3.2 MAIN EQUIPMENT INSTALLATION

A. Wall mounted equipment shall be fastened to steel brackets to provide an installation that is true, plumb, secure and safe.

B. Vendor drawings and instructions for the installation of Owner pre-purchased equipment will be made available to the Contractor. It shall be the responsibility of the Contractor to follow these documents during the installation, wiring, testing and energization of the equipment.

C. Installation of safety signs as required by code regulations or stipulated by the Engineer shall be the responsibility of the Contractor.

3.3 IDENTIFICATION

A. Equipment and Devices

1. All electrical equipment shall be clearly identified with its equipment number, function and voltage.

2. Each power and distribution panelboard, circuit breaker, junction box, etc. shall be identified with white lamacoid nameplate with black engraving, mechanically secured to the front with the screws or rivets to indicate function, voltage and equipment number as specified on the drawings. Enclosure ratings shall not be compromised in the attachment of labels. Labeling in accordance with NFPA70E must be applied where required.

3. Each power and distribution panelboard shall be equipped with a directory card, neatly typed with the final circuit designation and placed in the card holder under a transparent cover on the inside of the door of each panelboard.

4. The Contractor shall install “High Voltage” warning signs and “Danger” signs as called for by the safety regulations as required by code.

B. Cables and Conductors

1. All cables in panels, pullboxes, junction boxes and switchboards shall be tagged at both ends with the cable number assigned in the cable schedule/drawings. Tags shall be non-aging, labels which encircle the cable.

2. Both ends of all wires of each cable shall be clearly and permanently identified with wire markers, at the terminal to which they connect, with the proper wire number as shown on the drawings or wire termination sheets. Non-aging approved markers which encircle the wire shall be used.

3. All terminals for external connection shall be plainly and permanently marked, on approved marking strips as shown on the drawings or wire termination sheets.

3.4 AREA CLASSIFICATION

A. If the scope of work includes installations in hazardous area, the Contractor will be issued an area classification drawing indicating the Class, Division and Group designations in accordance with the NFPA classification for the different work areas.

B. The Contractor shall ensure that all equipment, materials and installation methods are suitable for the area classifications and shall report any discrepancies to the Owner for correction.

3.5 SEALS AND FIRE STOPS

A. In hazardous locations, sealing fittings (seal offs) shall be installed in all conduit runs on the outside of buildings/cabinets where the conduits enter the building/cabinets. In addition, approved drain fittings shall be installed at the bottom of these conduit runs and in all outdoor junction boxes to drain off any accumulated moisture.

B. Sealing fittings shall be installed for explosion proof work in accordance with in accordance with the provisions of Article 501 of the National Electric Code for Class 1, Group D, Division 1 and 2 locations. Compound filled seal off fittings as specified shall be installed as required.

C. Seal offs shall be located in conduits not more than 16 inches from points of penetrations through floors or walls and where emerging from earth. Seal offs shall be sized in accordance with the latest requirements of the NEC.

D. Fire stops shall be provided for all cable penetration in floors and walls to prevent spread of fire, dust, water and gases from one area to another. The material used for sealing of all cable penetrations shall be non-combustible and shall have low heat transfer. The sealed opening shall have a fire rating equal to that of the surrounding wall or floor.

E. Use 3M fire Barrier Caulk CP-25 or Putty 303 or equal.

3.6 ELECTRICAL EQUIPMENT PAINTING AND CLEANUP

A. All distribution panels, steel work and similar indoor and outdoor equipment furnished with enameled epoxy or lacquered finish or which are galvanized and which are scratched or defaced during construction shall be refinished and restored to the original finish by the Contractor.

B. All exposed steel surfaces on electrical equipment/panels, unless already supplied galvanized or epoxy painted, shall be cleaned, prime coated and finish coated with an epoxy enamel.

C. The Contractor shall make a thorough inspection of all electrical equipment, remove any left over packing braces, shipping supports and thoroughly clean all equipment by hand operated vacuum machine.

D. The Contractor shall clean up all lighting fixtures. Damaged parts shall be removed and replaced. All burned out lamps shall be replaced.

END OF SECTION

SECTION 260521 - WIRE & CABLE (600V OR LESS)

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This specification is for general site electrical work only relating to the CHA design drawings. This specification is not intended to be used with any other project design work/consultants including ARK Engineering.

B. Provide a cable system complete with all materials, including cables, wire, connectors, lugs and fittings as indicated in the specification or as indicated on the drawings. All cables and wiring shall be complete with identification tags per this Specification Section.

1.2 STANDARDS

A. Furnish cable, wire and wiring accessories listed by Underwritters' Laboratories (UL) as meeting National Electrical Code requirements and bearing the UL label where available for the equipment specified. In addition, the cable type shall have been submitted to standard tests established or approved by ASTM, ANSI, ICEA and NEMA.

1.3 SUBMITTALS

A. Submit Vendor data for all types and sizes of cables and wires being supplied by the Contractor. Identify material, construction data, color coding, insulation and jacket thickness and typical test data.

B. Submit Vendor data for the cable and wire identification tags to be supplied.

PART 2 - PRODUCTS

2.1 LOW VOLTAGE POWER CABLES (600 VOLTS OR LESS)

A. Multi-conductor low voltage power cables when installed in cable tray shall be type "MC", Class B stranded copper conductor, 600 Volt rated, XHHW or THHN conductor insulation, 90˚C conductor temperature, with bare copper ground wire, binder tape and overall black, flame retardant PVC jacket.

B. Low voltage power cables installed in conduit shall as listed below. A suitable insulated ground conductor shall be installed adjacent to the phase conductors and must not be less than 45% of the phase conductor cross sectional area.

1. THHN (90°C damp or dry) insulation shall be used in damp or dry locations for all sizes.
2. XHHW (75°C wet or 90°C dry) insulation shall be used in wet locations for all sizes.

C. Conductors shall be annealed copper, 98% conductivity.

D. Minimum size conductor for general wiring shall be #12 AWG.

2.2 CONTROL CABLING

A. Multi-conductor control cable shall be 600 Volt rated, type "MC" when installed in cable tray, Class B stranded copper conductor, PVC/nylon insulated, UL type THHN 90°C, with an overall flame retardant PVC jacket rated at 90˚C and overall aluminum mylar shield when indicated on the drawings. Conductors shall be color coded per ICEA S-66-524 Method 1, Table K-2 and shall be number printed.

B. Single conductor control wiring for insulation in conduit shall be of insulation type THHN for damp and dry locations and XHHW when installed in wet locations.

C. Minimum size conductor for control wiring shall be #14 AWG.

2.3 INSTRUMENTATION AND SIGNAL CABLE

A. Instrumentation and signal cables, shall be 300 Volt rated type "MC" when installed in cable tray, Class B stranded copper conductor, flame retardant, 105˚C PVC conductor insulation, color coded, twisted pairs, triplets or quads, with aluminum mylar shield, stranded tinned copper drain wire and overall PVC jacket rated at 90˚C. Belden Type or approved equal.

B. Minimum size of instrumentation and signal wiring shall be #18 AWG.

2.4 THERMOCOUPLE CABLE

A. Thermocouple cable shall be 300 Volt rated type "MC" when installed in cable tray, Class B stranded copper conductor, flame retardant, 105˚C PVC conductor insulation, color coded, twisted pairs, triplets or quads, with aluminum mylar shield, stranded tinned copper drain wire and overall PVC jacket rated at 90˚C. Belden Type or approved equal.

B. Minimum size of instrumentation and signal wiring shall be #18 AWG.

2.5 DIRECT BURIAL CABLES

A. Not used.

2.6 WIRE CONNECTION DEVICES FOR SPLICING

A. No splicing shall be permitted.

2.7 TERMINATING LUGS

A. Lugs for terminating power conductors up to and including #8 AWG shall be color coded, solderless compression or bolted type, unless otherwise indicated.

B. Lugs for terminating power conductors #6 AWG and larger shall be color coded, solderless compression type, one-hole for #6 AWG through #4 AWG inclusive, and two-hole for larger sizes.

C. Lugs for terminating control and switchboard wiring shall be color coded, solderless compression type with tinned copper ring tongue. Spade type lugs are not permitted in any control, protection or alarm circuits.

2.8 WIRE AND CABLE LABELS

A. Labels shall be non-aging, labels which encircle the cable or wire as applicable.

B. Refer to section 26 05 01 for cable and wire identification requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. No cables or wires shall be installed in conduits or ducts until the entire installation is completed and cleaned inside and out. When installing cables, the Contractor shall exercise due care to prevent damage to cables and raceways; avoid undue tension, bending and kinks.

B. Only approved cable lubricants, expressly manufactured for this purpose shall be used.

C. The Contractor shall install conductors in such a manner that the bending radius of any wire or cable is not less than the minimum recommended by ICEA and/or the manufacturer. Do not exceed the manufacturer's recommended values for maximum pulling tension applied to any cable or wire.

D. All power conductors and cables shall be run full length without splices and shall be continuous from origin to termination. Where splices are necessary and approved, they shall be made in approved splice boxes with suitable connectors. All splices shall be insulated with heat-shrinkable heavy-wall flame-retardant cable sleeves.

E. Thoroughly clean wire ends before connectors or lugs are applied.

F. Jumpers shall be installed inside the various panels as indicated in the cable termination sheets/drawings.

G. All power conductors in multi-color cables shall be color coded consistently, distinctly and continuously throughout the work. Color coding tape shall be utilized and applied at all terminations, junctions, pull boxes and condulet fittings.

H. Single conductor cables having black insulation for power feeders and sub-feeders shall be identified by colored tape as to phase connections.

I. Conductor terminators for all power cables sizes shall result in a connection both mechanically and electrically secure and approved for the application regarding dissimilar metals.

J. Control and instrument cables shall be terminated at panels, junction boxes and individual device enclosures using approved fittings.

K. The Contractor shall install phase and neutral conductors of each branch or feeder circuit in a single conduit except where paralleling circuits are indicated on the circuit schedule. Install paralleling circuits of identical makeup and length as the paralleled circuit, and terminate conductors at the same location, mechanically and electrically, at both ends, to ensure equal division of the total current between conductors.

L. The Contractor shall connect all AC power wiring to equipment.

END OF SECTION

SECTION 260527 - GROUNDING & BONDING SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This specification is for general site electrical work only relating to the CHA design drawings. This specification is not intended to be used with any other project design work/consultants including ARK Engineering.

