be warm tones of buff, beige, tan and gray. Color range shall be consistent throughout. Stone shall be clean and washed free of deleterious material. Contractor to submit 5-gallon container sample for each size range with source indicated.
- E. Rip-rap: rip-rap shall be sound, durable rock which is angular in shape in accordance with M2.02.0 of the State Specifications.

2.16 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:
- B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:
 - 1. Red: Electric.
 - 2. Yellow: Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water systems.
 - 5. Green: Sewer systems.

PART 3 – EXECUTION

3.1 GENERAL

- A. Prior to commencing work, the Contractor shall establish property line locations and place construction control markers clearly visible and understandable to workers in the field. The Contractor shall exercise due care so as not to disturb adjacent structures and shall leave the Site in clean and orderly condition upon completion of the work.
- B. Unanticipated Soil Conditions:

1. Removal of unsuitable materials up to the depths shown in the drawings and/or specified herein shall be part of the base bid and shall not be considered an unanticipated soil condition. The depth to the bottom of unsuitable material shall be estimated by interpolating between the depths to unsuitable material in the nearest borings and/or test pit.
 2. If unsuitable bearing materials are encountered at the specified subgrade depths, i.e., deeper than the elevations shown in the Geotechnical Report, the Contractor shall notify the Architect. The Contractor shall carry excavation deeper and replace the excavated material with suitable/approved compacted fill or lean concrete as directed by the Architect or geotechnical engineer.
 3. Removal of such material and its replacement as directed by the Architect will be paid as extra compensation in quantity approved by the Architect and calculated using survey points of the excavated area. Only changes in the work authorized in advance by the Architect in writing shall constitute an adjustment in the Contract Price.
 4. Material that is above or below optimum moisture for compaction of the particular material in place as determined by the Architect or the Soils Representative and is disturbed by the Contractor during construction operations so that proper compaction cannot be reached shall not be considered as unsuitable bearing materials. This material shall be removed and replaced with lean concrete or with approved material as directed by the Architect or Geotechnical Engineer or Soils Representative at no additional cost to the Owner.
 5. The Contractor shall follow a construction procedure which permits visual identification of firm natural ground.
- C. Excessive Excavation: If any part of the general or trench excavation is carried, through error, beyond the depth and dimensions indicated on the Drawings or called for in the Specifications, the Contractor at his own expense, shall furnish and install compacted gravel fill, concrete, or take other remedial measures as directed by the Architect to bring fill material up to the required level or dimension.
- D. The Contractor shall reuse onsite excavated soils that meet the gradation requirements of materials specified herein. Solid waste consisting of brick, concrete, asphalt, cobbles, boulders, excavated or blasted rock, and all unsuitable excavated materials shall become the property of the Contractor and be legally disposed of off-site at no additional cost to the Owner.

Samples and Testing:

1. Excavated material taken directly from onsite cuts that will meet the Specifications may be used as fill provided the Contractor obtains written approval from the Architect. No such fill material shall be placed until approved for use by the Architect in writing and until test results, including gradation and compaction tests are approved by the Geotechnical Engineer.
2. Testing of materials as delivered may be made from time to time. Materials in question may not be used, pending test results. Tests of compacted materials will be made regularly. Remove rejected materials and replace with approved backfill material, whether in stockpiles or in place.
3. The existing fill and the natural soil contain high fines contents. Such soils are very susceptible to disturbance when exposed to moisture. Care shall be exercised during construction to maintain a dry working subgrade. Provide working mats, e. g., crushed stone or concrete mud mats, to reduce the potential for disturbance of the foundation subgrade and to improve working conditions. The use of crushed stone to stabilize soft subgrade shall be at no additional cost to the Owner.

- E. Deficiency of Fill Material: Provide required additional fill material to complete the work if a sufficient quantity of suitable material is not available from the required excavation on the project site at no additional cost to the Owner.
- F. Surplus Fill Material: Surplus fill that is not required to fulfill the requirements of the Contract shall be removed from the site and legally disposed of at no additional cost to the Owner.
- G. Protect all benchmarks, monuments, and property boundary pins. Replace if destroyed by contractor's operation.

3.2 PREPARATION

- A. The Contractor shall be deemed to have inspected the Site and satisfied himself/herself as to actual grades and levels and true conditions under which the Work will be performed.
- B. Areas required for execution of Work shall be cleared. The work area shall be free of standing water and shall be dry.
- C. All site health and safety controls shall be fully established and in operation prior to beginning any demolition, soil, and fill excavation. Site controls shall include but not be limited to work zones properly barricaded, wheel wash and decontamination facilities, and all support equipment and supplies including personal protective equipment. All site controls shall be reviewed by the Architect in the field.
- D. The Contractor shall provide all layout field data, including ties, to the Architect. The Contractor shall maintain all required field controls throughout the performance of the Work.
- E. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- F. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, cobbles, boulders, rock as necessary, obstructions, and deleterious materials from ground surface is specified in Section 31 10 00 "Site Clearing and Preparation."
- G. Protect and maintain erosion and sedimentation controls, which are specified in Division 31 Section 31 25 00 – Erosion and Sedimentation Controls.
- H. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.
- I. Provide groundwater Control, dewatering, pumping, bailing and control of all groundwater and surface water for all work under this contract.

