

APPENDIX 2.11

Civil Engineering Design Specifications

BLACK NUBBLE WIND FARM
REDINGTON TOWNSHIP, MAINE

CIVIL ENGINEERING SPECIFICATIONS INDEX

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SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Protecting existing trees shrubs groundcovers plants and grass to remain.
2. Removing existing trees shrubs groundcovers plants and grass.
3. Stripping and stockpiling topsoil.
4. Stripping and stockpiling stumps and grubblings.
5. Temporary erosion and sedimentation control measures as required by the Erosion Control Plan.
6. Filing appropriate paperwork including a Notice of Intent to Harvest with the Maine Forest Service for clearing operations.
7. Survey and flagging of all areas for clearing.
8. Reviewing clearing limits with the Owner/Permittee, Engineer, and General Contractor before commencing clearing operations.
9. Close-out of stump dumps.

1.2 MATERIAL OWNERSHIP

- A. Cleared materials shall become Contractor's property and shall be removed from project site or be incorporated back into the project site improvements where appropriate.
- B. Stumps and grubblings from the site are to be processed into Erosion Control Mix material for use on the site, and excess stumps and grubblings are to be buried on site at locations approved by the Owner/Permittee and General Contractor.

1.3 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, logging roads, and other adjacent occupied or used facilities during site-clearing operations.
 1. Do not close or obstruct streets, logging roads, or other adjacent occupied or used facilities without permission from Owner/Permittee, General Contractor and authorities having jurisdiction.
 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
 - 1. Notify Owner/Permittee and General Contractor.
 - 2. Walk clearing limit lines with Owner/Permittee and General Contractor; adjust if requested by Owner/Permittee, General Contractor or Engineer.
 - 3. Provide survey data as required to Engineer for the necessary verification and adjustment of grades and clearing areas.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner/Permittee and General Contractor.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and natural resources, according to the Sediment and Erosion Control Plan for the project.
- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established or permanent erosion control measures are installed.
- C. Remove erosion and sedimentation controls once the site is stabilized with permanent measures. Restore and stabilize areas disturbed during removal of temporary erosion and sedimentation control measures.

3.3 TREE PROTECTION

- A. Clearly flag tree protection zones before starting site clearing.
- B. Do not excavate within tree protection zones, unless otherwise indicated.
- C. Replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Landscape Architect.

3.4 UTILITIES

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
 - 1. Protect any existing culverts.

3.5 CLEARING AND GRUBBING

- A. Perform all tree removal activities in accordance with Maine Forest Service and LURC Standards. It shall be the Contractor's responsibility to file the Notice of Intent to Harvest with the Maine Forest Service. This form will need to be signed by the Owner/Permittee or Owner's Authorized Agent.
- B. Stockpile stumps and grubblings at designated locations to be processed into Erosion Control Mix. Excess stumps and grubblings are to be buried at designated locations.

3.6 TOPSOIL STRIPPING

- A. Remove grubblings before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust. Surround perimeter of stockpile with silt fence, eco-logs, or Erosion Control Mix berms.

3.7 STUMP DUMPS

- A. One stump dump location is shown on the project Base Map. Clearing associated with this stump dump is not to exceed 2 acres. Side slopes of the stump dump is not to exceed 3H:1V and as part of close-out of the stump dump the surface of the stump dump is to be leveled and covered with mulch and balsam seed or erosion control mix and balsam seed. Close-out of the stump dump is to follow any other LURC guidelines and the lowest level of the stump dump is not to be below the existing water table level.

3.8 DISPOSAL

- A. Disposal: Remove unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, stumps and cleared material, and legally dispose of them. At least a portion of the sites stumps and grubblings are to be incorporated into Erosion Control Mix and reused on the project site.
 - 1. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to appropriate recycling facilities.

END OF SECTION 31 10 00

SECTION 31 20 00

EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for new access roads, summit roads, spur roads to turbine sites and roadway slope treatment areas associated with new roadways to access the turbine sites.
2. Excavating and backfilling new road construction.
3. Subbase and surfacing gravel.
4. Excavating and backfilling for utility trenches.

1.2 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Special Backfill: Backfill placed beside and over pipe or cable in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over special backfill to fill a trench.

B. Surface Gravel: Final section of gravel to be used as the travel surface.

C. Aggregate Subbase Gravel: Course placed over the excavated subgrade or borrow fill before placement of surface gravel.

D. Borrow Soil: Satisfactory onsite soil or soil imported from off-site for use as fill or backfill. These soils must comply with the Geotechnical Report findings for this project.

E. Choke Stone: Crushed stone to fill voids in subsequent layers of rock borrow.

F. Trap Rock Sandwich Stone: To be placed under road section to convey ground water in select areas of the site.

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

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

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

J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

- K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.
- L. Ordinary Fill: Material free of organics or stones over 6" in diameter.
- M. Granular Fill: Material for use within the reinforced zone behind fill retaining walls.
- N. Rock Fill: Processed rock material meeting the gradation requirements for MDOT Standard Specification 703.21 with a maximum particle size of 3 feet.

1.3 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner/Permittee, General Contractor or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated.

1.4 SUBMITTALS

- A. A 50lb container of all aggregates proposed for use on the site, and gradation and proctor tests (where applicable) shall be provided to the Owner/Permittee and General Contractor for approval.
- B. Submittals are required for any geotextiles, geogrids, fabrics, gabion wall systems and any other products associated with earthworks for approval by the Owner/Permittee, General Contractor and Engineer.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: The existing on-site glacial till soils and rock borrow generated from mass excavation and from on-site blasting activities will be allowed to be used as embankment fill and fill under the roadways except as noted in the project's Geotechnical Engineering Report. The native soil may require moisture conditioning during winter construction or wet weather. In no case should frozen soils be used beneath the roadways. Blasted bedrock and crushed boulders at the site may be used as riprap for slopes, as long as they are processed to meet the riprap grading specifications. These materials can also be used as site fill under the following conditions:
 - The bedrock or boulders are crushed and processed to provide a well-graded mixture of particle sizes meeting the gradation specification of MDOT Standard Specification 703.21 "Rock Borrow" with a maximum particle size of 3 feet.
 - The processed rock fill is placed in maximum lift thickness of 18 inches and is compacted using a minimum of 5 passes using a 10-ton (operating weight) vibratory roller.

- Rock fills are to be choked such that granular borrow materials do not infiltrate into the rock.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT or a combination of these groups and satisfactory soils not maintained within 4 percent of optimum moisture content at time of compaction.
- D. Subbase Gravel Material: MDOT 703.06 Type D.
- E. Surface Gravel:

SURFACE GRAVEL	
Sieve Size	Percent Passing By Weight
<u>1-inch</u>	<u>100</u>
<u>¾-inch</u>	<u>90-100</u>
<u>No. 4</u>	<u>45-70</u>
<u>No. 10</u>	<u>30-50</u>
<u>No. 40</u>	<u>15-35</u>
<u>No. 200</u>	<u>5-15</u>

- F. Granular Borrow for Embankment Construction: To meet MDOT Standard Specification 703.19 with a maximum particle size not to exceed two-thirds of the proposed loose lift thickness.
- G. Crushed Stone: Shall meet the requirements of MDOT Standard Specification 703.22 "Underdrain Backfill Type C".
- H. Granular Fill (Retaining Walls): For use within the reinforced zone behind fill retaining walls.

GRANULAR FILL	
Sieve Size	Percent Passing By Weight
<u>4-inch</u>	<u>100</u>
<u>3-inch</u>	<u>90-100</u>
<u>¼-inch</u>	<u>25-90</u>
<u>No. 40</u>	<u>0-30</u>
<u>No. 200</u>	<u>0-15</u>

- I. Granular Fill (Concrete Foundations): For use as backfill against concrete foundations.