B. Provide grounding and bonding system as specified or indicated on the drawings.

1.2 STANDARDS

A. Ground the electrical system neutrals and bond the non-current carrying parts of electrical equipment as indicated in the specification or drawings and as a minimum the grounding and bonding must meet the requirements of the National Electrical Code.

1.3 SUBMITTALS

A. Submit product data for conductors, connectors and devices supplied for use with the grounding system.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS, CONNECTORS AND DEVICES

A. Provide the grounding and bonding conductors, connectors and devices of the type specified on the drawings.

PART 3 - EXECUTION

3.1 EQUIPMENT AND BUILDING BONDING

A. Static grounding (bonding) of equipment shall be by means of bonding the equipment to the embedded ground grid as indicated on the drawings.

B. Bolted connections shall be used on all equipment and building bonding. A washer shall be used between the bolt head and terminal lug. Surfaces shall be free from paint, rust, dirt, grease and corrosion.

C. Holding down bolts or flange bolts shall not be used for bonding connections. Holes, if not provided, shall be drilled and tapped to suit the grounding bolt.

D. Building structural steel, steel structures, vessels, tanks and other similar process equipment, which is not in direct contact with the building steel structures, shall be bonded as noted on the drawing.

3.2 ELECTRICAL SYSTEM SERVICE GROUNDING

A. Service grounding of equipment (grounding) shall be by means of grounding the equipment to a continuous ground conductor, including all connections from source of power to the equipment. All grounding shall meet the requirements of the National Electrical Code.

B. Where UL type "MC" cable is specified, the bare internal copper ground wire shall be used for service grounding.

C. Service grounding shall be provided for all motors, housing of electrical equipment, transformers, transformer neutrals, grounding resistors, distribution equipment, lighting panel board and other similar equipment as required by the National Electrical Code and as indicated on the drawings.

D. The neutral conductor of any electrical distribution system shall not be used as an equipment grounding conductor. System neutrals shall be grounded in accordance with the National Electrical Code.

3.3 INSTALLATION

A. Immediately after installation, the equipment shall be grounded and bonded as indicated on the grounding layout and detail drawings.

B. Exposed grounding or bonding conductors shall not be routed across sections where they may be subject to damage or interfere with the movement of equipment or personnel .In such cases and as required, the conductor may be embedded in the floor, protected by conduit or copper strap of equivalent size shall be used.

C. Ground and bonding conductors shall be installed in a neat manner and rigidly supported by clips or straps at intervals not greater than 5 feet.

D. Install conductors of size required by the National Electrical Code unless otherwise indicated or specified on the drawings.

E. Power, control and instrumentation cable shields and/or sheaths shall be grounded in accordance with instructions contained in the cable schedules or wire termination sheets.

F. When it is indicated on the drawings that the conduit system serves as the equipment service grounding, the means and continuity of ground shall be permanent, effective and maintained throughout. Threaded couplings or double locknuts and bushings shall be used at all boxes and equipment enclosures, including lighting fixtures. All flexible conduits shall be properly grounded through a grounding jumper and the necessary fittings. A separate ground conductor shall be installed in epoxy coated or PVC coated conduit, or other non-metallic duct runs and so connected to maintain the ground continuity of the conduit or duct system.

G. Conduit expansion joints, not thoroughly bonded otherwise, shall be provided with approved bonding jumpers of not less than No. 6 AWG green insulated stranded copper.

H. A minimum No. 6 AWG green insulated stranded copper ground conductor shall be run in all cable tray and bonded to each tray section at intervals not exceeding 50 ft.

END OF SECTION

SECTION 260534 - CONDUITS

PART 1 GENERAL

1.1 SUMMARY

A. This specification is for general site electrical work only relating to the CHA design drawings. This specification is not intended to be used with any other project design work/consultants including ARK Engineering.

B. This Section includes the conduit systems required, specified, and/or shown on Contract Drawings including conduits, fittings, boxes, hangers, and accessories being installed for Vermont Gas Systems, Inc. (Company).

1.2 REFERENCES

A. Material and installation shall be in accordance with the latest revisions of the following codes, standards and specifications, except where more stringent requirements have been specified herein:

1. American National Standard Institute (ANSI)
2. National Electric Code (NEC)
3. National Electrical Manufacturers Association (NEMA)
4. Underwriters Laboratories, Inc. (UL)

1.3 QUALITY ASSURANCE

A. Qualifications of Manufacturer

1. All equipment furnished under this Section shall be furnished by manufacturers who meet the quality, workmanship, and experience requirements as specified and approved by Company.

1.4 SUBMITTALS

A. General

1. Submittals and samples shall be submitted upon Company’s request.
2. Prior to obtaining any material in connection with this Section, detailed shop drawings on all material shall be submitted upon Company’s request.
3. Submittals shall contain a material list with manufacturer's name and data describing the material and showing its compliance with specifications and associated standards.

PART 2 PRODUCT

2.1 CONDUIT

A. Rigid Galvanized Steel Conduit (RGS)

1. Rigid metal conduit shall be galvanized steel, hot-dipped with zinc over the entire length, both exterior and interior including threads.

2. Each conduit shall have a coupling on one end and a thread protector on the other.

3. Conduit shall meet ANSI Standards C80.1 and C80.4 latest revisions. The conduit shall be manufactured by Allied Tube & Conduit Corporation, Pittsburgh Standard Conduit Company, Triangle PWC Co. or equal.

B. Rigid PVC Coated Galvanized Steel (RPGS) Conduit

1. The conduit, prior to PVC coating, shall meet the requirements for RGS conduit above.

2. A PVC coating shall be bonded to the outer surface of the galvanized conduit. The bond between the coating and the conduit surface shall be greater than the tensile strength of the coating. The inside surface of the conduit shall have a urethane coating.

3. PVC coating thickness shall be not less than 40 mils.

4. PVC coated RGS shall be manufactured in accordance with ANSI C80.1, UL-6, Federal Specification WW-C-581E and NEMA RN1 – PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit standards.

5. Manufacturers or Equal

a. Robroy

b. Thomas & Betts

C. Electrical Metallic Tubing (EMT)

1. EMT shall be galvanized steel, hot-dipped with zinc over the entire length, both exterior and interior.

2. EMT shall be in accordance with ANSI Standards C80-3 latest revisions.

3. EMT shall be manufactured by Pittsburgh Standard Conduit Co., Allied Tube & Conduit Corporation, Triangle PWC Co., or equal.

D. Flexible Conduit

1. Flexible metallic conduit (Greenfield) - Shall be hot dipped zinc galvanized flexible steel or aluminum and shall comply with UL Standard No. 1, latest revisions. Conduit shall be manufactured by Anaconda Metal Hose Company, Triangle PWC Co. or equal.

2. Liquid-tight flexible metal conduit (Seal-tite) - Shall be constructed of flexible corrosion resistant zinc galvanized steel conduit with an extruded plastic jacket and built-in continuous copper ground strap under the jacket. Conduit shall be Type UA manufactured by Anaconda Metal Hose Company, Type LA manufactured by Electri-Flex Co. or equal.

3. Liquid-tight Flexible Non-Metallic Conduit - Shall be constructed of corrugated flexible PVC. Fittings shall be identified for use with flexible non-metallic conduit. Flexible non-metallic conduit shall be Carflex as manufactured by Carlon or equal.

4. Hazardous Area Flexible Metal Conduits - Flexible metal conduits installed in areas classified as Hazardous shall be Crouse-Hinds Series EC, Killark Series EK or equal.

2.2 JUNCTION, DEVICE AND PULL BOXES

A. Junction Boxes

1. Junction boxes and pull boxes shall be sized as required for the quantity and size of conductors to be installed within the box. Sizes shall comply with the requirements of the National Electric Code for wire bending space and radius.

2. Junction boxes installed in all non-hazardous open, wet areas or outdoors shall be NEMA type 4X with mounting lugs. Junction boxes shall have drilled and tapped holes for conduit terminations, gasketed covers secured by galvanized steel screws and drain holes.

3. Stamped Steel Junction Boxes -Junction boxes installed in areas approved for use with EMT conduit may be constructed of code-gaged galvanized steel.

4. Cast Junction Boxes -Junction boxes for use with RSC shall be constructed of hot dipped galvanized cast iron or copper free aluminum and shall be sized per NEC requirements. Boxes shall be manufactured by Crouse-Hinds Co., Killark Co. or equal.

5. Hazardous Area Junction Boxes - Junction boxes in areas classified as Hazardous shall be Series EJB or GU manufactured by Crouse-Hinds Co., Series XB or GR as manufactured by Killark Co., or equal.

B. Device Boxes for Outlets and Switches

1. Stamped Steel Device Boxes -In areas approved for use with EMT Conduit may be constructed of code-gage galvanized steel with required knockouts. Boxes shall be manufactured by Steel City Co., Raco Co. or equal.

2. Cast Device Boxes -In areas using exposed RSC boxes shall be constructed of hot dipped galvanized cast iron or copper free aluminum and sized per NEC requirements. Boxes shall be Series FD manufactured by Crouse-Hinds Co., Series FD, manufactured by Killark Co., or equal. (Use copper free aluminum boxes with RAC)

3. Hazardous Area Device Boxes -In areas classified as Hazardous, shall be Series ED manufactured by Crouse-Hinds; series SWB manufactured by Killark Co., or equal.

C. Pull Boxes

1. Pull boxes shall be used in dry locations only for pulling. No splicing of conductors shall be allowed. The boxes shall be constructed of galvanized steel, 12 gauge sheet metal, angle and frame members with welded joints. The box cover shall be gasketed and attached with stainless steel screws. A ground lug shall be provided, sized in accordance with the NEC.

2.3 CONDUIT OUTLET BODIES, FITTINGS, COUPLINGS AND EXPANSION COUPLINGS

A. Conduit Outlet Bodies

1. Conduit outlet bodies shall be used where required to permit ready fishing and withdrawing of wires. Conduit bodies not located in areas classified as Hazardous shall be gasketed. Bodies shall be of the cast iron or copper-free aluminum type. Bodies shall be Condulet series manufactured by Crouse-Hinds Co., Electrolet series manufactured by Killark Co., or equal.

B. Fittings and Couplings

1. EMT - All couplings and connectors for EMT shall be of the raintight cadmium plated, malleable iron gland compression type manufactured by O.Z. Gedney Co., Steel City Company, or equal.

2. Hazardous Areas - Seal off fittings in areas classified as Hazardous or Corrosive shall be Series EYS manufactured by Crouse-Hinds Co., Series E manufactured by Killark Co., or equal. Sealing compound shall be Chico manufactured by Crouse-Hinds or series SC manufactured by Killark or equal. Damming material shall be of the ceramic fiber type.