3.3 SUBGRADE PREPARATION

- A. Topsoil, subsoil, existing fill, buried organic soil, tree stumps, roots balls, cobbles, boulders, abandoned utilities, existing and abandoned foundations, asphalt, demolition debris, and other below-ground structures shall be entirely removed from within the footprint of the proposed building before the start of foundation work. The removal shall extend vertically to the top of the natural soil or to rock, and laterally beyond the limits of the influence zone of 5 feet beyond the limits of the proposed building, whichever is greater.
- B. The topsoil, subsoil, and surficial organic material, tree stumps, rootballs, asphalt, and concrete structures and other deleterious material shall be entirely removed from within the proposed

driveways and parking lots (paved areas). Abandoned/buried foundations, if any, shall be removed within the proposed paved areas and athletic fields at least 2 feet beneath the bottom of the subbase layer of the proposed paved areas, and 2 feet beneath the topsoil or the subbase of synthetic turf in athletic fields.

- C. Cobbles and boulders shall be removed at least 6 inches from beneath footings, 18 inches beneath the bottom of slabs and paved areas, and 24 inches beneath the topsoil or the base material for the synthetic turf in athletic fields. The resulting excavations shall be backfilled with compacted Structural Fill under the building, and with Ordinary Fill under the subbase of paved areas and under the base material in athletic fields.
- D. Tree stumps, root balls, and roots larger than ½ inch in diameter shall be removed and the cavities filled with approved backfill material and compacted in accordance with this Specification.
- E. After the existing fill, surficial and buried organic material, and unsuitable material are removed from within the proposed building, the exposed subgrade in the natural soil shall be compacted using at least four passes of a vibratory roller compactor imparting a minimum dynamic effort of 40 kips.
- F. The base of the footing excavations in the natural soil shall be compacted with a dynamic vibratory compactor weighing at least 200 pounds and imparting a minimum of 4 kips of force to the subgrade, before placing the backfill or concrete.
- G. The base material of athletic fields should conform to the gradation and placement requirements of the landscape architect or the manufacturer/installer of synthetic turf.
- H. The grades within the proposed building shall be restored using Structural Fill up to the bottom of the proposed slabs or bottom of the under-slab drainage system when required, in accordance with drawings and details.
- I. Due to the susceptibility of the natural soil to disturbance under foot and vehicular traffic, a minimum of 6 inches of Structural Fill or 3/4-inch crushed stone shall be placed under the footings to provide a firm working surface during placement of formwork and rebar.
- J. To improve the existing fill under the proposed paved areas, the exposed subgrade in the existing fill material (i.e., after removing the surficial topsoil, subsoil, organic material) shall be compacted with at least six (6) passes of a heavy vibratory roller compactor imparting a dynamic effort of at least 40 kips. Where soft zones of soil are observed, the soft soil shall be removed, and the grade shall be restored using Ordinary Fill to the bottom of the proposed subbase layer. Where buried organic material is present beneath the proposed paved areas, it shall be removed at least 1.5 feet beneath the bottom of the proposed subbase layer. The exposed surface shall be proofrolled before placing backfill.
- K. After the surficial organic topsoil is removed from within the proposed athletic fields, the subsoil, existing fill, or natural soil shall be proofrolled with a loaded rubber tire truck or with a large vibratory roller compactor imparting a minimum dynamic effort of 40 kips. Where soft zones are indicated by the proofrolling, the soft zones should be removed and the grades should be restored using Ordinary Fill to the bottom of the base material of the proposed turf designed by the landscape architect or the manufacturer/installer of synthetic turf, if any.
- L. In areas requiring rock excavations, disturbed rock material or rock that has heaved as a result of blasting shall be removed and replaced with Structural Fill or crushed stone within the footprint of the proposed building, and with Ordinary Fill beneath the pavement subbase of the proposed parking lots and driveways.

- M. The bottom of footings bearing in bedrock shall be prepared as level as possible and shall not be sloped steeper than 12H:1V.
- N. Rock surfaces that heave due to blasting shall be compacted with a vibratory roller compactor that imparts a minimum of 40 kips to the rock surface, prior to placing fill. Where the thickness of heaved rock is more than 2 feet, the heaved rock shall be removed and replaced with approved backfill material.
- O. Granular fill shall not be placed directly on rock surfaces containing voids. Suitably sized crushed stone or a geotextile for separation shall be placed on the fractured surface prior to placing the fill to limit migration of smaller particles into the voids.
- P. Under utility pipes, manholes, and catch basins, rock shall be cut a minimum of 12 inches beneath the pipe or structure.
- Q. Laterally, the rock shall be removed at least 1 foot beyond the limits of footings and 3 feet beyond the limits of walls. Rock shall be cut a minimum of 12 inches outside utility structures and a minimum of 18 inches on each side of utility pipes.
- R. To reduce overblasting and the potential for heaved rock, drill holes for blasting shall not extend more than 2 feet beneath the minimum depths shown above.
- S. Rock blasting, if needed, shall be controlled to reduce vibrations and airblast overpressure to below thresholds established in the contract documents. The peak particle velocity shall be maintained at less than 2 inches per second (ips) for concrete foundations, 1 ips for stone foundations, and 0.5 ips for rubble foundations at the nearest structure.
- T. Contractor shall excavate from within the Building Area/Zone of Influence all unsuitable soils to a depth sufficient to reach the native soils as specified herein, within the geotechnical report, and within the contract plans.
- U. All excavated materials shall be segregated such that reusable material meeting the gradations provided for above are separated from organics and all other deleterious material.
- V. Once the final subgrade has been reached, and upon acceptance by the Architect and Soils Representative, Contractor shall backfill the excavated area with Structural Fill in the influence zone of building areas and Ordinary Fill in paved areas. Limits of excavation shall be determined in the field based upon observed conditions.