GRANULAR FILL	
Sieve Size	Percent Passing By Weight
<u>4-inch</u>	<u>100</u>
<u>3-inch</u>	<u>90-100</u>
<u>¼-inch</u>	<u>25-90</u>
<u>No. 40</u>	<u>0-30</u>
<u>No. 200</u>	<u>0-5</u>

- J. Rock Fill: To be used as compacted fill more than 2 feet below roadway areas shall be well-graded bedrock fragments with a maximum particle size of 3 feet. Well-graded means the blast rock shall meet the gradation requirements for MDOT Standard Specification 703.21 "Rock Borrow". The Contractor shall vary rock excavation procedures as needed in order to meet these gradation requirements.
- K. Choke Stone: To be used as the first layer of fill over the surface of compacted Rock Fill to limit the migration of soil particles down into the Rock Fill. Choke Stone shall consist of either bank run sand and gravel or material that has been processed through a crusher to produce a mixture of sand and gravel that meets the gradation below.

CHOKE STONE	
<u>Sieve Size</u>	<u>Percent Passing By Weight</u>
<u>6-inch</u>	<u>100</u>
<u>¾-inch</u>	<u>40-75</u>
<u>No. 4</u>	<u>25-90</u>
<u>No. 40</u>	<u>0-50</u>
<u>No. 200</u>	<u>0-15</u>

This same material is to be used to armor road shoulders in one 6-inch section.

- L. Riprap: To be used for slope protection and erosion control shall consist of sound, durable stone, free from structural defects with approximately one reasonably flat side for the top surface. The stone shall meet the requirements of the Maine Department of Transportation "Standard Specifications for Highways and Bridges", Item 703.25, Stone Fill. Stones for stone fill shall consist of durable rock which will not disintegrate by exposure to water or weather. Stones shall meet the d_{50} stone size specified.
- M. Geotextile for Riprap: To be placed beneath riprap shall consist of a woven polypropylene fabric with a Puncture Resistance (ASTM D4833) of at least 140 pounds and an Apparent Opening Size (ASTM D4751) of 0.425 millimeters (No. 40 sieve), or less, such as Mirafi 500X, or Contech C-120NW, or approved equivalent.
- N. Geotextile for Underdrains: To be placed around perforated Underdrain pipes shall consist of a non-woven polypropylene fabric having a Puncture Resistance (ASTM D4833) of at least 65 pounds, a Permittivity (ASTM D4491) of at least 130 gal/min/sf, and an Apparent Opening Size (ASTM D4751) of 0.15 to 0.22 millimeters, such as Mirafi 140N, or approved equivalent.
- O. Compaction: All new site fills placed below roadways and within slopes and embankments associated with roadways should be compacted to 95 percent of ASTM D-1557. Surface gravel and subbase materials should be compacted to 95 percent of ASTM D-1557. Crushed stone should be compacted to 100 percent of its dry rodded unit weight as determined by ASTM C-29.
- P. Refer to the project's Geotechnical Engineering Report and foundation details for compaction and fill requirements at turbine foundations.

2.2 ACCESSORIES

- A. Warning Tape: Refer to electrical specifications.

PART 3 - EXECUTION (GENERAL)

3.1 PREPARATION

- A. Protect structures, utilities, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, unsuitable soils and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing."
- C. Protect and maintain erosion and sedimentation controls, which are specified in Division 31 Section 31 10 00 "Site Clearing" during earthwork operations.

3.2 EXCAVATION – GENERAL: REFER TO SECTION 3.3 TO 3.5

3.3 EXCAVATION FOR ROADS AND PADS

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). Tolerance at 50 foot by 80-foot area where erection crane will be located for heavy lifts shall be 1-inch.
 - 1. Proof roll in accordance with the Geotechnical Engineering Report.

3.4 EXCAVATION FOR STRUCTURES

- A. Refer to Geotechnical Engineering Report and Foundation Details.

3.5 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- B. Excavate trenches to uniform widths to provide the following trench width. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.
 - 1. A minimum of 3'-0" or 4/3 the pipe inside diameter plus 1'-6" for conduits over 18".
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material, 4 inches (100 mm) deeper elsewhere, to allow for bedding course.

3.6 SUBGRADE INSPECTION

- A. Proof-roll subgrade below the roadways with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
- B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavations as directed by Engineer.

3.8 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion.
 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course 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 of select backfill free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) 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. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- E. Install warning tape directly above utilities which are non-metallic, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.10 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.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under roads and slopes use satisfactory soil material.

3.11 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, with the exception of the satisfactory soils which should be within 4 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 2 percent except satisfactory soil should be 4 percent and is too wet to compact to specified density.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 12 inches for roadways and in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.
- B. Compact soil materials to not less than the following percentages of maximum dry density according to ASTM D 1557:
 - 1. Under roadways and within slopes and embankments compact to 95 percent.
 - 2. Crushed stone is to be compacted to 100 percent of its dry rodded unit weight as determined by ASTM C-29
 - 3. The backfill immediately behind retaining walls should be compacted using portable equipment and be compacted to between 92 and 95 percent of its maximum dry density in accordance with ASTM D-1557.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.13 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.
- B. Site Grading: Slope grades to direct water away from roads and turbine sites and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Slope Treatments: Plus or minus 2-inches.
2. Roads: Plus or minus 1".
3. Crane Pads: Plus or minus 1".

3.14 SUBBASE AND SURFACE GRAVEL COURSES

- A. Place subbase and surface gravel course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase and surface gravel course as follows:
 1. Shape subbase and surface gravel course to required crown elevations and cross-slope grades.
 2. Compact subbase and surface gravel course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.15 TRAP ROCK SANDWICH

- A. Place trap rock sandwich course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact trap rock sandwich course on-grade as follows:
 1. Place drainage course in compacted thickness in one layer of 6-inches.

3.16 FIELD QUALITY CONTROL

- A. Testing Agency: Owner/Permittee and General Contractor will engage a qualified independent geotechnical engineering testing agency to perform field quality control testing.
- B. 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.
- C. 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.
- D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.17 ROCK PH TESTING

- A. Rock to be incorporated into earthworks for the project is to be tested for pH levels at adequate spacing to satisfy LURC permit conditions. The pH of the rock shall be tested and the pH levels are to be provided to LURC and the Owner for review. It shall be the Contractor's responsibility to have S. W. Cole's Field Staff or equal geotechnical engineering staff onsite periodically as construction progresses to identify areas of potentially high pH rock and perform the required pH testing where encountered and provide results to the Owner and LURC. The

Contractor is required to implement necessary provisions including any relevant input from LURC staff following review of rock pH levels to ensure that excessively acidic runoff to streams does not occur.

3.18 PROTECTION

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

3.19 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.

END OF SECTION 31 20 00

SECTION 31 23 16.26

ROCK REMOVAL

PART 1 - GENERAL

- A. Rock removal shall only be conducted by qualified contractors who have at least 15 years experience in rock removal by blasting and have five recent projects and references for rock removal within 100 feet of existing buildings. The qualifications of the contractor who will conduct the rock removal shall be provided for review at the preconstruction conference.
- B. The Earthwork Contractor and the Contractor who will conduct the rock removal shall attend a public informational meeting to address questions and explain the techniques and methods which will be used for rock removal. This meeting shall occur at least 14 days prior to any rock removal.