3. Flexible metallic conduit (Greenfield), Liquid-tight flexible metal conduit (Sealtite), and Liquid-tight Flexible Non-Metallic Conduit -Fittings shall be compatible with raceway material and in conformance with NEMA FB-1 and UL 514B. C. Expansion Couplings

1. Expansion couplings shall be a water-tight, corrosion resistant coupling with flexible neoprene outer jacket, stainless steel jacket clamp, flexible copper ground strap, and internal hub bushing.

2. Coupling shall compensate for the following movements:

a. Axial expansion or contraction

b. Angular misalignment

c. Parallel misalignment

3. Coupling shall be Type XD as manufactured by Crouse-Hinds Company, Type DX as manufactured by O-Z Gedney Co., or equal.

2.4 CONDUIT SLEEVES

A. Where conduits pass through the walls of structures, they shall be installed in suitable sleeves. Sleeves, installed in the outside walls of structures or elsewhere where watertightness is required, shall be cast iron and shall be equal to thruwall and floor seals manufactured by O.Z. Gedney Electrical Manufacturing Company, Inc. Types No. FSK, WSK, FSC or WSC as required, or Link-Seal as manufactured by Thunderline Corp. When Link-Seal is used, a wall sleeve, with waterstop, shall be installed. All other sleeves shall be galvanized steel pipe.

2.5 CONDUIT HANGERS AND SUPPORTS

A. General

1. Hangers and supports for conduits shall be adequate to support conduit systems with a minimum safety factor of 10.

2. All steel parts of the conduit support systems shall be galvanized, cadmium plated or PVC coated.

3. Perforated strap hangers will not be accepted.

4. Conduit supports shall be as manufactured by T&B (Steel City-Kindorf or Superstrut), Unistrut, Allied, Globe, or B-Line.

5. One hole malleable iron pipe clamps shall be hot dipped galvanized. Pipe spacers shall be of malleable iron and have a hot dip galvanized finish.

6. Hanger rods shall be continuous thread and galvanized not less than 3/8" inch in diameter.

B. Slotted Channel Framing: Cold-Formed Metal Channels with Continuous Slot.

1. Size of Channels: Nominal 1-5/8 by 1-5/8 inches, 12 gauge unless otherwise indicated or required for the application.

2. Finish:

a. Indoor Dry Applications: Electro-plated zinc coating (Super-strut Gold- Galv, Kindorf Gold Galv-Krom, etc.).

b. Outdoor, wet applications: Hot dipped galvanized (Superstrut HDG, Kindorf HD, etc.).

c. Corrosive applications: PVC coated (Superstrut PVC, Kindorf "P", etc.).

3. Fittings

a. Channel attachment nuts shall be prelocated in channel and be self supporting (spring type).

b. Conduit straps shall be of the notched type to fit channel with captured nut and bolt for tightening.

c. Beam clamps shall be provided with jaw openings to accommodate selected beam and provided with tapped holes and/or captured nuts for support of threaded rods.

4. Manufacturer (refer to Finish above for correct product)

a. Kindorf B-900, 905 series

b. Superstrut A-1200, A-1200P series

c. Globe G-5812, G-5812PO series

d. B-Line B-22, B-22-1-7/8 H series

e. Unistrut P-I000, P-1000-HS series

f. Power Strut PS-200, PS-200-H-1-7/8 series

g. Equal

C. Fasteners

1. All fasteners shall be stainless steel or silicon bronze.

2. All expansion anchors shall be self-drilling type.

2.6 MISCELLANEOUS ACCESSORIES

A. Warning Tape

1. Tape shall be of the detectable type and shall consist of a polyethylene tape with aluminum foil coil. Tape shall be 6" wide and shall have the legend "CAUTION ELECTRIC LINE BURIED BELOW". Lettering shall be black, on a red background. Tape shall be Panduit HTDU6R-E, Seton 37236, or equal.

B. Duct Bank Conduit Spacers

1. Underground ductbank conduit spacers shall provide stability and consistent separation of conduits within duct banks. Spacers shall be sized for the conduits with which they are used. They shall provide both vertical and horizontal spacing with interlocking intermediate and base spacers.

2. The separation between adjacent conduits shall be in accordance with NEC Article 310.

3. Manufacturer:

a. Carlon

b. Equal

PART 3 EXECUTION

3.1 INSTALLATION

A. General

1. All interior conduit work shall be installed exposed except areas in which there is a finished ceiling, or as indicated on the Contract Drawings, "Room Finish Schedule," a finished ceiling will be installed. These areas shall have all conduit work concealed.
2. No exterior conduits shall be run exposed on outside walls of buildings or structures.
3. Minimum size shall be 3/4 inch unless specifically shown otherwise.
4. Terminations of metallic conduits shall be furnished with grounding bushings.
5. Where exposed conduit requires clamping to the building structure, clamps shall consist of galvanized iron one-hole pipe straps and expansion shields.
6. Support outlets; pull boxes and junction boxes separately from building construction, not from conduit.
7. Where exposed conduit is permitted, install conduit parallel to or at right angles with lines of building in neat and organized configurations.
8. Coordinate all conduit installations with other trades in advance of installation.
9. Plug conduit openings until wires are installed.
10. Conduit reducers shall not be allowed.
11. Expansion couplings shall be installed in conduits crossing buildings expansion joints.
12. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
13. Complete raceway installation before starting conductor installation.
14. Install temporary closures to prevent foreign matter from entering raceways.
15. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
16. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
17. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
18. Run parallel or banked raceways together on common supports.
19. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
20. Join raceways with fittings designed and approved for that purpose and make joints tight.
21. Provide insulating bushings to meet NEC requirements.

B. Conduit Supports and Hangers

1. Conduit supports shall be spaced at intervals of 8 feet or less as required to obtain rigid construction.

2. Single conduits shall be supported by pipe clamps with clamp backs to raise conduits at least ¼ inch from the surface.

3. Multiple runs of conduits shall be supported on trapeze type hangers with steel horizontal members and threaded hanger rods.

4. Trapeze hangers shall be crossed braced to prevent spreading.

5. Conduit hangers shall be attached to structural steel by means of beam or channel clamps.

6. Supports located in corrosive areas and or where shown shall be PVC coated.

3.2 UNDERGROUND CONDUITS

A. Conduits shall be buried to a minimum depth of 24 inches unless otherwise shown or specified.

B. All buried conduits or groups of conduits shall have a warning tape buried 12 inches under finished grade and located directly over the centerline of the conduits. A second tape shall be buried 12 inches above the top of the highest conduit in the group. Where shown on the drawings, additional tapes shall be provided for ductbanks wider than 30 inches.

C. Underground conduits exiting and entering structures shall have expansion couplings as specified.

D. Where conduit is buried below grade, Contractor shall excavate, install, backfill and compact buried conduit prior to final compaction by General Contractor.

E. Any Earthwork shall be in accordance with Division 31 – Earthworks.

F. All conduits shall be cleaned and tested with a mandrel, prior to pulling cables.

G. The transition from the underground conduit system to the building interior conduit system shall occur at the first junction box, device, or equipment enclosure within the building. Conduit seals shall be provided at this location. Such seals shall minimize the circulation of air between the underground conduit system and the indoor enclosures. Seals shall be composed of Duct Seal sealing compound or similar non-hardening removable sealant.

H. Conduit bends in underground conduits shall have a minimum centerline radius as follows:

Conduit Size	Radius (inches)
3 inch	36
4 inch	42
5 inch	48

I. Conduit spacers shall be used when installing two or more underground conduits. Conduit spacers shall be located at intervals of 8 feet or less.

3.3 CONDUITS IN CORROSIVE AREAS

A. Where conduits pass through Corrosive Area walls and/or floors, seal off fittings as specified shall be installed to prevent gas leakage through conduit system.

3.4 CONDUITS IN HAZARDOUS AREAS

A. All conduit and equipment, in or through areas classified as Hazardous and all conduit and equipment for explosion proof work, shall be in accordance with the provisions of Article 501 of the National Electric Code for Class 1, Group D, Division 1 and 2 locations. Compound filled sealoff fittings as specified shall be installed as required.

3.5 CONDUIT TYPES

A. Rigid steel conduit shall be provided unless specifically noted otherwise on the Contract Drawings.

END OF SECTION

SECTION 260800 - ELECTRICAL ACCEPTANCE TESTING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This specification is for general site electrical work only relating to the CHA design drawings. This specification is not intended to be used with any other project design work/consultants including ARK Engineering.

B. All electrical equipment, devices, electrical systems installed or provided by the Contractor under this Section shall be inspected and tested by the Contractor to ensure that they operate correctly for the specific installation and are operating as designed, based on the associated layout drawings.

C. Refer to Section 3.0 for the Contractors' responsibilities related to inspection, testing, and commissioning of Company Furnished equipment.

D. Any defects in the Contractor's workmanship disclosed by such tests shall be corrected by the Contractor at the expense of the Contractor and the work shall be tested again. All changes made in the installation shall be marked by the Contractor on a master set of "As-Built" drawings.

E. When required by the Company, the Contractor shall provide at the Contractor's expense, equipment field Representatives for Contractor supplied equipment to perform equipment tests and train Company's operating staff.

F. The Company will provide specialized commissioning personnel when required to complete the commissioning of Company pre-purchased equipment, wire terminations or for other specialized testing when and as needed. The Contactor will provide support personnel as needed during system checkout, start up, commissioning and acceptance testing.

G. The Contractor shall provide instruments, meters, equipment and qualified personnel required to conduct tests and studies during and at the conclusion of the project.

H. The Contractor shall implement a safety test and commissioning tagging procedure. The tags shall be dated and signed and shall indicate equipment checked, equipment tested, equipment energized and equipment commissioned.

I. The Contractor shall perform all the equipment field tests as required to support Company commissioning plan.

J. In general, the work shall be performed as outlined in Section 3.0 of this Specification.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 INSPECTION

A. The first stage shall be inspection of all equipment associated with the Contractor installation responsibility, including Company Pre-Purchased equipment and prefabricated buildings and Contractor supplied equipment.

B. The Contractor shall confirm that all equipment and required quantities are complete and that equipment make and model specifications comply with the specified Project drawings and documentation.

C. The Contractor shall record that all equipment is without defects or damage. Any deviations shall be recorded and the Company immediately informed of any discrepancy.