3.4 PROOF COMPACTING

- A. Areas requiring excavation shall be excavated to subgrade and then proof compacted as specified in Section 1.2 of this Specification Section.
- B. Where soft zones are revealed by compaction efforts and where organic soil is exposed, the soft material or organic soil shall be removed and replaced with Structural Fill in the influence zone of building areas and utility trenches and Ordinary Fill in paved areas.

3.5 REUSE OF ONSITE MATERIALS AND PROCESSING OF ONSITE MATERIALS

- A. Based on the borings and test pits, the existing fill contains up to 30 percent fines and the natural soil layer contains up to 40 percent fines. Subgrade support capacities may deteriorate when such soils become wet and/or disturbed. The contractor shall keep exposed subgrades properly drained and free of ponded water. Subgrades shall be protected from machine and foot traffic to reduce disturbance. Placed onsite material

- that become soft and unsuitable to support additional lifts of fill shall be removed and replaced at no additional cost to the owner. The contractor shall not make claims due to difficulty handling the onsite material.
- B. Organic soils cannot be reused for backfill except as directed by the landscape architect.
 - C. The contractor shall plan on disposing of the excavated existing fill that does not meet the gradation requirements set forth by this specification and importing offsite materials for backfill. This backfill material shall be replaced at contractor's cost if it becomes soft as a result of exposure to wetness.
 - D. Should onsite materials be encountered that are suitable for reuse in accordance with the requirements for these specifications, the Owner shall receive a credit from the contractor for the quantity of reused onsite material. The credit shall be based on the difference in unit rates between imported and onsite material for the particular soil designation. The contractor shall provide Unit Rates for these materials in his base bid.
 - E. Solid waste consisting of brick, concrete, asphalt, cobbles and boulders that measure less than 3 cubic yards in volume shall become the property of the Contractor and be legally disposed of off-site at no additional cost to the Owner.
 - F. Excavated onsite soils which are suitable for re-use at the time of excavation but become frozen or too wet for re-use due to poor material handling practices shall be disposed of off-site and replaced as necessary at no additional cost to the Owner.
 - G. The processing of the existing building concrete and brick materials into Ordinary Fill shall be allowed.
 - H. The Contractor must inspect all existing stockpiles on site including soil testing for each stockpiled material.
 - I. The Contractor must amend the existing stockpiles if testing determines that the stockpiles do not meet the specifications for their intended use. The Contractor shall provide third party sampling and testing for all soils amended on-site.
 - J. The Contractor shall be allowed to mobilize a rock crusher to the site to process cobbles, boulders, blasted rock, and imported rock by blending these materials with the existing fill and natural soil and crushing them to produce well graded materials, provided that these materials are maintained at suitable moisture contents for proper compaction. Processed material obtained by crushing blasted rock, boulders, and soil shall meet the gradation requirements of Ordinary Fill and Structural Fill. Material produced by the crushing operation shall be well graded so as to reduce the potential for formation of honeycombs during its placement and compaction.
 - K. The contractor shall protect stockpiled unprocessed materials from exposure to moisture using tarps. The tarps shall be secured so as not to be moved by wind or other action. No claim shall be made, by the contractor, due to failure to comply with this requirement.
 - L. When processing the blasted rock, the Contractor shall mix the blasted rock with onsite soil free of organic soil to produce a well graded processed material meeting the specification of the material for which it is intended for use.
 - M. Before blasted rock, cobbles, and boulders that are crushed and processed onsite is reused, they shall be observed and approved by the geotechnical engineer. At the start of the crushing operations, the soil to rock proportions placed into the crusher shall be varied until the processed material meets the appropriate gradation requirements. The soil to rock proportion thus achieved shall be maintained throughout the duration of the project.
 - N. The material placed into the crusher shall be free of organics, wood, and other deleterious matter.

- O. The jaws of the crusher shall be adjusted periodically to maintain the crushing gradation.
- P. Excess blasted rock, processed or unprocessed, not used on site shall be the property of the Contractor and shall be removed offsite at no additional cost to the Owner.