1.01 SECTION INCLUDES

- A. The work to be done includes furnishing all labor, equipment, materials and services and performing operations required to fragment intact bedrock utilizing controlled blasting techniques to enable the excavation of blasted material using conventional excavation equipment. The work shall be completed such that damage is prevented to adjacent pipes, structures, property, utilities and operations. Controlled perimeter blasting and pre-splitting the bedrock shall be utilized to create foundation holes for wind turbines where required and to create desired grades for the proposed access roads. Controlled perimeter blasting and pre-splitting the bedrock shall also be utilized to create a permanent and stable rock face at 6V:1H along roadways and near select turbine sites.
- B. Pre-blast Surveys, Public Meetings, and Quality Control.
- C. Removal of identified and discovered rock during excavation.
- D. Use of Explosives to assist rock removal.
- E. Incorporating removed rock into fills and embankments.
- F. Conducting blast monitoring of every blast round during construction and utilizing the blast monitoring procedures and equipment specified herein.
- G. Overblasting in the foundation area for future footings, foundations, and underslab utilities.
- H. Coordinate work with other trades affecting or affected by the work and cooperate with such trades to assure the steady progress of work.
- I. Obtaining all required permits and licenses to perform the blasting for this project.

1.02 RELATED SECTIONS

- A. Section 31 20 00 – Earth Moving
- B. Section 31 25 13 – Slope Protection and Erosion Control
- C. Section 33 41 00 – Storm Culvert and Cross Drainage Piping
- D. Geotechnical Engineering Reports for boring locations and findings of subsurface materials and conditions.
- E. Construction Drawings.

1.03 REFERENCE STANDARDS

NFPA 495 - Code for Explosive Materials

1.04 ENVIRONMENTAL REQUIREMENTS

Determine all environmental effects associated with proposed work and safeguard those concerns as regulated by law and all others by reasonable and practiced methods.

Coordinate blasting, monitoring, seismographs, and Owner/Permittee radon testing.

1.05 JOB CONDITIONS

- A. The contractor shall be fully responsible for conducting any investigations necessary to determine the extent and quality of rock on the site prior to submitting his bid. Rock locations may vary from that inferred by the geotechnical reports.
- B. The Owner/Permittee may elect to modify the design to reduce rock removal cost. The reduction and or adjustment of rock removal quantity shall not be a basis of claims for loss of materials obtained from rock removal for use on other portions of the work.

1.06 QUALIFICATIONS

Contractor to remove rock by blasting shall submit records of documented experience to the Owner/Permittee.

1.07 QUALITY ASSURANCE

- A. Qualifications
 - 1. Persons responsible for blasting shall be licensed blasters in the State of Maine and shall have had experience in similar excavations in rock and controlled blasting techniques.
 - 2. The contractor shall engage the services of a qualified, independent professional consultant, acceptable to the Engineer, to conduct a pre-blast condition survey of adjacent buildings, utilities and other concerned structures within 2,000 ft. of the blast or as required by Code.
 - 3. Blast monitoring shall be conducted by a qualified professional engineer or seismologist trained in the use of seismographs. The name and experience of the seismologist shall be submitted to the Owner/Permittee for review and approval. The seismologist shall also attend the public

informational meeting. The blast records shall be maintained, analyzed and reported by persons familiar with the frequency content of a seismograph record.

B. Codes, Permits and Regulations

1. The contractor shall comply with all applicable laws, rules, ordinances and regulations of the Federal Government, the State of Maine, and the Redington Township, governing the transportation, storage, handling and use of explosives. All labor, material, equipment and services necessary to make a blasting operation comply with such requirements shall be provided without additional cost to the Owner/Permittee.
2. The contractor shall obtain and pay for all permits and licenses required to complete the work of this Section.
3. In the case of a conflict between regulations or between regulations and Specifications, the contractor shall comply with the strictest applicable codes, regulation or specification.

C. Blast Vibration Limits for Curing Concrete

1. Mass concrete on-grade which would not be subject to bending such as footings:

<u>Age of Concrete</u>	<u>Allowable (PPV)</u>
<u>Less than 72 hours</u>	<u>1.0 inch/second</u>
<u>At least 72 hours</u>	<u>4.0 inch/second</u>

2. Concrete which could potentially undergo bending such as walls, structural slabs, columns, and elevated slabs:

<u>Age of Concrete</u>	<u>Allowable (PPV)</u>
<u>Less than 72 hours</u>	<u>0.5 inch/second</u>
<u>At least 72 hours</u>	<u>2.0 inch/second</u>

3. Blasting shall not be permitted within 50 ft. of new concrete unless a blast plan for the specified blast is forwarded by the contractor and approved by the Civil and Structural Engineer.
4. The contractor shall comply with the Blasting Limit Criteria during all blasting. Adjustments to the drilling and blasting program and procedures to comply with the Blasting Limit Criteria shall be made by the contractor during the execution of the work at no additional expense to the Owner/Permittee.

D. Blast Monitoring

1. The contractor shall monitor PPV and air-blast over-pressures resulting from each blast. Additional locations for blast monitoring may be necessary due to concerned structures within and around the blast.

E. Blast Monitoring Reports

1. Following each blast, a Blast Monitoring Report shall be submitted to the Owner/Permittee and Engineer within 24 hours.

2. Any vibrations or air over-blast pressures close to or outside the specified limits shall be immediately reported to the Owner/Permittee and Engineer.

F. Blast Monitoring Instrumentation

1. All instrumentation proposed for use on the project shall have been calibrated within the previous six (6) months to a standard which is traceable to the National Bureau of Standards. Characteristics of the required instrumentation are listed below.
2. Measure the three (3) mutually perpendicular components of particle velocity and frequency in directions vertical, horizontal and longitudinal from the vibration source.
3. Measure and display the maximum PPV component, the associated frequency, and the peak air-blast over-pressure. The readings must be displayed and be able to read in the field immediately after each blast.
4. Furnish a permanent time history paper record (or from computer disk), of PPV and frequency components and air-blast over-pressure.
5. The contractor shall cooperate with the Engineer in permitting observation of the contractor's drilling and loading procedures, as well as providing detailed information on blasting operations.

- G. The contractor shall be completely responsible for all damages resulting from the blasting operations and shall, at a minimum, take whatever measures necessary to maintain PPV, frequency and peak air-blast over-pressure within specified or required limits. Modifications to the blasting and excavation methods required to meet these requirements shall be undertaken at no additional cost to the Owner/Permittee.

- H. Airborne Dust and Noise Limits: The contractor shall take precautions, such as the use of water, vacuums, and mufflers to minimize noise and dust from the air track operations, and shall keep noise and airborne dust levels below regulatory limits.

1.08 SUBMITTALS

- A. The contractor shall submit the following information to the Owner/Permittee and Engineer within twenty-one (21) days prior to commencing drilling and blasting operations. Technical Submittals and blast designs shall be completed by experienced, competent Engineers familiar with controlled blasting.