3.2 TESTING (PRE-COMMISSIONING)

A. The second stage shall be Testing (Pre-Commissioning), prior to system power up, consisting of the following items.

1. Check that the installation is complete and that all interconnections are correct.

2. Check all power, control and signal wiring for continuity to ensure a clear path has been maintained. A formal sign off list of all wiring checks shall be provided to the Company prior to equipment energization.

3. Perform all equipment testing and correct deficiencies.

4. Provide assistance for third party commissioning and testing of the equipment:

5. Perform function tests to confirm correct operation of all devices, subsystems and systems, and correct all deficiencies.

3.3 COMMISSIONING (START-UP)

A. Commissioning (Start-up) Mainline Valve Station equipment and systems will be carried out by the Company or equipment manufacturer. The Contractor shall provide personnel throughout the commissioning period to assist and carry out any equipment adjustments, corrections or repairs, as required.

3.4 TEST PROCEDURES AND RECORD FORMS

A. The Contractor shall work with Company, develop and submit for approval to the Company's Representative an outline of proposed inspection and test procedures, checklists and test record forms for each system or piece of equipment, prior to the start of testing.

B. Test record forms shall include equipment number and system, method of testing, test equipment used, final readings obtained, adjustments made, test results and associated data.

C. The Contractor shall submit inspection and test results including complete data on actual readings taken and corrected values, to the Company's Representative for approval after each test period.

3.5 TESTING AND PRE-COMMISSIONING OF COMPANY FURNISHED EQUIPMENT

A. The Contractor shall provide testing and pre-commissioning of Company-furnished equipment. The Contractor shall submit for approval to the Company's Representative an outline of proposed tests for approval 30 days prior to the scheduled testing. The Contractor shall be responsible to thoroughly checkout, test and pre-commission all Company-furnished and Contractor supplied equipment and materials.

B. Field Representatives shall be provided by the Company for specialized testing and commissioning of the Company furnished equipment.

C. The Contractor will assist the Manufacturers' field representatives and Company's Field Personnel or commissioning representatives, as required, to complete final commissioning, startup and acceptance testing up to and including placing all equipment into Service.

D. The Contractor shall assist in correcting any manufacturer defects in the Company-furnished equipment, as required by the Company. The Contractor will be reimbursed under the terms of the Contract.

3.6 GENERAL GUIDELINES

A. All inspections and testing shall be performed in accordance with, OEM instructions, applicable codes and standards including but not limited to NEC, ANSI, IEEE, NFPA, NEMA, and OSHA.

B. All testing and commissioning shall also be performed in accordance with the following guidelines, as a minimum:

1. NETA Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

2. Equipment Manufacturer Guidelines

C. In general the Contractor's tests shall include the items listed in this specification and as further detailed in the following sections.

C. Verify that the installed equipment and systems are installed correctly with respect to the site layout and interconnection drawings, schematics, and drawings and specifications, and bill of materials

D. Check that all grounding terminals are connected to the correct grounding terminal and verify there are no ground loops.

3.7 DETAILED GUIDELINES

A. The Contractor shall test all equipment or devices in accordance with the equipment manuals and manufacturer's instructions. The test shall include as a minimum the items covered in the following sections.

3.8 GROUNDING

A. The grounding system shall be tested to ensure that all parts of the steel structures, motor frames, switchgear, trays, conduit and other electrical equipment will be at a potential in accordance with specifications.

3.9 LOW VOLTAGE (POWER & CONTROL) CABLES

A. Testing of all low voltage cable shall be performed by Company personnel. Contractor shall retain the responsibility for correction of any faulty installation or replacement of defective equipment as identified by the Company.

3.10 FINAL TEST REPORTS AND ACCEPTANCE

A. The Contractor shall submit the final approved test reports to the Company at the completion of the work under this Section.

B. Inspection and approval of Contractor tests will not constitute a waiver of his responsibility for the successful operation of the installed systems.

C. When all tests and commissioning have been completed to the satisfaction of the Company, the work shall be released by the Contractor to the Company.

END OF SECTION

SECTION 270000 - DATA & COMMUNICATIONS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This specification is for general site electrical work only relating to the CHA design drawings. This specification is not intended to be used with any other project design work/consultants including ARK Engineering.

B. Provide data and communication system raceways, equipment mounting backboards, wall jacks and cabling as specified or indicated on the drawings.

C. Data and communication systems shall include telephone systems and data/computer communications systems, as specified or indicated on the drawings.

1.2 STANDARDS

A. Furnish communication systems cabling, and wall jacks listed by Underwriters' Laboratories as meeting National Electrical Code requirements and bearing the UL label where available for equipment specified.

1.3 SUBMITTALS

A. Submit product data for the communication systems cabling and wall jacks. Include manufacturer model number and detailed product data to evaluate the products.

PART 2 - PRODUCTS

2.1 GENERAL

A. System cabling, wall jacks and raceway systems shall be of the type indicated or specified on the drawings.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide and install the data and communication raceway system, including conduits complete with pull boxes, as specified or indicated on the drawings.

B. All openings for cables or conduit that penetrate exit corridors or as indicated on the drawings shall be sealed to maintain the fire ratings and integrity of these areas.

C. Provide pull lines in all spare conduits or ducts.

END OF SECTION

SECTION 311000 - 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, crops and grass.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and relocating site utilities in place.

1.2 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches (50 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

C. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots.

D. Clearing: Removal or cutting and disposal of trees, farm crops, bushes or undergrowth vegetation.

1.3 MATERIAL OWNERSHIP

A. Cleared materials shall become Contractor's property, shall be removed from Project site, and disposed of at an approved location, unless otherwise specified by landowner or easement/line list conditions.

1.4 SUBMITTALS

A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

B. Record drawings, according to Section "Project Record Documents," identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.5 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner, Construction Management Team and authorities having jurisdiction.

2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction. Detour routes shall be identified by adequate signs in accordance with the MUTCD and/or Traffic Control Plans and/or the project permits (Local and State).

B. Protect areas outside limits of disturbance from encroachment by construction personnel or equipment, regardless of property Ownership. Access shall be by specific, written permission or easement only

C. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Construction Management Team.

D. Call Dig Safe at 811 before starting any excavation or verify that a Dig Safe ticket exists and is valid for the area. Contractor shall maintain Dig Safe marks and follow all Dig Safe laws. Contractor is responsible for contacting and complying with municipal and private utilities that are not members of Dig Safe. Excavate with care to avoid damage to structures and utilities - excavations shall be completed by hand if necessary. Promptly report any damages to utilities to Utility Owner and Construction Management Team, do not attempt repairs without the Utility Owners consent.

E. Site clearing operations shall adhere to the "Acceptable Management Practices for Maintaining Water Quality of Logging Jobs in Vermont", 10th Printing, 2009. Prior to any additional work, applicable EPSC measures shall be implemented.

F. Contractor shall verify existing grades prior to performing work under this section. If existing grades are at variance with the drawings, notify the Construction Management Team and Engineer and receive instructions prior to proceeding.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate all clearing activities with the Construction Management Team and applicable authorities having jurisdiction (e.g. VELCO, Green Mountain Power, VTrans). A minimum notice of seven (7) days is required prior to beginning construction activities in distinct areas.

B. Work near high voltage infrastructure shall follow applicable utility company guidelines, safety procedures, and other applicable specifications.

C. Protect and maintain benchmarks and survey control points from disturbance during all construction activities including clearing.

D. Locate and clearly flag, fence and protect trees and vegetation to remain or to be relocated.

E. Any grading or earthwork required - refer to Technical Specification "Earthwork - 312000"

F. Remove branches from trees that are to remain, if required to clear new construction and only if specifically approved by the Construction Management Team.

1. Where directed by Construction Management Team, extend pruning operation to restore natural shape of entire tree.

2. Cut branches and roots, if required, with sharp pruning instruments; do not break or chop.

G. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner and Construction Management Team.

3.2 TREE PROTECTION

A. If noted on the plans or directed by the Construction Management Team, erect and maintain temporary fencing around tree drip line before starting site clearing. Remove fence when construction is complete.

1. Do not store construction materials, debris, or excavated material within fenced area.

2. Do not permit vehicles, equipment, or foot traffic within fenced area.

3. Maintain fenced area free of weeds and trash.

4. Special care shall be taken when work is being completed adjacent to designated bat trees. Trees shall be flagged for avoidance and adequately protected from construction activities.

B. Do not machine excavate within tree drip line (if designated for avoidance).

C. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Construction Management Team and acceptable to the Owner.

1. Employ an arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.

2. Replace trees that cannot be repaired and restored to full-growth status, as determined by Construction Management Team and acceptable to Owner.

3.3 UTILITIES

A. Construction Management Team will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. Arrange with utility companies to shut off indicated utilities.

2. Construction Management Team will arrange to shut off indicated utilities when requested by Contractor.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Construction Management Team and Owner not less than seven days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Construction Management Team's written permission.

D. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

A. Completely remove obstructions, trees, shrubs, stumps, roots, grass, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.

2. If necessary, cut minor roots and branches of trees indicated to remain in a clean and careful manner.

3. Chip removed tree branches and distribute in areas approved by Construction Management Team. If acceptable to the OSPC, EPSC Specialist, and Construction Management Team, chipped vegetation may be utilized for soil stabilization.

B. Fill depressions caused by clearing and grubbing operations to match pre-construction site contours.

C. All conditions listed in the Construction Line List shall be maintained.

3.5 TOPSOIL STRIPPING

A. Remove sod, grass, and crops before stripping topsoil.

B. Where trees are designated to remain, stop topsoil stripping and adequate distance from the trees to prevent damage to the main root system.

C. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

2. Soil segregation is further specified and detailed on EPSC plans and in applicable environmental permits.

D. 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.

1. Do not stockpile topsoil within tree protection zones.

3.6 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

3.7 DISPOSAL

A. Burning of debris onsite is not permitted.

B. If directed by the Construction Management Team, remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property/easement.

1. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the preparation of the facility sites, protection, excavation, embankment, drainage, dewatering, for facility site grading, as shown on the Drawings, and as herein specified. Specifically, this specification shall be utilized for site work associated with the proposed facilities (Colchester Tie-in Site, and Mainline Valve Sites).

B. This Section includes any required earth moving, excluding the pipe trenching and backfilling, for construction activities within the right-of-way including clearing, grubbing, stringing operations, backfilling, and restoration.