3.6 EXCAVATION, GENERAL

- A. The Contractor shall remain responsible for adequacy and safety of construction means, methods and techniques.
- B. The Contractor shall complete all excavations regardless of the type, nature or condition of the material encountered. The Contractor shall be solely responsible for making all excavations in a safe manner.
- C. The Architect shall be notified of unexpected subsurface conditions. Work shall be discontinued in affected areas until notified in writing to resume work by the Architect. No claim shall be made, by the contractor, due to failure to comply with this requirement.
- D. Displaced or loose soil shall be prevented from falling into any excavation. The stability of soil slopes shall be maintained in accordance with applicable local, state and federal regulations and guidelines.
- E. All loose material shall be removed from the bottom of the excavation so that the bottom shall be in an undisturbed condition. If removal of the loose material results in excavation beyond the work limits and over excavation has not been approved by the Architect; the restoration of the excavation to grade shall be done at no additional cost to the Owner.
- F. When the bottom of the excavation shall, by error of the Contractor, have been taken to a depth greater than the depth specified, or directed by the Architect, said condition shall be corrected by refilling to the proper grade with approved backfill material or the design shall be altered in a fashion acceptable to the Architect to compensate for said error. All measures taken to rectify conditions caused by over excavation shall have the Architect's approval, and any increase in cost resulting from such measures shall be borne by the Contractor.
- G. Excavation shall not be performed when weather conditions or the conditions of the materials are such that, in the opinion of the Architect, work cannot be performed satisfactorily.
- H. Appropriate measures shall be provided to retain excavation sidewalls and to ensure that persons working in or near the excavation are protected. Sheeting shoring or bracing may be used to support the walls of excavations. Method, design, construction, and adequacy of any required bracing shall meet the OSHA requirements of 29 CFR Part 1926 and are the responsibility of the Contractor.
- I. All damage related to or caused by the excavation shall be repaired at the expense of the Contractor.
 - 1. Unclassified Excavation - For the purposes of payment, materials shall be unclassified except for those materials beyond the limits specified in Section item 3.6.1.2 as described in item 3.1-B of these specifications. Excavation shall comprise and include the satisfactory excavation, removal, and disposal of all materials encountered within the lines and grades shown in the Drawings or limits specified herein, whichever is deeper, regardless of the nature of the materials, and shall be understood to include, but not be limited to, earth, topsoil, subsoil, hardpan, fill, foundations, pavements, curbs, piping, railroad track and ties, cobblestones, footings, bricks, concrete, abandoned drainage and utility structures, debris, and materials classified as unsuitable materials. All excavation and replacement, if applicable, with suitable material within the lines and grades shown in the Drawings or the limits specified herein, whichever is deeper, will be considered and bid as unclassified and shall be included in the Contractor's lump sum (i.e., shall not be paid for using Unit Rates).

2. For bidding purposes, the limits of unclassified excavation (i.e., excavations included as part of the base bid and for which there will be no payment using Contract Unit Rates) to remove the subsoil, existing fill and organic soil within the building, paved areas, and athletic fields shall be as defined in section 3.3 of these specifications. For rock excavations, the limits of unclassified excavation are defined in Section 3.7H. Rock excavation beyond the lines defined in Section 3.7H will be paid using unit prices.
 3. All excavation and replacement, if applicable, with suitable material within the lines and grades shown in item 3.6.1.2 shall be considered and bid as unclassified and shall be included in the Contractor's lump sum (i.e., shall not be paid for using Contract Unit Rates). Excavations beyond these lines described in the item shall be measured and paid for after approval of the measurements by the Architects as Classified Excavation using the Contract Unit Rates for respective classification in accordance with the allowance included in the contract documents.
- J. The Contractor shall submit with the bid documents the quantities used to estimate the lump sum for Unclassified Excavation. Should quantities of certain materials or classes of work be increased or decreased from what is shown in the drawings and specified herein, the Contract Unit Rates listed below shall be the basis of payment to the Contractor, or credit to the Owner, for such increase or decrease in the work. The Contract Unit Rates shall represent the exact net amount, per unit, to be paid to the Contractor in the case of increases in the quantities, and the exact amount to be refunded to the Owner in the case of decreases in the quantities. No additional adjustment shall be allowed for overhead, profit, insurance, or other direct or indirect expenses by the Contractor. Contract Unit Rates of materials shall include hauling, storing, stockpiling, moving, importing, spreading, and compacting. Increases or decreases in the quantities shall be approved by the Owner. Should quantities of certain materials or classes of work be increased or decreased from what is shown in the drawings and specified herein, the Contract Unit Rates listed below (see Section 3.6.M) shall be the basis of payment to the Contractor, or credit to the Owner, for such increase or decrease in the work. The Contract Unit Rates shall represent the exact net amount, per unit, to be paid to the Contractor in the case of increases in the quantities, and the exact amount to be refunded to the Owner in the case of decreases in the quantities. No additional adjustment shall be allowed for overhead, profit, insurance, or other direct or indirect expenses by the Contractor. Contract Unit Rates of materials shall include hauling, storing, stockpiling, moving, importing, spreading, and compacting. Increases or decreases in the quantities shall be approved by the Owner.
1. The Contractor shall excavate soil and fill to the limits necessary to achieve the required grades determined by the Architect. The limits of excavation may not coincide with those areas indicated on the Drawings. The excavation areas shown on the Drawings are estimated areas only.
- M. Provide unit process as follows:
1. For each type of material listed in PART 2 - PRODUCTS, separate unit rates shall be provided for imported material and material processed onsite. The unit rates shall include furnishing/processing, stockpiling, placing, and compacting the material)
 2. Provide unit rate for rock excavation in trenches and pits, removed from the site, and any placement of fill required to bring excavated surface to specified subgrade.
 3. Provide unit rate for rock excavation as open excavation, removed from the site, and any placement of fill required to bring excavated surface to specified subgrade.
- N. Unsuitable Soil Allowance: The Contractor shall carry an allowance of 1,500 cubic yards for excavation and placement/replacement of materials beyond the limits specified item 3.6.1.2. Allowance shall cover removal and disposal of unsuitable soil and furnishing imported suitable backfill materials compacted in place as directed herein.