1. Sequence and schedule of blasting rounds, including the general method developing the excavation, lift heights, etc.
2. Specifics of a typical blast round to be implemented in each of the following areas:
 - (a) Test blast areas,
 - (b) The closest blasting area to adjacent structures,

- (c) Where perimeter control blasting is required and
 - (d) At the deepest rock cut areas.
3. In each area specified, include the following blast round details:
- (a) Diameter, spacing, burden, depth and orientation of each blast hole for each round design.
 - (b) Nomenclature and amount (in terms of weight and number of cartridges) of explosive and distribution of charge to be used within each hole, on each delay and the total for the blast.
 - (c) Nomenclature and type of detonators, delay pattern wiring diagram for the round, type and capacity of firing source, size, type and location of safety switches and lightening gap.
 - (d) Type and location of stemming to be used in the holes.
 - (e) Calculations of anticipated vibration levels at nearest adjacent structure.
 - (f) Methods of matting or covering of the blast area in open excavations to prevent fly rock and excessive air-blast over-pressure.
 - (g) Written evidence of the licensing, experience and qualifications of the blasters who will be directly responsible for the loading and firing of each shot.
 - (h) Name and qualifications of the person(s) responsible for the design and directing the blasting.
 - (i) Name and qualifications of the independent professional responsible for conducting the pre-blast condition surveys.
 - (j) Name and qualifications of the independent professional or seismologist responsible for monitoring and reporting blast vibrations.
 - (k) Recent calibration certificates (within previous 6 months) for the proposed blast monitoring instrumentation.
 - (l) Listing of instrumentation that the contractor proposed to use to monitor vibrations and air-blast over-pressure levels complete with performance specifications and users manual supplied by the manufacturer.
 - (m) Pre-blast condition surveys for neighboring residential and commercial property. A written report of the pre-condition survey shall be provided to the property owners. Notification shall be given to the neighbors no more than 30 days and no less than 10 days prior to the commencement of any blasting.
 - (n) The contractor shall perform a pre-blast survey of nearby structures as specified in this specification. The survey will include, as a minimum, photographs made with a 35 mm or digital camera or video with audio description of areas of exterior and interior building surfaces. One copy will be maintained by the contractor and one copy shall be supplied to the Owner/Permittee.
- B. In the event that the ground vibrations and/or air blast over-pressures exceed the blasting limit criteria in this Section, the contractor shall immediately notify the Engineer, then revise the design appropriately and submit the revised design to the Engineer for review.
- C. Review by the Engineer or Owner/Permittee of the blast design and techniques shall not relieve the contractor of responsibility for the accuracy, adequacy and safety of the blasting as well as the protection of existing structures and overall safety. Loose, over-hanging or unstable rock

along permanent rock cuts shall be removed as necessary or as directed by the Engineer. Controlled blasting procedures shall be utilized in areas of permanent rock cuts to minimize over-breakage and fracturing.

- D. Resume supporting compliance with Part 1-A.

PART 2 - PRODUCTS

2.01 MATERIALS

Explosives, delay device and blast mat materials shall be the type recommended by the explosive firm that will comply with the requirements of this section.

PART 3 - EXECUTION

3.01 SAFETY PRECAUTIONS

- A. A detailed, project specific blasting plan shall be submitted to the General Contractor a minimum of twenty-one (21) days prior to the initial blast activities.
- B. Clearing the Danger Area Before Blasting: No blasting shall be permitted until all personnel in the danger area have been removed to a place of safety. A loud, audible warning system shall be sounded before each blast. The contractor shall familiarize all personnel on the project, Engineer, Owner/Permittee and the general public with the implemented system. The danger area shall be patrolled before each blast to make certain that it has been completely cleared prior to a blast.
- C. Explosives shall be stored, handled and employed in accordance with federal, state and local regulations.
- D. No explosives, caps, detonators or fuses shall be stored on the site during non-working hours.
- E. The contractor shall be responsible for determining any other safety requirements unique to blasting operations so as not to endanger life, property, utility services, any existing or new construction, or any property adjacent to the site.
- F. Blasting mats or other cover shall be used for each blast if needed to secure fly rock as directed by Owner/Permittee or General Contractor.

3.02 GENERAL BLASTING PROCEDURES

- A. Blasting timeframes shall be coordinated with the local AHJ's and emergency responders. No blasting shall be completed on weekends, holidays or other weekday times until written permission is received by the Redington Fire Department and the Owner/Permittee.
- B. The contractor shall notify the Owner/Permittee and Engineer at least 48 hours before blasting operations are to commence.

- C. The contractor shall conduct all blasting operations such that damage or disruption is prevented to adjacent structures, utilities, property and operations, and such that PPV, frequency and air-blast over-pressure levels do not exceed the specified limits.
- D. The contractor shall control dust so as to prevent dust from leaving the site boundaries.
- E. Designed blast rounds shall be utilized with adjacent relief to allow the rock to move out towards a free face.
- F. All overburden soils and loose rock shall be removed from areas where blasting is planned. The exposed bedrock surface shall be surveyed by a licensed land surveyor to determine the limits for payment.
- G. *In areas where blasting is required in the foundation footprint, a base gravel fill is required one foot below and laterally beyond the footing limits. Loose, heaved and/or highly fractured bedrock below this depth shall be completely removed to expose intact bedrock or a tight fragmented over-blast suitable to the Engineer. In order to ensure good bearing material for the footings, the contractor shall conduct blasting such that over-break and fracturing of the rock is minimized below the required subgrade level. Sub-drilling (depth of blast hole below required subgrade) shall be kept to the minimum necessary to adequately fragment and remove the rock to the limits of excavation. The sub-drilling shall not exceed 2 ft. unless the contractor has submitted in advance a written request indicating why additional sub-drilling is necessary for the project.*
- H. Highly fractured, heaved and/or disturbed over-blast ledge shall be removed by the contractor and replaced with compacted Structural Fill or ¾ inch crushed stone at no additional cost to the Owner/Permittee. Tight over blast ledge may remain in-place provided it is reviewed and acceptable to the Engineer.
- I. The contractor shall use controlled blasting procedures. The permanent rock face shall be stable with no over-hanging or highly fractured rock. Particular attention, design, precautions and blasting operations shall be focused on these areas of the site.

3.03 MEASUREMENT, PAYMENT AND BLASTING LIMITS

- A. Bedrock blasting will be based on a lump sum price for the entire project. The contractor will submit progress claims to the Owner/Permittee upon completion of each milestone. The following blasting limits shall apply.
 - 1. For wind turbine foundations, The blasting limits will be 2 ft beyond the bottom of the foundation.
 - 2. For utility poles, the blasting limit will be at the minimum amount required to install utility poles to proper depth.
 - 3. For utility trenches, the blasting limit will be one foot below the pipe invert and two feet beyond the outside diameter of the typical pipe section.
 - 4. For access roads segments, the blasting limit shall be 2 ft. below the finish road grade.
 - 5. For rock cut slopes, the blasting limit shall be as shown on the Drawings for location and batter.

- B. Bedrock blasting and removal beyond the blasting limits shall be replaced with compacted structural fill at no additional cost to the Owner/Permittee. Highly fractured, heaved, and/or distribution over-blast shall be removed from the project area as required by the Engineer at no additional cost to the Owner/Permittee.
- C. No separate payment will be made for pre-condition surveys, surveying, vibration monitoring, blast designs, blast re-designs, acquisition of permits, safety measures, or other associated items which are considered incidental to the safe performance of controlled drilling and blasting.

3.04 PREPARATION

- A. Verify site conditions and note subsurface conditions affecting work of this section. Coordinate Owner/Permittee radon monitoring.
- B. Identify required lines, levels, and elevations that will determine the extent of the proposed removals.
- C. Conduct a pre-blast survey in accordance with the following requirements:

1. The contractor shall conduct a Pre-Blast Survey of all structures within the Blast Area and provide the Owner/Permittee and LURC in accordance with MeDEP requirements, a written report of the Pre-Blast Survey and Blasting Plan. The Pre-Blast Survey shall be filed with LURC for future reference and kept on file for a period of at least 6 months. This survey should include:

- All structures within a minimum distance of 2,000 feet from any blasting activity. The area extending beyond the 2,000 feet minimum shall be determined by the contractor. This distance shall be confirmed after consultation of the General Contractor, Site Contractor, Blasting Contractor and Insurance Companies.
- A blasting plan which addresses:
 - Airblast limits
 - Maximum peak particle velocity
 - Frequency
- The blasting plan shall meet criteria established in Chapter 3 (Control of Adverse Effects) in the Blasting Guidance Manual of the United States Dept. of the Interior.
- Provisions and measures to monitor and assure compliance with the blasting plan.