C. This specification is not for pipeline (facility yard piping or mainline construction) trenching and backfilling.

D. The Contractor shall accept the site in the condition in which it exists at the time of the award of the Contract.

E. The Construction Management Team shall determine the suitability of materials that are to be used in the work and should any materials encountered be unsatisfactory for the purpose intended, they shall be removed from the site at the Contractor's expense.

1.2 QUALITY ASSURANCE

A. Reference Standards:

1. The latest edition of the following standards, as referenced herein, shall be applicable.

a. "Standard Specifications for Highway Materials and Methods of Sampling and Testing, American Association of State Highway and Transportation Officials (AASHTO)."

b. Vermont Agency of Transportation, Standard Specifications for Construction

B. The Contractor shall comply with the requirements for soil erosion and sedimentation control, and other requirements of governmental authorities having jurisdiction. .

C. The Contractor shall provide and pay for all costs in connection with an approved independent testing facility to determine conformance of soils and aggregate with the specifications in accordance with Section “Quality Requirements.”

1.3 SUBMITTALS

A. Test Results:

1. The testing laboratory shall submit written reports of all tests, investigations, and recommendations to the Contractor and Construction Management Team.

1.4 PROJECT REQUIREMENTS

A. Call Dig Safe at 811 before starting any excavation or verify that a Dig Safe ticket exists and is valid for the area. Contractor shall maintain Dig Safe marks and follow all Dig Safe laws. Contractor is responsible for contacting and complying with municipal and private utilities that are not members of Dig Safe. Excavate with care to avoid damage to structures and utilities - excavations shall be completed by hand if necessary. Promptly report any damages to utilities to Utility Owner and Construction Management Team, do not attempt repairs without the Utility Owners consent.

B. Notify the Construction Management Team of any unexpected subsurface condition.

C. Protection of Existing Utilities:

1. Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate support and protection during earthwork operations, comply with VOSHA/OSHA requirements.

2. Coordinate interruption and/or termination of utilities with the utility companies and the Construction Management Team,..

3. Provide a minimum of seven days notice to the Construction Management Team and receive written notice to proceed before interrupting any utility.

4. Demolish and completely remove from the site any existing underground utilities designated to be removed as shown on the Drawings or as specified in Section "Site Clearing."

D. Protection of Persons and Property:

1. Barricade open excavations occurring as part of this work, and post with warning lights and/or other approved protective measures, as necessary or directed by Construction Manager.

2. Operate warning lights and implement protective measures as recommended or required by authorities having jurisdiction.

3. Protect structures, utilities, sidewalks, pavements, and other facilities (both above and below ground) from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork and construction operations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Common Fill: Common fill shall not be used under improved surfaces (driveways, gravel pads, buildings, foundations, structures). Common fill shall be clean material not containing contaminants, large amounts of organic materials, trash or stones greater than 6" in any one dimension.

B. Crushed Stone Pad, Driveway, Sub-base Fill Areas: See specification 321500 Crushed Stone Surfacing.

C. Selected Fill/Structural Fill: Sound, durable, sand, gravel, stone, or blends of these materials, free from organic, frozen or other deleterious materials. Material shall be in accordance with VTrans Standard 704.08A "Granular Backfill for Structures", or approved equal, as indicated below.

Sieve	**Percent Passing**
3"	100
No. 4	45 - 75
No. 100	0 – 12
No. 200	0 – 6

1. Fines passing No. 200 shall be non-plastic.

PART 3 - EXECUTION

3.1 PRECONSTRUCTION MATERIAL QUALIFICATION TESTING

A. Each potential borrow source shall be tested and reviewed, prior to use on site, as follows:

1. Particle Size Analysis:
   a. Method: ASTM D422.
   b. Number of Tests: One (1) per potential source.
   c. Acceptance Criteria: Gradation within specified limits.
2. Maximum Density Determination:
   a. Method: ASTM D1557, Modified Proctor.
   b. Number of Tests: One (1) per potential source.
3. Re-establish gradation and maximum density of fill material if source is changed during construction..

3.2 PREPARATION

A. Establish required lines, levels, contours and datum.

B. Maintain benchmarks and other elevation control points. Re-establish, if disturbed or destroyed, at no additional cost to the Owner.

C. Establish location and extent of utilities before commencement of grading operations.

3.3 EXCAVATION

A. Excavation shall consist, in general, of the excavation of whatever substance is encountered to the lines, grades and sections shown on the Drawings, including excavation as necessary for grading and other similar features.

B. All suitable materials removed in excavation shall be used in the construction of embankments, subgrade, shoulders, slopes and at such other places as directed. The Construction Management Team shall be the sole judge of what constitutes suitable material.

C. During construction, the grading operations shall be executed in such a manner that the excavation will be well drained at all times. All grading shall be finished on neat, regular lines conforming to the sections and contours shown on the Plans.

D. Removal of materials beyond the indicated subgrade elevations, without authorization by the Construction Management Team, shall be classified as unauthorized excavation and shall be performed at no additional cost to the Owner.

E. Excavation shall be performed in proper sequence with all other associated operations.

F. Maintain the slopes of excavation in a safe condition until completion of the grading operation.

G. All excavation work shall be inspected and approved by the Construction Management Team before proceeding with construction.

H. Any excess excavation materials shall be removed from the site to approved disposal areas at the Contractor's expense.

3.4 FILL

A. All site fill shall be “selected fill” unless otherwise shown on the Drawings, or directed by the Construction Management Team.

B. Before depositing fills, the surface of the ground shall be cleared of all refuse, brush and large stones. Conform to Section “Site Clearing.”

C. Prior to placing fill over undistributed material, scarify to a minimum depth of six (6) inches or until a depth where all organic material has been removed.

D. Where fills are made on hillsides or slopes, the slope of the original ground upon which the fill is to be placed shall be plowed or scarified deeply or where the slope ratio of the original ground is steeper than 2 horizontal to 1 vertical, the bank shall be stepped or benched.

E. At the facility locations where earthwork is required, the original ground shall be proof rolled until the underlying soil is thoroughly compacted to the satisfaction of the Construction Management Team before any filling is begun. A steel-wheel tandem roller weighing 8 to 10 tons or equipment capable of obtaining the same effort shall be used to obtain a thoroughly compacted subgrade. Remove or recompact any soft or loose soils as determined by the Construction Management Team prior to filling.

F. A thoroughly and satisfactorily compacted subgrade is defined as having a minimum dry density of 95 percent of the maximum density of the material used. The subgrade material shall be compacted at a moisture content suitable for obtaining the required density.

G. Place backfill and fill materials in layers not more than 12" in loose depth unless shown otherwise on the Drawings. Lift height shall be governed by the ability of the compaction equipment to obtain the required compaction with 12" as a maximum lift height. Before compaction, moisten or aerate each layer as necessary to facilitate compaction to the required density. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost, ice, ponded water or extraneous debris.

H. When work is suspended during periods of freezing weather, measures shall be taken to prevent fill already in place from freezing. Upon resumption of work after any inclement weather, prepare the exposed surface by proof rolling to identify any zones of soft/loose soils. Soft/loose materials or frozen soils shall be removed and replaced by compacted select fill.

I. Moisture Control:

1. Where fill or backfill must be moisture conditioned before compaction, uniformly apply water to the surface and to each layer of fill or backfill. Prevent ponding or other free water on surface subsequent to, or during, compaction operations.

2. Remove and replace, or scarify and air dry, soil that is too wet to permit compaction to specified density. Soil that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing, until moisture content is reduced to a value which will permit compaction to the percentage of maximum density specified.

J. All fill shall be thoroughly and satisfactorily compacted to 95 percent of the maximum density of material used.

3.5 GRADING

A. The present and finished grade lines are shown on the contract drawings. Grade over the entire area, as shown on the drawings, shall be to the finished subgrade levels. Upon completion of this work, all debris shall be cleaned out and removed from the premises.

B. All cutting, filling, backfilling and grading necessary shall be done to bring the area to the following grade or subgrade levels:

1. For roadway surface areas; to the finished subgrade levels specified on the contract drawings.

2. For areas to be topsoiled and seeded; to within three (3) inches of the finished grade.

3. For other surface treatments; as detailed on the Drawings.

C. Sufficient grading must be done during the progress of the work so that the entire site shall be well drained and free from water pockets.

D. Finish grading, including dressing swales, cleaning up excess footing excavation, dressing terraces, disposing of excess material and all other work necessary to prepare the site for topsoil and seeding shall be done after construction of structures and roadway surface areas are substantially complete.

E. Where the pipeline right-of-way was graded or leveled during clearing or prior to other construction activities, the Contractor shall return the finished grade to the pre-construction contours, as acceptable to the Construction Management Team, after pipeline installation is complete.

3.6 COMPACTION EQUIPMENT

A. Compaction equipment used for the Work is subject to approval by the Construction Management Team. Any equipment not originally manufactured for compaction purposes and equipment which is not in proper working order will not be allowable. If requested, Contractor shall furnish manufacturer's specifications covering data not obvious from a visual inspection of the equipment and necessary to determine its classification and performance characteristics.

B. Do not use vibratory compactors closer than five hundred (500') feet within 24 hours of any concrete placement.

3.7 DRAINAGE AND DEWATERING

A. Prevent surface, subsurface or ground water from flowing into excavation and from flooding project area, as well as surrounding areas.

B. Coordinate all de-watering efforts with the EPSC specialist.

C. Do not allow water to accumulate in excavations. Remove water to prevent soil changes detrimental to the stability of subgrades.

D. Provide and maintain the pumps, well points, sumps, suction and discharge lines, and other dewatering components necessary to convey water away from excavations.

E. Provide and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations by dewatering, to collection or run-off areas.

3.8 FIELD QUALITY CONTROL

A. Notify the Construction Management Team at least three (3) working days in advance of all phases of filling and backfilling operations.

B. When working on the facility sites, compaction testing shall be performed to ascertain the compacted density of the fill and backfill materials in accordance with the following methods:

1. In-place relative density:

a. Method: AASHTO T238, Nuclear Method

b. Number of Tests: One (1) per 8" vertical lift.

c. Test frequency: Testing shall occur at the lesser rate of every day or every 100 C.Y. of fill material.

C. If temporary grading is needed within the pipeline right-of-way, in-place relative density is not required.

D. The Construction Management Team may direct additional tests to establish gradation, maximum density, and in-place density as required by working conditions.

E. Acceptance Criteria: For improved areas (driveways, foundations, buildings, equipment pads, parking areas), the sole criterion for acceptability of in-place fill shall be in situ dry density. Minimum dry density for all fill or backfill shall be 95 percent of the maximum dry density. If a test fails to qualify, the fill shall be further compacted and re-tested. Subsequent test failures shall be followed by removal and replacement of the material.