1. If the total void volume of unanticipated unsuitable material excavation below specified subgrades, and its replacement with compacted fill exceeds the amount included in the Contract as listed above, the Owner shall pay the excess excavation and replacement at the Unit Rate submitted in the Bid Attachment – Unit Rates Schedule.
 2. If the total quantity of unanticipated unsuitable materials below specified subgrades, and its replacement with compacted fill is less than the amount included in the Contract as listed above, the contract sum will be decreased by the difference in excavation and its replacement multiplied by the Unit Rate submitted in the Bid Attachment – Unit Rates Schedule.
 3. Final excavated surfaces shall be surveyed by the Contractor and shall be measured from specified subgrade to bottom of excavation. Payment shall be based upon actual volumes with no bulking or swell factors applied. Contractor shall submit all survey data and quantity calculations to Architect for approval.
- O. Petroleum Contaminated Soil Allowance: The Contractor shall carry in the base bid an allowance of 25 cubic yards for removal of unanticipated as directed in Section 01 22 00 Unit prices, petroleum contaminated soil materials. Allowance shall cover removal and disposal of petroleum contaminated soil and furnishing imported suitable backfill materials compacted in place as directed herein. The base bid shall cover all costs related to such excavation, removal off site, disposal, and replacement with compacted fill of approved material, overhead, and profit. No amount other than that herein specified will be paid by the Owner for the work defined herein.
1. If the total void volume of unanticipated petroleum contaminated material excavation, and its replacement with compacted fill exceeds the amount included in the Contract as listed above, the Owner shall pay the excess excavation and replacement at the Unit Rate submitted in the Bid Attachment – Unit Rates Schedule.
 2. If the total quantity of unanticipated petroleum contaminated materials, and its replacement with compacted fill is less than the amount included in the Contract as listed above, the contract sum will be decreased by the difference in excavation and its replacement multiplied by the Unit Rate submitted in the Bid Attachment – Unit Rates Schedule.
 3. Final excavated surfaces shall be surveyed by the Contractor and shall be measured from specified subgrade to bottom of excavation. Payment shall be based upon actual volumes with no bulking or swell factors applied. Contractor shall submit all survey data and quantity calculations to Architect for approval.

3.7 ROCK EXCAVATION

- A. Definitions and Classifications: The following classifications of excavation will be made only when rock excavation is required.
1. “Earth Excavation” consists of removal and disposal of pavement and other obstructions visible on ground surface, underground structures and utilities indicated to be demolished and removed, material of any classification indicated in data on subsurface conditions, and other materials encountered that are not classified as rock excavation.
 2. “Rock Excavation” consists of removal and disposal of materials encountered that cannot be excavated without continuous and systematic drilling and blasting or continuous use of a ripper or other special equipment, except such materials that are classed as earth excavation. Typical of materials classified as rock excavation are as follows:
 - a. Rock or stone in original ledge.
 - b. Hard shale in original ledge.
 - c. Boulders on site, outside trench limits, exceeding three cubic yards in volume.
 - d. Boulders within trench limits, exceeding one cubic yard in volume.
 - e. Rock that is blasted and excavated in large pieces shall not be paid for as boulders.
 3. Should highly fractured or weathered bedrock be encountered during excavation, the following shall apply:

4. When the material is encountered in trenching operations or under footings, it shall be excavated or ripped with a hydraulic backhoe equal to or larger than Caterpillar 336 excavator and will be classified as Earth Excavation. When it is demonstrated to the satisfaction of the Architect and the Soils Representative that this material can no longer be removed with a hydraulic backhoe and requires drilling and blasting, this material shall be classified as Rock Excavation. For excavation procedures when this material is encountered under footings, refer to paragraph below.
 5. When this material is encountered in open excavation, it shall be classified as earth excavation until drilling and blasting or continuous ripping is necessary as defined hereinabove.
 6. Intermittent drilling and ripping performed to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.
 7. Allowance for Rock Excavation: The Contractor shall carry in the Base Bid an allowance of 100 cubic yards for rock encountered in trench excavation removed from the site as directed in Section 01 22 00 Unit Prices. The Contractor shall also carry in the Base Bid an allowance of 200 cubic yards for open rock excavation removed from the site as directed in Section 01 22 00 Unit Prices. The Base Bid shall cover all costs relating to such rock excavation, including blasting, removal and placement of the excavated material, overhead and profit. No amount other than that herein specified will be paid by the Owner for excavation herein defined.
 8. Quantities shall be measured by the volume of void created using survey points of the excavated area. The fixed Unit Rate shall be applicable to variations in excess of the allowance quantity up to 100% of the allowance quantity.
 9. If the total quantity of Rock Excavation, open and/or trench, is less than the amount of Rock Excavation included in the Contract as listed above, the Contract sum will be decreased by the difference in Rock Excavation multiplied at the fixed Unit Rate. Quantities shall be measured by the volume of void created using survey points of the excavated area. The fixed Unit Rate shall be applicable to variations of the allowance quantity by decreases of 100% of the allowance quantity.
 10. Hoe ramming rock shall be paid for as rock excavation and shall not be paid for as time and material (T&M).
- B. Measurements:
1. When, during the process of excavation, rock is encountered, such material shall be uncovered and exposed in such a manner that the unbroken ledge surface is clearly visible, and the Architect shall be notified by the Contractor, before proceeding further. The areas in question shall then be cross-sectioned as hereinafter specified.
 2. Failure on the part of the Contractor to uncover such material and to notify the Architect and proceeding by the Contractor with the rock excavation before cross-sections are taken, will forfeit the Contractor's right of claim towards the stated allowance or additional payment over and above the stated allowance at the quoted Unit Rate.
 3. The Contractor shall employ and pay for a Professional Civil Engineer or Land Surveyor registered in the Commonwealth of Massachusetts to take cross-sections of rock before removal and to make computations of volume of rock encountered within the Payment Lines. Cross-sections shall be taken in the presence of the Soils Representative and the computations approved by the Architect. The Owner has the option to perform independent cross-sections and computation of rock quantities.
 4. Where removal of boulder or ledge is required outside the established payment lines, the extent of this removal and basis of payment shall be determined by the Architect.