2. The contractor shall provide the Engineer with a Blasting Log for the work. The Blasting Log shall contain the following information:

- Location
- Time and Date
- Number of Holes

- Amount and type of explosive used per hole
 - The names of persons, companies, corporations, or public utilities contacted, owning, leasing, or occupying property or structures in proximity to the site of the work of the contractor's intention to use explosives.
3. Drilling equipment will be equipped with suitable dust control apparatus which must be kept in repair and used during all drilling operations.

A copy of the LURC approval of the pre-blast survey and blasting plan obtained by the contractor shall be submitted to the Owner/Permittee prior to blasting.

4. Blasting shall not commence until the Owner/Permittee has secured baseline radon tests.

3.05 ROCK EXCAVATION

- A. Rock Excavation - definition - Igneous, metamorphic or sedimentary rock that cannot be removed by rippers or other mechanical methods and, therefore, requires drilling and blasting. Cut rock to form level bearing at bottom of trench. In the utility trenches, excavate to 6" below invert elevation of pipe. This excludes pavement, concrete, and boulders less than 3 cubic yards.

Contractor shall coordinate blasting with other wall construction project elements to maintain construction within approved project limits.

Reuse excavated materials on-site in accordance with Section 31 20 00, if applicable.

- B. Comply with all laws, rules, and regulations of Federal, State and local authorities and insurer which govern storage, use, manufacture, sale, handling, transportation, licensing, or other disposition of explosives. Take special precautions for proper use of explosives to prevent harm to human life and damage to surface structures, all utility lines, or other subsurface structures.

Do not conduct blasting operations until persons in vicinity have had ample notice and have reached positions of safety.

All blasting shall be performed in accordance with all pertinent provisions of the "Manual of Accident Prevention in Construction" issued by the Associated General Contractors of America, Inc., of the "Construction Safety Rules and Regulations," as adopted by the State Board of Construction Safety, Redington, Maine, and Maine Department of Transportation "Standard Specifications" Section 107.12, Use of Explosives. Blasting through the over burden will not be allowed.

- C. Contractor shall save harmless Owner/Permittee, architect, engineer, and Owner/Permittee's representative from any claim growing out of use of such explosives. Removal of materials of any nature by blasting shall be done in such manner and such time as to avoid damage affecting integrity of design and to avoid damage to any new or existing structure included in or adjacent to work. It shall be the contractor's responsibility to determine method of operation to ensure desired results and integrity of completed work.

- D. Perform rock excavation in a manner that will produce material of such size as to permit it being placed in embankments in accordance with Section 31 20 00. Remove rock to limits as indicated. Remove loose or shattered rock, overhanging ledges and boulders which might dislodge.
- E. When during the process of excavation rock is encountered, such material shall be uncovered and exposed. Remove as much weathered rock as possible with conventional excavating equipment.

Blasting operations shall be accomplished in compliance with the "Blasting" clause of the Supplemental General Conditions. Rock shall be trimmed so that none protrudes within 6 inches of all utilities when said utilities are installed to correct line and grade.

F. Extra Rock Removal

Rock removal for this project is to be completed and paid for on a lump sum basis; however, if work elements beyond the scope of the Base Bid are requested, rock removal for this added work may be done on a unit price basis.

G. Provisions for Blasting

Blasting shall be performed only after approval has been given by the Owner/Permittee for such operations and must comply with the following provisions:

1. The contractor or any subcontractor shall use sufficient stemming, matting or natural protective cover to prevent flyrock from leaving property owned or under control of the Owner/Permittee or operator or from entering protected natural resources or natural buffer strips. Crushed rock or other suitable material must be used for stemming when available; native gravel, drill cuttings or other material may be used for stemming only if no other suitable material is available.
2. The maximum allowable airblast at any inhabited building not owned or controlled by the developer may not exceed 129 decibels peak when measured by an instrument having a flat response (+ or - 3 decibels) over the range of 5 to 200 hertz.
3. The maximum allowable airblast at an uninhabited building not owned or controlled by the developer may not exceed 140 decibels peak when measured by an instrument having a flat response (+ or - 3 decibels) over the range of 5 to 200 hertz.
4. Monitoring of airblast levels is required in all cases for which a preblast survey is required by paragraph F. The contractor may file a permit modification with LURC requesting they waive the monitoring requirement if the contractor or subcontractor secures the permission of affected property owners to increase allowable airblast levels on their property and the department determines that no protected natural resource will be adversely affected by the increased airblast levels. The cost to prepare the permit modification and the effect of project delay while LURC reviews the request shall be borne solely by the contractor or his subcontractor.
5. If a blast is to be initiated by detonating cord, the detonating cord must be covered by crushed rock or other suitable cover to reduce noise and concussion effects.

6. A preblast survey is required and must extend a minimum radius of 2,000 feet from the blast site. The preblast survey must document any preexisting damage to structures and buildings and any other physical features within the survey radius that could reasonably be affected by blasting. Assessment of features such as pipes, cables, transmission lines and wells and other water supply systems must be limited to surface conditions and other readily available data, such as well yield and water quality. The preblast survey must be conducted prior to the initiation of blasting at the operation. The contractor or subcontractor shall retain a copy of all preblast surveys for at least one year from the date of the last blast on the development site.

(a) The contractor or the subcontractor is not required to conduct a preblast survey on properties for which the Owner/Permittee or operator documents the rejection of an offer by registered letter, return receipt requested, to conduct a preblast survey. Any person owning a building within a preblast survey radius may voluntarily waive the right to a survey.

7. Sound from blasting may not exceed the following limits at any protected location:

<u>Number of Blasts Per Day</u>	<u>Sound Level Limit</u>
1	<u>129 dbl</u>
2	<u>126 dbl</u>
3	<u>124 dbl</u>
4 or more	<u>123 dbl</u>

8. The maximum peak particle velocity at inhabitable structures not owned or controlled by the developer may not exceed the levels established in Table 1 in paragraph E and the graph published by the United States Department of the Interior in "Bureau of Mines Report of Investigations 8507," Appendix B, Figure B-1. The contractor or subcontractor may apply for a LURC project modification to request a variance to allow ground vibration levels greater than 2 inches per second on undeveloped property not owned or controlled by the Owner/Permittee if the department determines that no protected natural resource, unusual natural area or historic site will be adversely affected by the increased ground vibration levels. If inhabitable structures are constructed on the property after approval of LURC and prior to completion of blasting, the contractor immediately must notify the department and modify blasting procedures to remain in compliance with the standards of this subsection. The cost to prepare the permit modification and the effect of project delay while LURC reviews the request shall be borne solely by the contractor or his subcontractor.

9. Table 1 of this paragraph or the graph published by the United States Department of the Interior in "Bureau of Mines Report of Investigations 8507", Appendix B, Figure B-1 must be used to evaluate ground vibration effects for those blasts for which a preblast survey is required.

(a) Either Table 1 of this paragraph or graph published by the United States Department of the Interior in "Bureau of Mines report of Investigations 8507", Appendix B, Figure B-1 may be used to evaluate ground vibration when blasting is to be monitored by seismic instrumentation.

(b) Blasting measured in accordance with Table 1 of this paragraph must be conducted so that the peak particle velocity of any one of the 3 mutually perpendicular components of motion does not exceed the ground vibration limits at the distances specified in Table 1 of this paragraph.