3.9 CLEAN UP

A. Provide and maintain protections or newly filled areas against damage. Upon completion or when directed, correct all damaged and deficient work by building up low spots and remove temporary protections, fencing, shoring and bracing.

B. Remove all surplus excavated material not required for filling and backfilling and legally dispose of away from premises.

C. Leave the premises and work in clean, satisfactory condition, ready to receive subsequent operations.

END OF SECTION

SECTION 312316.16 - STRUCTURE EXCAVATION FOR MINOR STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the excavation, backfilling, compaction, protection and dewatering for placement of minor structures (e.g. foundations, sono-tubes, equipment pads) as shown on the Drawings and as specified herein.

B. The Contractor shall accept the site in the condition in which it exists at the time of the award of the Contract.

C. The Construction Management Team shall determine the suitability of materials that are to be used in the work and should any materials encountered be unsatisfactory for the purpose intended, they shall be removed from the site at the Contractor's expense.

1.2 QUALITY ASSURANCE

A. Reference Standards:

1. The latest edition of the following standards, as referenced herein, shall be applicable.

a. "Standard Specifications for Highway Materials and Methods of Sampling and Testing, American Association of State Highway and Transportation Officials (AASHTO)."

b. Vermont Agency of Transportation, Standard Specifications for Construction.

B. The Contractor shall provide and pay for all costs in connection with an approved independent testing facility to determine conformance of soils and aggregate with the specifications, in accordance with Section "Quality Requirements."

1.3 SUBMITTALS

A. Test Results:

1. The testing laboratory shall submit written reports of all tests, investigations, and recommendations to the Contractor and Construction Management Team.

1.4 PROJECT REQUIREMENTS

A. Call Dig Safe at 811 before starting any excavation or verify that a Dig Safe ticket exists and is valid for the area. Contractor shall maintain Dig Safe marks and follow all Dig Safe laws. Contractor is responsible for contacting and complying with municipal and private utilities that are not members of Dig Safe. Excavate with care to avoid damage to structures and utilities - excavations shall be completed by hand if necessary. Promptly report any damages to utilities to Utility Owner and Construction Management Team, do not attempt repairs without the Utility Owners consent.

B. Notify the Construction Management Team of any unexpected subsurface condition.

C. All Work shall comply with VOSHA/OSHA regulations or requirements.

D. Protect excavations by shoring, bracing, sheet, piling, underpinning or by other methods, as required to ensure the stability of the excavation.

E. Underpin or otherwise support structure adjacent to the excavation which may be damaged by the excavation. This includes service lines.

F. Protection of Existing Utilities:

1. Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.

2. Coordinate interruption and/or termination of utilities with the utility companies and the Owner.

3. Provide a minimum of seventy-two (72) hours' notice to the Owner and receive written notice to proceed before interrupting any utility.

4. Demolish and completely remove from the site any existing underground utilities designated to be removed, as shown on the Drawings or as specified in Section "Clearing and Grubbing."

G. Protection of Persons and Property:

1. Barricade open excavations occurring as part of this work and post with warning lights and/or other approved protective measures, as necessary or directed by the Construction Management Team.

2. Operate warning lights and implement protective measures as recommended, or required, by authorities having jurisdiction.

3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Selected Fill/Structural Fill: Sound, durable, sand, gravel, stone, or blends of these materials, free from organic, frozen or other deleterious materials. Material shall be in accordance with VTrans Standard 704.08A "Granular Backfill for Structures", or approved equal, as indicated below.

Sieve	Percent Passing
3"	100
No. 4	45 - 75
No. 100	0 – 12
No. 200	0 – 6

1. Fines passing No. 200 shall be non-plastic.

B. Geotextile: As noted on project drawings.

PART 3 - EXECUTION

3.1 PRECONSTRUCTION MATERIAL QUALIFICATION TESTING

A. Each potential borrow source shall be tested and reviewed, prior to use on site, as follows:

1. Particle Size Analysis:

a. Method: AASHTO D422.

b. Number of Tests: One (1) per potential source.

c. Acceptance Criteria: Gradation within specified limits.

2. Maximum Density Determination:

a. Method: ASTM D698, Modified Proctor.

b. Number of Tests: One (1) per potential source.

3. Re-establish gradation and maximum density of fill material if source is changed during construction.

3.2 PREPARATION

A. Establish required lines, levels, contours and datum.

B. Maintain benchmarks and other elevation control points. Re-establish, if disturbed or destroyed, at no additional cost to the Owner.

C. Establish location and extent of utilities before commencement of excavation.

3.3 EXCAVATION

A. Excavate subsoil in accordance with the lines and levels as shown on the Drawings and as necessary for installation of the work. The excavation lines shall be such that sufficient clearances exist for the proper execution of the work, including space for formwork and bracing.

B. Maintain the slopes of excavation in safe condition until completion of the backfilling operation, in accordance with VOSHA/OSHA requirements.

C. Trim the bottom of all excavation to the required levels, and leave free from loose or organic matter. Fill over-excavated areas under structure bearing surfaces with concrete as specified for foundations, or other material as approved by the Construction Management Team.

D. When the excavation has been carried to the required depth, the Contractor shall await inspection of the bearing surface by the Construction Management Team and authorization to proceed with the work. A minimum notice of 72 hours will be given to the Construction Management Team prior to inspection.

E. Sloping surfaces under footings and foundations, or other work where required, shall be cut in steps as indicated on the Drawings or as directed by the Construction Management Team.

F. Any excess excavation shall be removed from the site to disposal areas at the Contractor's expense.

G. In the event the Contractor excavates below the correct elevations, they shall backfill to the correct elevation with approved material that is reviewed and acceptable to the Engineer of Record.

3.4 DRAINAGE AND DEWATERING

A. Prevent surface, subsurface or ground water from flowing into excavation and from flooding project area, as well as surrounding areas. Keep the excavated areas dry until the structures, pipes, and appurtenances are constructed and properly backfilled in accordance with the contract documents.

B. Do not allow water to accumulate in excavations. Remove water to prevent soil changes detrimental to the stability of subgrades.

C. Provide and maintain the pumps, well points, sumps, suction and discharge lines, and other dewatering components necessary to convey water away from excavations.

D. Provide and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations by dewatering, to collection or run-off areas.

E. Coordinate all de-watering efforts with the EPSC specialist and in compliance with applicable environmental permit conditions.

3.5 STRUCTURAL FILL, BACKFILL, AND COMPACTION

A. Place fill materials in the types and thicknesses as detailed on the Drawings. All backfill shall be Selected Fill unless otherwise directed by the Construction Management Team, or shown on the Drawings.

B. After approval of the subgrade by the Construction Management Team, the geotextile shall be placed, where shown on the Drawings, upon the subgrade in accordance with the manufacturer's instructions and the following:

1. After acceptance of the subgrade, the fabric shall be installed prior to placement of the first course of structural fill.

2. Geotextile may be joined by either sewing or overlapping. Sewn seams shall be lapped a minimum of 4 inches and double sewn with nylon or polypropylene. Overlapping seams shall have a minimum overlap of 18 inches, except where placed underwater where the overlap shall be a minimum of 3 feet.

3. Fabric which is torn or damaged shall be replaced or patched. The patch shall extend 3 feet beyond the perimeter of the tear of damage.

4. Traffic or construction equipment shall not be permitted directly upon the fabric. Maintain a minimum of 8 inches loose thickness of aggregate above the stabilization fabric subject to traffic.

C. Place backfill and fill materials in layers not more than 12" in loose depth. Lift height shall be governed by the ability of the compaction equipment to obtain the required compaction with 12" as a maximum lift height. Before compaction, moisten or aerate each layer as necessary to facilitate compaction to the required density. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost, ice, ponded water or extraneous debris.

D. When work is suspended during periods of freezing weather, measures shall be taken to prevent fill already in place from freezing. Upon resumption of work after any inclement weather, prepare the exposed surface by proof rolling to identify any zones of soft/loose soils. Soft/loose materials or frozen soils shall be removed and replaced at the Contractor's expense.

E. Moisture Control:

1. Where fill or backfill must be moisture conditioned before compaction, uniformly apply water to the surface and to each layer of fill or backfill. Prevent ponding or other free water on surface subsequent to, or during, compaction operations.

2. Remove and replace, or scarify and air dry, soil that is too wet to permit compaction to specified density. Soil that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing, until moisture content is reduced to a value which will permit compaction to the percentage of maximum density specified.

F. All fill shall be thoroughly and satisfactorily compacted to 95 percent of the maximum density of material used and within 3% of the optimum moisture.

G. If the surface of any layer becomes contaminated by mud or unsuitable materials, the contaminated soil shall be removed.

H. Fill placement shall be suspended when wet weather prevents proper operation of compaction equipment.

I. Adjacent to structures, fill shall be placed in a manner which will prevent damage to the structures and will allow the structures to assume the loads from the fill gradually and uniformly. The height of the fill adjacent to structure shall be increased at approximately the same rate on all sides of the structure.

J. No backfilling or compaction shall take place against any cast-in- place concrete footings or slabs prior to 3 days initial concrete set.

K. Heavy equipment shall not be operated within 4 feet of any structure. Heavy vibratory compactors shall not be operated within 4 feet of any structure.

L. Excavated material meeting the requirements of Selected Fill shall be spread and allowed to dry until obtaining the required moisture content prior to re-use.

3.6 FIELD QUALITY CONTROL

A. Notify the Construction Management Team at least three (3) working day in advance of all phases of filling and backfilling operations.

B. Compaction testing shall be performed to ascertain the compacted density of the fill and backfill materials in accordance with the following methods:

1. In-place relative density:

a. Method: AASHTO T191, Sand Cone Method
AASHTO T238, Nuclear Method

b. Number of Tests: One (1) per 8" vertical lift.

C. The Construction Management Team may direct additional tests to establish gradation, maximum density, and in-place density as required by working conditions, at the Contractor's expense.

D. Acceptance Criteria: The sole criterion for acceptability of in-place fill shall be in situ dry density and optimum moisture content.. Minimum dry density for all fill or backfill shall be 95 percent of the maximum dry density and the moisture shall be +/- 3% of optimum. If a test fails to qualify, the fill shall be further compacted and re-tested. Subsequent test failures shall be followed by removal and replacement of the material.