- C. If ledge is encountered within the limits of the Proposed Building Area, the Contractor shall excavate this material 12 inches below subgrade of footings and 18 inches below subgrade of slabs and pavement unless otherwise directed by the Architect or Soils Representative. All loose or shaken rock shall be removed and replaced with compacted gravel fill, crushed stone or lean concrete as directed by the Soils Representative.
- D. Rock excavation for foundations outside of the Building Area: Remove rock to 6 inches below foundation or footing subgrade. All rock bottoms for foundations shall be carefully examined. Loose or shaken rock shall be removed to solid bearing, and the rock surface leveled, or shelved to a slope not exceeding one inch per two feet, or as directed.
- E. Prepared rock subgrades shall be compacted with at least four passes of a self-propelled vibratory roller such as Dyna Pac CA-30D (44,000 lbs. Centrifugal force) or equivalent. Rock subgrades in utility trenches shall be recompacted with at least four passes using a walk-behind vibratory drum roller or other equivalent equipment having at least 10,000 pounds centrifugal force and sufficient to provide a firm, stable subgrade.
- F. If any part of the rock excavation at footings to be carried beyond the depth and the dimensions indicated on the Drawings or called for in the Specifications, the Contractor shall, at his own expense, furnish and install concrete of same strength as footings to the required subgrade level of the footings as shown on the Drawings. Dowelling or other corrective structural measures as directed by the Architect may also be required to properly anchor or reinforce the concrete. If rock excavation is carried beyond the depth and dimensions to subgrade in other areas, the Contractor shall, at his own expense, furnish and install compacted gravel fill to subgrade as directed by the Architect.
- G. Basis of Payment: The total amount of rock excavation will be based upon the in-situ volume of rock excavated within and/or above the lines referred to in the next paragraph as "Payment Lines". The payment lines are only to be used as a basis of payment and are not to be used as limits of excavation. Limits of excavation area as shown on the Drawings and as specified herein.
- H. Payment Lines for Rock Excavation:
 - 1. Payment lines for columns footings shall be a vertical line 12 inches (laterally) from the edge of the footings. Payment lines for walls shall be a vertical line three feet (laterally) outside the walls or 12 inches (laterally) from the edge of the wall footing, whichever is greater. The depth of rock removal under footings shall be 12 inches below the bottom elevations shown on the Drawings.
 - 2. Payment lines for manholes and catch basins shall be one-foot outside of the outer wall and 12 inches beneath the structure.
 - 3. Payment lines for rock excavation under slabs on grade shall be 18 inches below the bottom of the slab. Payment lines for rock excavation at plant beds shall be 12" at edge and full depth of required elevation for loam.
 - 4. Payment lines for rock excavation at paved areas and lawns shall be 18 inches below bottom of asphalts.
 - 5. Payment lines for rock excavation under pipes within the building and for utility trenches outside the building lines shall in no case be calculated as greater in width than the outside diameter of the pipe plus two feet for pipes up to 18 inches. For pipes 18 inches and larger payment lines shall in no case be calculated as greater in width than the outside diameter of the pipe plus three feet. Payment lines at bottom of all pipe and utility trenches shall be 12 inches below the bottom of the pipe.

3.8 STORAGE OF SOIL MATERIALS - STOCKPILING

- A. The Contractor shall be responsible for managing and tracking any and all materials excavated and placed in stockpiles for testing.
- B. Materials shall be stockpiled on site at locations proposed by the Contractor and approved by the Architect. Stockpiled materials shall be of sufficient quantities to meet project schedule and requirements.
- D. The temporary stockpiled fill must be removed from the Site in accordance with applicable regulatory deadlines however no later than the completion date of this contract or 90 days from the date the stockpile was created, whichever is encountered first.
- E. Stockpiles shall be securely barricaded and clearly labeled. Differing materials shall be separated with dividers or stockpiled apart to prevent mixing.
- F. The Contractor shall direct surface water away from stockpile site to prevent erosion or deterioration of materials. Soils shall be suitably dewatered prior to their relocation on Site or disposal off site.
- G. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 EXCAVATION FOR WALKS AND PAVEMENTS

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

3.10 EXCAVATION FOR UTILITY TRENCHES

- B. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - a. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- C. Trenches shall be excavated to the necessary width and depth for proper laying of pipe or other utility and excavation side slopes shall conform to OSHA requirements. Minimum width of trenches shall provide clearance between the sides of the trench and the outside face of the utility. Maximum trench sizes are as shown on the Drawings or as specified herein. The depth of the trench shall be twelve inches below the bottom of the pipe barrel or respective utility. If the existing soil at the final subgrade excavation is found not suitable, the Architect or Soils Representative may approve removal and replacement of material.
 - 1. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.
 - 2. Clearance: As indicated on plans.
 - 3. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
 - 4. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- C. The Contractor shall provide, at his own expense, suitable bridges over trenches where required for accommodation and safety of the traveling public and as necessary to satisfy the required permits and codes.