- (c) Seismic instruments that monitor blasting in accordance with Table 1 of this paragraph must have the instrument's transducer firmly coupled to the ground.
- (d) An Owner/Permittee or operator using Table 1 of this paragraph must use the scaled-distance equation, $W=(D/D_s)^2$, to determine the allowable charge weight of explosives to be detonated in any 8 millisecond or greater delay period without seismic monitoring, where W is equal to the maximum weight of explosives, in pounds, and D and D_s are defined as in Table 1 of this paragraph. The contractor may apply for a permit modification to LURC to authorize the use of a modified scaled-distance factor for production blasting if the contractor can demonstrate to a 95% confidence level, based upon records of seismographic monitoring at the specific site of the mining activity covered by the permit, that use of the modified scaled-distance factor will not cause the ground vibration to exceed the maximum allowable peak particle velocities of Table 1 of this paragraph. The cost to prepare the permit modification and the effect of project delay while LURC reviews the request shall be borne solely by the contractor or his subcontractor.
- (e) Blasting monitored in accordance with the graph published by the United States Department of the Interior in "Bureau of Mines Report of Investigations 8507", Appendix B, Figure B-1 must be conducted so that the continuously variable particle velocity criteria are not exceeded.

The contractor may apply for a permit modification to LURC for a variance of the ground vibration monitoring requirement prior to conducting blasting at the development site if the contractor agrees to design all blasts so that the weight of explosives per 8 millisecond or greater delay does not exceed that determined by the equation $W=(D/D_s)^2$, where W is the maximum allowable weight of explosives per delay of 8 milliseconds or greater, D is the shortest distance between any area to be blasted and any inhabitable structure not owned or controlled by the developer, and D_s equals 70 ft./lb.^{1/2}. As a condition of the variance, the department may require submission of records certified as accurate by the blaster and may require the Owner/Permittee or operator to document compliance with the conditions of this paragraph. The cost to prepare the permit modification and the effect of project delay while LURC reviews the request shall be borne solely by the contractor or his subcontractor.

The following is Table 1.

<u>Distance Versus Peak Particle Velocity Method</u>		
<u>Distance (D) from the blast area</u>	<u>Maximum allowable peak particle velocity (Vmax) for ground vibration (in./sec.)</u>	<u>Scaled-distance factor (Ds) to be applied without seismic monitoring</u>
<u>0 to 300</u>	<u>1.25</u>	<u>50</u>
<u>301-5000</u>	<u>1.00</u>	<u>55</u>
<u>Greater than 5000</u>	<u>0.75</u>	<u>65</u>

10. A record of each blast, including seismographic data, must be kept for at least one year from the date of the last blast, must be available for inspection at the development or at the offices of the Owner/Permittee or operator if the development has been closed, completed or abandoned before the one-year limit has passed and must contain at a minimum the following data:

- (a) Name of blasting company or blasting contractor;
- (b) Location, date and time of blast;
- (c) Name, signature and social security number of blaster;
- (d) Type of material blasted;
- (e) Number and spacing of holes and depth of burden or stemming;
- (f) Diameter and depth of holes;
- (g) Type of explosives used;
- (h) Total amount of explosives used;
- (i) Maximum amount of explosives used per delay period of 8 milliseconds or greater;
- (j) Maximum number of holes per delay period of 8 milliseconds or greater;
- (k) Method of firing and type of circuit;
- (l) Direction and distance in feet to the nearest structure neither owned nor controller by the developer;
- (m) Weather conditions, including such factors as wind direction and cloud cover;
- (n) Height or length of stemming;
- (o) Amount of mats or other protection used;
- (p) Type of detonators used and delay periods used;
- (q) The exact location of each geophone and the distance of each geophone from the blast;
- (r) Seismographic readings;
- (s) Name and signature of the person operating each seismograph; and
- (t) Names of the person and the firm analyzing the seismographic data.

11. All field seismographs must record the full analog waveform of each of the 3 mutually perpendicular components of motion in terms of particle velocity and frequency. All seismographs must be capable of sensor check and must be calibrated according to the manufacturer's recommendations.

3.06 SPECIAL PERIMETER CONTROL BLASTING PROCEDURES

- A. When blasting at the perimeter of the excavation area, care shall be taken at the excavation limits to minimize over-breakage and fracturing of remaining rock. Pre-splitting or cushion blasting or line drilling shall be utilized at such locations and/or as indicated on the Drawings as described below.
- B. If, in the judgment of the Engineer, the contractor's perimeter control blasting procedures are causing rock fracturing at a distance beyond the limits of work, the geometry (diameter,

spacing), stemming and loading of perimeter holes and adjacent production holes shall be adjusted until results acceptable to the Engineer are obtained or the perimeter control blasting technique shall be changed. The following descriptions of pre-splitting, cushion blasting and line drilling should be considered general guidelines. The contractor shall use appropriate methods to conduct the work based on his experience, the project requirement and site conditions.

- C. The perimeter controlled blasting procedures shall be employed in areas where a permanent rock slope is to be constructed for site grading and other critical areas. Perimeter rock slopes steeper than 1H:4V and taller than 5 ft. in overall vertical height as shown on the Drawings shall require special controlled blasting procedures.
- D. The contractor shall adjust the blasting operations according to the characteristic and structure of the rock formation to obtain the required slope without fracturing the rock beyond the pre-split face.
- E. Pre-Splitting
 - 1. Pre-splitting rock shall, at a minimum, conform to the *Maine Highway Department-Standard Specifications for Highways and Bridges. Section 203.04 – Pre-splitting Rock* shall be used for this project on 1:6 slopes.
 - 2. Pre-split blast holes shall be loaded and fired separately before the main round to create a fracture plane along the perimeter of the excavation.
 - 3. Pre-split holes shall be string-loaded or space-loaded with light, distributed charges and shall be thoroughly stemmed for the full length of hole with sand. The top of the hole, for a minimum 18 inches, shall be unloaded and stemmed with tamped sand and gravel.
 - 4. Spacing, burden, hole diameter and loading shall be maintained within the Guidelines listed in Table I unless deviation from the Guidelines is approved by the Engineer based on field performance.

TABLE I
PRE-SPLITTING GUIDELINES

<u>HOLE DIAMETER (in)</u>	<u>HOLE SPACING (ft)</u>	<u>COLUMN LOAD CHARGE CONCENTRATION (lb/ft)</u>
<u>1.5 to 2.5</u>	<u>1.0 to 1.5</u>	<u>0.06 to 0.15</u>
<u>3.0 to 4.0</u>	<u>1.5 to 2.0</u>	<u>0.10 to 0.20</u>

- 5. The bottom charge concentration within the bottom 1 to 3 ft. of hole shall be approximately three (3) times the column charge concentration.
- 6. Pre-split holes shall be fired simultaneously if particle velocity and air blast considerations will permit. Otherwise, groups of pre-split holes in segments along the pre-split line shall be systematically fired with millisecond (ms) delays.

7. Pre-split holes shall not deviate more than 6 inches out of alignment over the full maximum vertical lift height.
8. Loading of the first-row-in of production holes shall be approximately 50 to 75% of normal production hole loading.

F. Cushion Blasting

1. If used, cushion blast holes shall be loaded and fired separately after the main round to ensure a free face and equal burden.
2. Cushion blast holes shall be string-loaded or space-loaded with light charges, and shall be thoroughly stemmed with a maximum of 18 inches of tamped sand, peastone or other material capable of maintaining explosive gas pressures. Spacing, burden, blast hole diameter and loading shall be maintained within the Guidelines outlined in Table II.