3.7 CLEAN UP

A. Provide and maintain protections or newly filled areas against damage. Upon completion or when directed, correct all damaged and deficient work by building up low spots and remove temporary protections, fencing, shoring and bracing.

B. Remove all surplus excavated material not required for filling and backfilling and legally dispose of same away from premises, at no additional cost to the Owner.

C. Leave the premises and work in clean, satisfactory condition, ready to receive subsequent operations.

END OF SECTION

SECTION 312316.26 - ROCK REMOVAL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes drilling, blasting, excavation, removal and disposal of rock as necessary for the installation of the Work, and as indicated and specified herein. This specification shall be used as a supplement to the following documents: "Blasting Plan for Addison Natural Gas Project, Vermont Gas Systems, Inc." dated June 25, 2012. All requirements listed in the "Blasting Plan" and other applicable Contract Documents (e.g. MOU's) shall be followed - in the event of a conflict, the more stringent condition shall apply.

1.2 REFERENCES

A. The latest edition of the following standards, as referenced herein, shall be applicable.

1. "Structure Response and Damage Produced by Ground Vibration From Surface Mine Blasting," U.S. Bureau of Mines Publication RI 8507.

1.3 DEFINITIONS

A. Rock: Limestone, sandstone, shale, granite, quartz, and formations of other varying mineral or aggregate composition in solid beds or masses in its original or stratified position that exceed 2 cubic yards and that cannot be excavated with one of the following

1. A crawler tractor having a minimum draw bar pull rated at not less than 71,000 lbs. (Caterpillar D9N or equivalent), and occupying an original volume of at least 2 cubic yards or more.

2. A backhoe having a break out force rated at not less than 44,000 lbs. (Caterpillar 235D or equivalent), and occupying an original volume of at least 2 cubic yards.

B. Rock Excavation: Removal of rock by means of drilling, blasting, hydraulic machinery, or use of pneumatic tools. Removal of materials which, in the opinion of the Construction Management Team, can be loosened and excavated by mechanical means (ripping, etc.) including frozen materials, soft laminated shale or hardpan, pavements, curbs and similar materials shall be not be classified as rock excavation. Do not proceed with the excavation of this material until the Construction Management Team has classified the materials as common excavation or rock excavation and has taken cross sections as required. Failure on the part of the Contractor to uncover such material, notify the Construction Management Team, and allow ample time for classification and cross sectioning of the undisturbed surface of such material will cause the forfeiture of the Contractor's right of claim to any classification or volume of material to be paid for other than that allowed by the Construction Management Team for the areas of work in which such deposits occur.

C. Unauthorized Excavation: Removal of any material beyond horizontal and vertical limits indicated on the Drawings or as specified herein, without the prior approval of the Construction Management Team.

D. Blasting Specialty Contractor: A subcontractor approved by the Owner and Construction Management Team retained by the Contractor performing all work related to drilling and blasting for rock excavating.

E. Independent Specialty Condition Survey Contractor: A subcontractor approved by the Construction Management Team retained by the Contractor to perform pre and post blast condition surveys of nearby structures.

F. Independent Specialty Condition Seismic Survey Contractor: A subcontractor approved by the Construction Management Team retained by the Contractor to perform seismic vibration monitoring on-site and off-site at locations specified or designated by the Construction Management Team.

G. Line Drilling: A controlled blasting method in which a single row of closely spaced, unloaded holes are drilled along the neat excavation line to create a plane of weakness which the primary blast can break. Center-to-center spacing of line drilled holes shall be no more than twice the hole diameter.

1.4 SUBMITTALS

A. General:

1. Submit Specialty Contractors' qualifications, to the Construction Management Team for approval.

2. Submit work plans, site safety plans, proposed equipment, and a detailed outline of intended rock removal procedures and any other information listed in this specification to the Construction Management Team for approval. This submittal shall not relieve the Contractor of complete responsibility for the successful performance of the method(s) used.

3. A detailed storage plan shall be submitted to the Construction Management Team for approval. Plan shall contain information regarding storage containers, location(s), storage protocol for handling/receiving, blasting material inventory measures, and other applicable practices.

4. The submittal requirements stated herein in no way relieve the Contractor of their responsibility of carrying out safe blasting operations. The Contractor shall be solely responsible for damages and claims thereof.

B. Blast Plan:

1. The Blasting Specialty Contractor shall develop a detailed written blast design plan complying with the applicable requirements in NFPA 495, "Explosive Materials Code". A copy of the blast design plan shall be furnished to the Construction Management Team two weeks prior to blasting operations and shall include the types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, loading of explosives, drilling of new holes/extending existing holes, handling explosives at site, tamping explosives, equipment required, initiation procedures of blasting, safety practices, vibration control and monitoring, blasting pattern and shot size, addressing mis-fires., emergency procedures and other pertinent procedures/protocols that will prevent damage to site improvements and structures on Project site and adjacent properties.

2. The blasting plan shall specifically address blasting in the vicinity of existing gas infrastructure. Owner will provide guidance and seismic requirements depending on the location of the blast.

C. Pre and Post Blast Surveys:

1. Pre- and post-blast conditions surveys shall be completed for all nearby properties where ground vibrations will be perceptible (peak particle velocity greater than 0.1 in./sec.) prior to blasting. This survey shall include, at a minimum, all properties within a 600 ft. radius surrounding the construction area and any critical structures of interest as determined by the Construction Management Team. Prior to execution of the survey, a plan noting structures to be surveyed and survey methods shall be submitted to the Construction Management Team for approval.

2. During these surveys, all structures and installations, buildings, bridges, water sources, storage tanks, utilities and other significant features, etc., shall be examined and photographed or videoed as necessary. Pre and post blast surveys shall include all accessible indoor areas and outdoor sections of surveyed structures. Photographs accompanied by audio tape or written field reports, or narrated video tape shall be included as part of the surveys. A written survey summary shall also be included with all submittals. Within thirty (30) days of completion of this survey and prior to blasting, a pre-blasting conditions survey report shall be submitted to the Construction Management Team and Owner. Within thirty (30) days after completion of blasting operations, the Independent Specialty Condition Survey Contractor shall conduct a post-blasting survey of all the same properties. The post-blast conditions survey report shall be submitted to the Construction Management Team and Owner within thirty (30) days.

3. Well testing shall include both quality and flow testing, both pre-blast and post-blasting, when within 600 feet of the blasting activities. Well quality shall be tested utilizing the Vermont Department of Health "Kit A", "Kit C", and "Kit RA". Well quantity shall be tested by a licensed Vermont Well Driller utilizing the "blow down" method.

D. Seismic Monitoring Plan:

1. The Seismic Specialty Contractor shall develop a written monitoring plan detailing equipment to be used, monitoring locations, seismic event record format example, and schedule. A copy of the seismic monitoring plan shall be furnished to the Construction Management Team two weeks prior to blasting operations.

E. Seismic Monitoring Records:

1. A written seismic monitoring record of each monitoring/blast event shall be submitted to the Construction Management Team the work day following each blast event. Monitoring shall be performed at the nearest point of the nearest structure to the blast, unless directed otherwise by the Construction Management Team. The record shall include at least the following information:

   a. Location of seismic vibration and sound level transducers;

   b. Peak Particle Velocity (PPV), Vibration Frequency (Frq), Peak Displacement (PD) and Peak Particle Acceleration (PPA) in the longitudinal, vertical, and transverse directions as well as Resultant PPV and Peak Sound levels (dB) for each event;

   c. Seismograph printout;

   d. Date and time of blast event;

   e. Distance from seismograph to the blast

   f. Monitored time interval.

2. The Seismic Specialty Contractor shall immediately inform the Construction Management Team if vibration levels or sound levels exceed specified values.

F. Blast Hole Records:

1. Written records of each blast shall be submitted to the Construction Management Team the work day after each blast event and shall include at least the following items:

a. Surface elevation;

b. Location;

c. Number of holes;

d. Depth of holes;

e. Water conditions in each hole (if any);

f. Quantity and type of explosives used;

g. Maximum quantity of explosives per delay and number of delays. A delay shall be considered detonations separated by a minimum of 8 milliseconds;

h. Detonation delay pattern;

i. Stemmed length of hole;

j. Date and blast time.

G. Log of Complaints:

1. A log of all complaints and responses resulting from blasting operations shall be kept by the Contractor's designated contact person. The log should include as a minimum the following information: name and address of person registering complaint/inquiry; time and date when annoyance occurred; time and date when complaint/inquiry filed; nature of complaint/inquiry; action taken by contact person; follow-up action. A copy of all complaints and responses shall be submitted to the Owner and Construction Management Team by the following work day.

H. Site Safety Plan:

1. Site safety shall be coordinated through the Contractor's office. A written safety plan shall be developed and distributed to all subcontractors, the Owner and the Construction Management Team.

I. Certifications/Licenses:

1. One (1) copy of each certificate, license, permit and proof of insurance required by this specification shall be submitted to the Construction Management Team after award of contract and prior to commencement of work.

J. Quality Assurance:

1. The Contractor shall use the services of an experienced Specialty Contractor to perform all blasting operations.

2. The Blasting Specialty Contractor and the blasting foreman shall be regularly engaged in blasting work of similar magnitude and scope and shall be approved by the Construction Management Team to perform this project. A list of prior work experience for the Blasting Specialty Contractor and foreman shall be submitted with the bid.

1.5 REGULATORY REQUIREMENTS

A. The Blasting Specialty Contractor shall obtain all required permits, certificates, and licenses (City, State, Local etc.) prior to the commencement of any blasting operations.

B. Blasting safety procedures and operations shall comply with Title 29 Code of Federal Regulations Part 1910.109, and all other applicable state and local standards and regulations.

1.6 PROJECT/SITE CONDITIONS

A. Existing Conditions: Existing physical conditions as defined for design purposes are noted on the Drawings and are described in the Information Available to Bidders section of the Contract Documents.

1.7 SEQUENCING AND SCHEDULING

A. Work associated with blasting shall be performed in accordance with the following general sequence:

1. Complete and submit pre-blast survey and other pre-blast documentation;
2. Notify all appropriate authorities having jurisdiction of proposed activities;
3. Prepare site for blasting;
4. Notify affected utility owners, operators and nearby residents as required in Part 3 - Execution;
5. Complete test blast program simultaneously with seismic monitoring;
6. Complete production blasting work simultaneously with seismic monitoring;
7. Complete and submit post-blast survey.

1.8 MAINTENANCE

A. Any and all damage caused by the Blasting operations shall be repaired or replaced to the property Owner's and Construction Management Team's satisfaction at the expense of the Blasting Specialty Contractor within thirty (30) days of completion of the Post-Blast Survey.