3.11 SUBGRADE INSPECTION, COMPACTION AND PROOF ROLLING

- A. Notify Architect when excavations have reached required subgrade.
- B. Proof compact all subgrades in accordance with Sections 1.2 and 3.3 of these Specifications and the Geotechnical Report to identify soft pockets and areas of excess yielding. Do not proof compact wet or saturated subgrades.
 - 1. Completely proof compact subgrade in one direction repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
 - 2. Revise minimum weight or type of vehicle in first subparagraph below if required.
 - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect and/or Soil Representative, and replace with compacted fill as directed.
 - 4. Proof compacting shall be completed utilizing a 20-Ton vibratory drum roller for granular soils. Should clay or other cohesive soils be encountered, sheep's foot roller shall be utilized. A total of 6 passes shall be considered complete.
- C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect and/or soil representative, without additional compensation.

3.12 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage,
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring and bracing and sheeting.
- B. If, through failure or neglect of the Contractor to conduct the excavation work in a proper manner, the surface of the subgrade is in an unsuitable condition for proceeding with construction, the Contractor shall, at his own expense, remove the unsuitable material and replace it. Failure of the Contractor to control surface or ground water adequately, premature excavation at the work site, or other manifestations of the Contractor's neglect or improper conduct of the work, as determined by the Architect, shall be grounds for requiring removal and replacement of unsuitable subgrade without additional compensation.
- C. Grading in the vicinity of backfilling shall be properly pitched to prevent water from running into the backfilled area. Work areas shall be kept free from water during performance of the work under this Contract at no expense to the Architect. The Contractor shall build diversion berms and other devices necessary for this purpose.
- D. The Contractor shall not commence backfilling operations until the Architect gives approval.
- E. After the subgrade has been prepared, fill material shall be placed and built-up in successive layers until the required elevations are reached. No fill shall be placed on a frozen surface, nor shall snow, ice, or other frozen material be included in fill. Wet materials containing moisture in excess of the amount necessary for satisfactory placement or compaction shall not be used.
- F. All fill shall be brought up in essentially level lifts and shall be placed in levels by standard methods. The method of placement shall not disturb or damage other work. Layers of fill shall not exceed

twelve inches of uncompacted thickness before compaction, unless otherwise specified or as necessary for proper subgrade stabilization.

- G. Place backfill on subgrades free of mud, frost, snow, or ice.
- H. Filling operations shall continue until the fill has been brought up to the finished slopes, lines, and grades making proper allowances for thickness of surface treatment.
- I. The entire surface of the work shall be maintained free from ruts and in a condition that will permit construction equipment to travel readily over any Section. The top surface of each layer shall be made level or slightly sloped away from the center of the filled area. Fills shall be graded to drain and compacted/sealed whenever precipitation is expected.
- J. Backfilling shall not be performed when weather conditions or the conditions of the material are such that, in the opinion of the Architect, work cannot be performed satisfactorily.

3.13 ACCEPTABLE BACKFILL MATERIALS

- A. Backfill materials shall be placed in the areas as indicated in the table below:

Fill below footings, including site retaining walls, below slabs, and below the under-slab drainage system within the Building Area	Structural Fill
Fill for under-slab drainage system	3/4-inch Crushed Stone over geotextile fabric
Fill around footings for building and structures within the Influence zone	Structural Fill
Fill below pavement subbase	Ordinary Fill
Fill below sidewalk subbase	Ordinary Fill
Fill placed in top 1 foot below sidewalks, walkways, rubber play areas, exterior stairs, unheated and exterior slabs and pads	Select Fill
Fill within utility trenches below pavement and sidewalk subbase	Ordinary Fill
Fill below utility bedding	Ordinary Fill
Fill placed in landscaped areas outside of the Influence Area of footings, retaining walls, and slopes	Common Borrow
Fill placed around banks of pipes	Sand Fill
Under site retaining walls and hardscape features	Structural Fill

3.14 UTILITY TRENCH BACKFILL

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

- B. Place and compact bedding on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Place and compact initial backfill material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- D. Backfill voids with satisfactory soil while installing and removing shoring and bracing.
- E. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- F. Backfill voids with approved backfill material while installing and removing shoring and bracing. Where voids cannot be backfilled with compacted backfill, the voids shall be filled with flowable fill.
- G. Backfilling around banks of pipes shall be performed by chinking the Sand Fill with hand shovel and pouring water on the backfill material (Sand Fill) to fill the voids.
- H. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.15 BELOW GRADE TANK BACKFILL

- A. Backfill with Pea Gravel as specified herein. The use of the proper material is critical to the long-term tank performance.
- B. Do not mix approved backfill material with sand or native materials. Do not backfill tank with sand or native materials.
- C. Replace all excavated native materials with approved Pea Gravel which meets ASTM C 33 for quality and soundness.

3.16 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
 - 1. Sequentially place and compact fill material in layers to required elevations.
- B. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.17 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by +3 to -3 percent and is too wet to compact to specified dry unit weight.
 - 3. If in the opinion of the Architect or Geotechnical Engineer, additional moisture is required, water shall be applied by sprinkler tanks or other uniform distribution devices. If excessive

amounts of water or if rain should cause excessive wetness, the area shall be allowed to dry as provided above.