TABLE II
CUSHION BLASTING GUIDELINES

<u>HOLE DIAMETER (in)</u>	<u>SPACING (ft)</u>	<u>BURDEN (ft)</u>	<u>COLUMN LOAD CHARGE CONCENTRATION (ob/ft)</u>
<u>1.5 to 2.0</u>	<u>1.0 to 1.5</u>	<u>2.5 to 3.0</u>	<u>0.06 to 0.15</u>
<u>2.5 to 4.0</u>	<u>1.5 to 2.0</u>	<u>3.0 to 3.5</u>	<u>0.15 to 0.25</u>

NOTE: Small diameter, unloaded guide holes shall be used if required for satisfactory results, located midway between each cushion blast hole.

3. The first row of drill holes in from the perimeter row shall be loaded with not more than four (4) times the charge weight indicated in the Table. Spacing and burden of the first-row-in holes shall be decreased sufficiently from those of other production holes to ensure that the perimeter holes have a free face and equal burden for the full depth of the round.

G. Line Drilling

1. Line drilling shall consist of a minimum of 3-inch diameter holes evenly spaced at 2 per lineal foot. Drill holes shall not be deviated by more than 3-inches from their required plane over the entire length of the hole. The line drilled holes are to be left unloaded. As the perimeter is approached with the primary blasting, the distance should be about 50% of the normal hole spacing. The spacing of holes in the row adjacent to the perimeter holes shall also be about 50-75% of the normal hole spacing. The loading of the holes in the adjacent row should be about 50% of the loading used in the primary holes.

H. Condition of the Permanent Rock Face

1. The permanent rock face shall not deviate by more than 5% batter and 2 ft. in plan location as shown on the Drawings. Loose, fractured or over-hanging rock as determined by the Engineer to be unstable shall be removed as directed. Care shall be taken during the excavation to minimize over-breakage and fracturing.

END OF SECTION 31 23 16.26

SECTION 31 25 13

SLOPE PROTECTION AND EROSION CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Temporary and permanent erosion control systems.
- B. Slope Protection Systems.

1.2 RELATED SECTIONS

- A. Project Permits
- B. Section 31 10 00 - Site Clearing
- C. Section 31 20 00 – Earth Moving
- D. Erosion and Sedimentation Control Plan (Attached to this specification)
- E. Construction Requirements

1.3 ENVIRONMENTAL REQUIREMENTS

- A. The contractor shall protect adjacent properties and water resources from erosion and sediment damage throughout the life of the contract in accordance with the Erosion and Sediment Control Plan prepared for this project and in accordance with the requirements of the LURC Permit and special conditions of the permits. The Erosion and Sediment Control Plan and Site Permits have specific restrictions on seasonal work limits, the amount of area which can be exposed at a given time, the general sequence of construction, and contractor monitoring. Other restrictions notes are to be added once project permits are issued.
- B. The general contractor will be required to designate, by name, a Registered Professional Engineer or equivalent person responsible for implementation of all erosion control measures as required by the LURC Permit for this project. Specific responsibilities will include:
 - 1. Assuring and certifying the contractor's construction sequence is in conformance with the specified schedule. In addition, a weekly certification stating compliance, any deviations, and corrective measures shall be filed with the Owner/Permittee by this person. A copy of the certification form is contained the Erosion and Sedimentation Control Plan.
 - 2. Inspection of the project work site on a weekly basis, with the installation of added erosion control measures in areas which are identified as vulnerable to erosion.

3. Inspection of all erosion control measures and drainage inlets after any significant rainfall. Accumulated silt/sediment should be removed when the depth of sediment reaches 50 percent of the barrier height. Accumulated silt/sediment should be removed from behind silt fencing and erosion control mix berms when the depth of the sediment reaches 6 inches. A significant rainfall shall be defined as over ½ inch of precipitation in any consecutive 24-hour period.
4. Inspect areas for catch of grass. A minimum catch of 75 percent is required prior to removal of erosion control measures.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Quick growing grasses for temporary seeding (see seed mixes contained in Erosion and Sedimentation Plan).
- B. Hay or straw bales.
- C. Fencing for siltation control as specified on the plans.
- D. Curlex blankets by American Excelsior Company or approved equal.
- E. Bale stakes shall be a minimum of 4 feet in length and 1" in width.
- F. Temporary mulches such as loose hay, straw, netting, wood cellulose or agricultural siltage.
- G. Fence stakes shall be metal stakes a minimum of 8 feet in length.
- H. Stone check dams shall be spaced according to the Erosion Control Detail Plan.
- I. Stone Sediment Barriers or SiltSacks™, or approved equal for inlet protection.
- J. A stabilized construction entrance shall be constructed temporarily.
- K. Riprap for slopes, culvert, storm drain inlet, and outlet aprons.
- L. Reinforced turf.
- M. Erosion Control Mix Material.
- N. Calcium chloride and water for dust control.
- O. DIRTBAGS™ as outlined on the contract drawings.
- P. DirtGlue® or other environmentally safe soil stabilizer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Review site erosion control plan attached to this section of the specifications.
- B. Deficiencies or changes in the erosion control plan as it is applied to current conditions will be brought to the attention of the Engineer for remedial action.

3.2 EROSION CONTROL AND SLOPE PROTECTION IMPLEMENTATION

- A. Provide catalog cuts and information concerning the erosion control products which will be used for construction for review by the Owner/Permittee.
- B. Provide information concerning the installation of the erosion sedimentation control including anchorage trench provisions and anchorage devices and spacing for review by the Owner/Permittee.
- C. Place erosion control systems in accordance with the erosion control plan and in accordance with approved installation procedures.
- D. This contract limits the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and embankment operations. The Owner/Permittee has the authority to direct the contractor to provide immediate permanent or temporary pollution control measures. The contractor will be required to incorporate all permanent erosion control features into the project at the earliest practical time to minimize the need for temporary controls. Timing requirements for site stabilization included cut slopes, fill slopes and ditch treatments are identified in the attached Erosion and Sedimentation Control Plan.
- E. The temporary erosion control systems installed by the contractor shall be maintained as directed by the Engineer to control siltation at all times during the life of the Contract. The contractor must respond to any maintenance or additional work ordered by the Engineer within a 48-hour period.
- F. Any additional material work required beyond the extent of the erosion control plan shall be paid for by the Owner/Permittee except where such measures are required to correct deficiencies caused by the failure of the contractor to construct the work in accordance with the erosion sediment control plan.
- G. Slopes that erode easily shall be stabilized with Erosion Control Mix or temporarily stabilized with DirtGlue® Light as the work progresses.

END OF SECTION 31 25 13

SECTION 31 25 73

DIRTBAG® SPECIFICATIONS FOR CONTROL OF SEDIMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This work shall consist of furnishing, placing and removing the DIRTBAG® pumped sediment control device for erosion-sediment control. The DIRTBAG® pumped-silt control system is marketed by:

ACF Environmental, Inc.
2831 Cardwell Drive
Richmond, Virginia 23234
Phone: 800-448-3636
Fax: 804-743-7779

- B. DIRTBAGS® shall be used by the Contractor as necessary to control sediment.

PART 2 - MATERIALS

2.1 DIRTBAG®

- A. The DIRTBAG® shall be a non-woven bag which is sewn with a double needle matching using a high strength thread.
- B. The DIRTBAG® seams shall have an average wide width strength per ASTM D-4884 as follows.