3.18 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross-sections, lines, and elevations indicated. Grading shall be done by standard methods. Areas adjacent to structures and other areas inaccessible to heavy grading equipment shall be graded by manual methods. Embankments shall be graded at all times to ensure runoff of water.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
 - 3. Provide proper drainage from the site, no grading shall be done to direct water to damage or potentially damage adjacent property or work executed under this contract.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Lawn or Unpaved Areas: Plus or minus [1 inch]
 - 2. Walks: Plus or minus [1 inch]
 - 3. Pavements: Plus or minus [1/2 inch]

3.19 FIELD QUALITY CONTROL

- A. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- B. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed in accordance with Sections 1.7 and 1.20 of this Specification and:
 - 1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 500 sq. ft. or less of paved area, but in no case fewer than 3 tests.
 - 2. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet or less of trench length, but no fewer than 2 tests.
- C. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.20 COMPACTION REQUIREMENTS

- A. The following table lists minimum compactive efforts, which are required for all, fill materials. Compaction of each lift shall be completed before placement and compaction of the next lift is started. The compaction equipment shall make an equal number of transverse and longitudinal coverages of each lift. The degree of compaction for fill placed in various areas shall be as follows:
 - 1. Under concrete slabs and footings 95%
 - 2. In paved areas
 - Within aggregate base course 95%
 - Within aggregate subbase course 95%
 - Below subbase course 95%

- 3. In landscaped areas (To be checked/approved by RLA) 90%
- 4. Around and Above Utilities below
Below Pavement subbase in paved areas 95%

*Percentage of maximum dry density of the materials at optimum moisture content as determined by methods or tests for ASTM designation D1551 Method D.

- B. Compaction shall be accomplished by vibratory rollers, multiple wheel pneumatic tire rollers or other types of approved compacting equipment. Loaded trucks, low beds, water wagons and the like shall not be considered as acceptable compaction equipment unless specifically approved by the Architect for a particular location. Equipment shall be of any such design that it will be able to compact the fill to the specified density in a reasonable length of time. All compaction equipment shall be subject to the approval of the Architect.
- C. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- D. Backfill shall not be placed against walls until they are braced or have cured sufficiently to develop strength necessary to withstand, without damage, pressure from backfilling and compacting operations.
- E. Before backfilling against walls, the permanent structures must be completed and sufficiently aged to attain strength required to resist backfill pressures without damage. Temporary bracing will not be permitted except by written permission from the Architect. Correct any damage to the structure caused by backfilling operations at no cost to the Owner.
- F. During backfilling, the difference in elevation of backfill on opposite sides of the structure shall not exceed 24 inches, except as noted. Where backfill of wall is only on one side, only hand-operated roller or plate compactors shall be used within a lateral distance of 5 feet of back of wall for walls less than 15 feet high and within 10 feet of back of wall for walls more than 15 feet high. The backfill material shall be compacted with a dynamic vibratory compactor weighing no more than 1000 pounds and imparting a minimum of no more than 8 kips of force to the subgrade.
- G. The Contractor shall compact all fills made during the day of work prior to leaving the project for the evening. The upper layer shall be pitched as necessary to provide positive drainage towards swales or interceptor ditches to minimize ponding and erosion should it rain.

3.21 COMPACTION TESTING

- A. The Contractor shall make all necessary excavations and preparations for testing. Excavations for density tests shall be backfilled with material similar to that excavated, and compacted to the specified density by the Contractor. Failure of the backfill material to achieve the specified density will be just cause for rejection of any or all portions of the excavation section tested. The Contractor will not be granted an extension of time or additional compensation for testing or repair of backfill ordered by the Architect.
- B. Field density tests will be made by the Owner's Inspection Agency in accordance with the Method of Test for ASTM Designation D1556 or D6938, to determine adequacy of compaction; the location and frequency of such field tests shall be at the Architect's Inspection Agency's discretion.
- C. All field density tests results shall be reviewed by the Architect prior to the placement of concrete.
- D. The Contractor shall notify the Inspection Agency when an area is ready for compaction testing. This notification shall be 48 hours in advance of placing or final compaction so that the Architect Inspection Agency has adequate time to take compaction tests.

- E. Cooperate with the Architect in obtaining field samples of in-place materials after compaction. Furnish incidental field labor in connection with these tests. The Contractor will be informed by the Architect of areas of unsatisfactory density which may require improvements by removal and replacement, or by scarifying, aerating, sprinkling (as needed), and recompaction prior to the placement of the new lift. No additional compensation shall be paid for work required to achieve proper compaction.
- F. The Owner or Architect's Inspection Agency's presence does not include supervision or direction of the actual work by the Contractor, his employees, or agents. Neither the presence of the Inspection Agency nor any observations and testing performed by him shall excuse the Contractor from defects discovered in his work.

3.22 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
 - 1. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
- B. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
 - 1. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 2. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Project property.

3.24 REMOVAL OF EROSION CONTROL MEASURES

- A. Remove temporary drainage swales, check dams, siltation sumps, hay bales, siltation fencing and other temporary drainage, erosion and siltation control measures when permanent drainage control measures have been installed and grass is established in drainage areas leading to siltation sumps. Contractor shall excavate and remove all sediments from siltation sumps prior to backfilling the sumps. Remove erosion control measures when approved by the Architect.

End of Section