<u>DIRTBAG® Style</u>	<u>Test Method</u>	<u>Test Result</u>
<u>DIRTBAG® 53</u>	<u>ASTM D-4884</u>	<u>60 LB/IN</u>
<u>DIRTBAG® 55</u>	<u>ASTM D-4884</u>	<u>100 LB/IN</u>

- C. Each standard DIRTBAG® shall be supplied with fill spout large enough to accommodate a 4" discharge hose and straps to secure the hose and prevent pumped water from escaping without being filtered.
- D. The geotextile fabric shall be non-woven fabric with the following properties:

<u>Properties</u>	<u>Test Method</u>	<u>Units</u>	<u>Non-Woven</u>	
			<u>53</u>	<u>55</u>
<u>Weight</u>	<u>ASTM D-3776</u>	<u>Oz/yd</u>	<u>8</u>	<u>10</u>
<u>Grab Tensile</u>	<u>ASTM D-4632</u>	<u>Lbs.</u>	<u>203</u>	<u>250</u>
<u>Puncture</u>	<u>ASTM D-4833</u>	<u>Lbs.</u>	<u>130</u>	<u>165</u>
<u>Flow Rate</u>	<u>ASTM D-4491</u>	<u>Gal/Min/Ft2</u>	<u>80</u>	<u>70</u>
<u>Permittivity</u>	<u>ASTM D-4491</u>	<u>Sec.¹</u>	<u>1.5</u>	<u>1.3</u>
<u>Mullen Burst</u>	<u>ASTM D-3786</u>	<u>Lbs.ⁱⁿ²</u>	<u>400</u>	<u>550</u>
<u>UV Resistant</u>	<u>ASTM D-4355</u>	<u>%</u>	<u>70</u>	<u>70</u>
<u>AOS % Retained</u>	<u>ASTM D-4751</u>	<u>%</u>	<u>100</u>	<u>100</u>

All properties are minimum average roll value except the weight of the fabric which is given for information only.

PART 3 – CONSTRUCTION SEQUENCE

- 3.1 Install DIRTBAG® on a prepared crushed stone pad overlying Mirafi 600X as shown on the contract drawings. Strap the neck of the DIRTBAG® tightly to the discharge hose. The preparation of a DIRTBAG® area is required before any trenching. Any water pumped from the construction site must be discharged through a DIRTBAG®.
- 3.2 It may be necessary to use hay/poly or other measures to keep the DIRTBAG® from freezing during winter months.
- 3.3 The DIRTBAG® is full when it no longer can efficiently filter sediment or pass water at a reasonable rate. Flow rates will vary depending on the size of the DIRTBAG®, the type and amount of sediment discharged into the DIRTBAG®, the type of ground, rock or other substance under the bag and the degree of the slope on which the bag lies. Under most circumstances, the vendor claims DIRTBAGS® will accommodate flow rates of 1,500 gallons per minute. Use of excessive flow rates or overfilling DIRTBAG® with sediment will cause ruptures of the bags or failure of the hose attachment straps.
- 3.4 Dispose of DIRTBAG® in accordance with Local, State, and Federal regulations. If allowed, the DIRTBAG® may be cut open and the contents seeded after removing visible fabric. DIRTBAG® is strong enough to be lifted with added straps if it must be hauled away (extra option). Off-site disposal may be facilitated by placing the DIRTBAG® in the back of the dump truck or flatbed prior to use and allowing the water to drain from the bag in place, thereby dismissing the need to lift the DIRTBAG®.

END OF SECTION 31 25 73

SECTION 33 41 00

STORM CULVERT AND CROSS DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes gravity-flow, non-pressure storm and soil hydrology preservation drainage with the following components:

1. Culverts.
2. Cross Drain Piping.
3. Flared Inlets/Outlets.

1.2 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: To be installed silt tight.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports. Product Data: For each type of product indicated.

1.4 DEFINITIONS

Granular Base Bedding: Fill placed under, beside and directly beside pipe to midpoint of pipe, prior to subsequent backfill operations.

Special Backfill: Fill placed above bedding beside and over pipe prior to other backfill operations.

1.5 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of pipes, connections, cleanouts and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 COORDINATION

- A. Coordinate the work with ditching and other project details.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

Provide any one of the following materials subject to any restrictions noted in this subsection or on plans. The contractor shall provide catalog cuts to the Owner/Permittee and indicate the proposed materials to be used prior to ordering materials. The approval of the Owner/Permittee must be obtained prior to ordering materials. Any piping used on this project must meet H-20 loading when 2-feet of gravel cover is provided.

- A. Reinforced Concrete Pipe: Comply with requirements of ASTM C 76, Class IV unless another class type is indicated on Drawings, installed with flexible plastic (Bitumen) gaskets at all joints. Gaskets shall comply with AASHTO M-198 75I, Type B, and shall be installed in strict accordance with pipe manufacturer's recommendations.
- B. Corrugated Polyethylene Pipe (CPP) or HDPE, Smooth Interior: Shall conform with AASHTO Designations M294 and M252. Pipe must be installed in accordance with manufacturer's installation guidelines for culvert and other heavy duty drainage applications. Acceptable manufacturers: Advanced Drainage Systems, Inc. (ADS) N-12 and HANCOR, INC. (HiQ smooth interior). Piping below the water table, subject to surcharge, or which could affect a pond level, shall be watertight. All other piping shall be silt tight.
- C. Corrugated Metal Pipe: Provided it meets the H-20 loading requirement noted above.
- D. Storm drain inlets, outlets, and culverts to include:
 - Rip rapped aprons.
 - Concrete flared inlets/outlets for pipes larger than 18" in diameter.
 - HDPE flares for pipe smaller than 18" in diameter. High density polyethylene flares with added carbon black for exposure to sunlight.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Pipe couplings and fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
 - 1. Use non pressure-type flexible couplings where required to join gravity-flow, non pressure sewer piping, unless otherwise indicated.
 - a. Flexible couplings for same or minor difference OD pipes.
 - b. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- D. Install gravity-flow, non pressure drainage piping according to the following:

- 1. Install piping pitched down in direction of flow, at the slope provided on the contract drawing.
- 2. The pipe shall be accurately laid to the line and grades to the satisfaction of the Engineer. The line and grade may be adjusted by the Engineer from that shown on the Drawings to meet field conditions and no extra compensation shall be claimed therefore.

The Owner/Permittee or his representative reserves the right to check the elevations and alignment on any pipe for conformance with proposed line and grade. Installed grades shall be within the tolerance of plus or minus 0.04 feet from theoretical computed grades. Alignment shall be within a tolerance of plus or minus 0.50 feet. Pipe grade shall be defined as the invert elevation of the pipe. Pipe not meeting the grade tolerance or of poor alignment shall be adjusted by the Contractor.

- 3. The pipe shall be cut as necessary for appurtenances. In general, the pipe material shall be cut by using a saw or milling process, approved by the pipe manufacturer and not by using any impact device, such as a hammer and chisel, to break the pipe. The pipe shall be cut, not broken. The cut end of the pipe shall be square to the axis of the pipe and any rough edges ground smooth.
 - 4. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely, in a manner approved by the Engineer, to prevent entrance of trench water, dirt, or other substances.
 - 5. All joints shall be made in a dry trench in accordance with the manufacturer's recommendations.
 - 6. When connections are made between new work and existing piping, make connection using suitable fittings for conditions encountered. Make each connection with existing pipe at time and under conditions which least interfere with operation of existing pipeline service. Provide facilities for dewatering and for disposal of water removed from dewatering lines and excavations without damage to adjacent properties.
- E. Clear interior of piping of dirt and superfluous material as work progresses.

3.3 PIPE JOINT CONSTRUCTION

- A. Where specific joint construction is not indicated, follow piping manufacturer's written instructions and provide a positive longitudinal connection at joints.
- B. Join gravity-flow, non pressure drainage piping according to the following:
 - 1. Join such that no separation of pipe segments will occur, i.e. all pipe segments are to be positively attached to resist longitudinal forces.

3.4 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of Project.
 - 1. Submit separate report for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Horizontal Alignment: Less than full diameter of inside of pipe is visible between ends or 0.50 feet off design alignment.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - f. Vertical Alignment: Within .04 feet of design grade.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.

END OF SECTION 33 41 00