PART 2 - PRODUCTS (Not Applicable)

2.1 GENERAL

A. No perchlorates shall be acceptable in any blasting products. All caps, charges and other applicable blasting materials shall be perchlorate-free.

B. Materials: All materials such as explosives, detonators, fuses, tamping materials, and other accessories proposed to be used by the Contractor, shall be approved for use by the Construction Management Team.

1. All electric detonators used in the blast shall be of the same electrical sensitivity and be produced/procured from the same manufacturer.

2. The detonators used shall be capable of giving effective blasting of the explosives. Damaged explosive material shall be destroyed by a responsible person as per manufacturer's instructions, or returned to the manufacturer.

3. No explosive materials shall be abandoned.

4. All blasting materials and testing equipment shall be regularly tested for correct performance. The intervals between tests shall be decided based on manufacturer recommendations, but shall always be carried out if the blast materials and/or test equipment have been subjected to abnormal conditions or following any misfires. Guidelines / recommendations of the manufacturer shall be strictly adhered to.

5. Materials shall be stored in accordance with an approved material storage plan.

PART 3 - EXECUTION

3.1 PREPARATION

A. All personnel working on-site shall be instructed as to the nature, times, duration, site safety and warning signals concerning blasting operations.

B. In each Town, a public information hearing shall be conducted a minimum of one month prior to the commencement of blasting activities.

C. Date/time restrictions noted in applicable Contract Documents (e.g. MOU's) shall be strictly followed by the Contractor.

D. Local residents within the Pre-Blast Survey area shall be notified at least one week in advance, then again at 24 hours prior to initial blasting operations and provided with the name and phone number of one full-time, on-site contact person designated by the Contractor for handling all complaints and inquiries. Residents shall be notified of blast schedule and changes on at least a weekly basis throughout the duration of blasting operations. Residents shall also be informed of warning signals identifying an upcoming blast and all-clear signals following completion of a blast as outlined in Site Safety Plan.

E. Blasting contractor shall coordinate with, and obtain approval from, the Construction Management Team and utility authorities in the vicinity of the blasting operations having jurisdiction - this includes overhead powerline/cable utilities.

F. Explosives and blasting caps shall not be brought onto the site or used without appropriate permits, licenses, certificates and/or prior written approval of authorities having jurisdiction. The Specialty Contractor is solely responsible for handling, storage, and use of explosive materials in accordance with regulatory and permit requirements.

3.2 ROCK REMOVAL

A. Remove rock as indicated by the Drawings and as necessary for the installation of the Work. Provide sufficient clearance, within the limits specified, for the proper execution of the Work.

B. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:

1. 24 inches outside of concrete forms other than at footings.
2. 12 inches outside of concrete forms at footings.
3. 6 inches outside of minimum required dimensions of concrete cast against grade.
4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
5. 6 inches beneath bottom of concrete slabs on grade.
6. 6 inches beneath pipe in trenches, and 12 inches on each side of the pipe in trenches.

C. Fill areas of over-excavated rock to the proposed subgrade elevations as required by Drawings with selected fill in accordance with Section "Trenching and Backfilling" or Section "Earth Moving". Over-excavation beneath foundations shall be filled with footing concrete (f^1 = 3000 psi minimum). This will be completed at no additional cost to the Owner.

D. A test blast shall be performed and monitored prior to commencement of production blasting. Test blast records and seismic records shall be reported to the Construction Management Team prior to continuation of blasting. If test blast indicates that the blasting plan requires modification, such changes shall be reported to the Construction Management Team immediately. Reporting this information to the Construction Management Team shall not relieve the Contractor(s) of complete responsibility for the successful performance of the method(s) used, nor shall the reporting constitute approval by the Construction Management Team for the proposed plans.

E. The Seismic Specialty Contractor shall monitor the vibrations and sound levels caused by Blasting.

F. Seismic monitoring shall be performed for each blast, unless specified otherwise. Monitoring shall be performed at the nearest structure or at locations designated by the Construction Management Team on each field day.

G. If the ground vibrations exceed specified tolerances the Blasting Specialty Contractor's operations shall cease immediately and remain stopped until the Blasting Specialty Contractor has taken all necessary additional measures to protect adjacent property and personnel.

H. The Blasting Specialty Contractor shall use steel or rubber blasting mats as necessary to control fly-rock. Blasting mats shall be connected to adjacent mats prior to blasting.

3.3 EXCAVATION TOLERANCES

A. Blast hole drilling and overblast beyond the vertical limits indicated shall be less than 2.5 feet.

B. Rock removal limits shall include all materials defined as rock whether removal is accomplished by mechanical means (ripping, etc.) or by drilling and blasting.

3.4 VIBRATION AND SOUND TOLERANCES

A. Blast vibrations shall be maintained within safe limits as defined by the Peak Particle Velocity (in./sec.) vs. Blast Frequency (Hz) as described in the United States Bureau of Mines Publication RI-8507, Appendix B ("Siskind Curve").

B. Sound levels shall not exceed 130dB at the nearest structure.

C. Vibrations levels at new concrete structures shall be limited to the following levels:

Age of Concrete (days)	Maximum Allowable PPV
Less than 3	No blasting
3 to 7	1.0 in./sec
Greater than 7	2.0 in./sec.

END OF SECTION

SECTION 312333 - TRENCHING, PIPE LAYING AND BACKFILLING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the excavation of trenching, pipe laying, backfilling, compacting, dewatering, excavation support and disposal, as shown on the Contract Drawings, and as herein specified.

B. The Construction Management Team will determine the suitability of materials that are to be used in the work and should any materials encountered be unsatisfactory for the purpose intended, they shall be removed from the site at the Contractor's expense.

1.2 QUALITY ASSURANCE

A. Reference Standards:

1. The latest edition of the following standards, as referenced herein, shall be applicable.

a. "Standard Specifications for Highway Materials and Methods of Sampling and Testing, American Association of State Highway and Transportation Officials (AASHTO)."

b. American Society for Testing and Materials (ASTM).

c. Vermont Agency of Transportation (VTrans) Standard Specifications

B. The Contractor shall comply with the requirements for soil erosion and sedimentation control and other requirements of governmental authorities having jurisdiction, including the State.

C. The Owner shall provide and pay for all costs in connection with an approved independent testing facility to determine conformance of soils and aggregate with the specifications, in accordance with Section "Quality Requirements."

1.3 SUBMITTALS

A. The Contractor shall submit certified gradation curves and moisture-density compaction results for each imported material. If multiple sources are utilized, information shall be submitted from each individual supplier.

B. Pipe support systems: Contractor shall submit method of pipe support system(s) to be utilized, including details on how supports will be installed.

C. Contractor shall submit details/designs for all shoring and trench boxes for excavations that exceed 20’ in depth. Details and designs shall be sealed by a registered Vermont Professional Engineer.

1.4 PROJECT REQUIREMENTS

A. Call Dig Safe at 811 before starting any excavation or verify that a Dig Safe ticket exists and is valid for the area. Contractor shall maintain Dig Safe marks and follow all Dig Safe laws. Contractor is responsible for contacting and complying with municipal and private utilities that are not members of Dig Safe. Excavate with care to avoid damage to structures and utilities - excavations shall be completed by hand if necessary. Promptly report any damages to utilities to Utility Owner and Construction Management Team, do not attempt repairs without the Utility Owners consent.

B. Notify the Construction Management Team and Owner of any unexpected subsurface condition.

C. Protect excavations by shoring, bracing, sheet piling, or by other methods, as required to ensure the stability of the excavation. Comply with VOSHA/OSHA requirements.

D. Underpin or otherwise support structures and improved surfaces adjacent to the excavation which may be damaged by the excavation. This includes service lines and existing utilities.

E. Contractor is responsible for protection of Existing Utilities:

1. Specifically, Contractor shall use extreme protection around existing 10-inch transmission main in the vicinity of the Colchester Tie-in Site. This is the primary feed for the Burlington area. Owner will locate/flag the line prior to Contractor beginning work in this area. Contractor shall take all measures necessary to protect this existing transmission main during construction. The Owner must be present for any work or excavation around the existing 10-inch transmission main.

2. Contractor will notify Owner before excavating around, or crossing, any existing natural gas distribution lines. Owner will determine if Owner should be present during any work.

3. Locate existing underground and above ground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations. Comply with OSHA requirements.

4. If necessary, coordinate interruption and/or termination of utilities with the utility companies and the Owner.

5. Provide a minimum of seven days notice to the Owner and receive written notice to proceed before interrupting any utility.

F. Demolish and completely remove from the site any existing underground utilities designated to be removed, as shown on the Drawings or as specified.

G. Repair any damaged utilities as acceptable to the Owner, Construction Management Team, and utility companies at no additional cost to the Owner.

H. Contractor shall comply with maintenance and protection requirements as approved by the authority having jurisdiction.

I. Protection of Persons and Property:

1. Barricade open excavations occurring as part of this work and post with warning lights, if required or comply with any applicable permits.

2. Operate warning lights as recommended by authorities having jurisdiction.

3. Protect structures, utilities, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by construction operations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Select Backfill/Pipe Padding:

1. ***On-site material: The use of on-site native material for select backfill/pipe padding shall be approved and inspected by the Construction Management Team. Native material shall not contain any stones that are larger than 1.5" in the longest dimension, or that contain sharp/angular pieces that may impact pipe coating integrity. Native material that consists of fractured/processed rock that has been blasted or mechanically removed cannot be utilized as select backfill material due to the angularity of the material, unless used in conjunction with Tuff-N-Nuff 11 mm Rockshield installed per the manufacturer's recommendations. A shaker bucket or screen may be used if native material is too large, given that the characteristics of the material are suitable for successful shaker bucket or screen use.***

2. Borrow Material: If native material is not acceptable, as determined by the Construction Management Team, a sand material shall be imported to the site meeting the following criteria. Alternate select backfill/pipe padding materials may be submitted by the Contractor for review and approval from Construction Management Team.

Sieve	**Percent Passing**
1-1/2"	100
½"	70 - 100
No. 4	60-100
No. 100	0-20

B. General Backfill: Native materials containing no stones or clods larger than ***6***" in the longest dimension are acceptable. If native material is not acceptable, as determined by the Construction Management Team, bank run gravel fill shall be imported to the site meeting the following criteria. General backfill area will be limited to the trench, or a maximum of 12-inches laterally from each side of the pipe. Alternative general backfill materials may be submitted by the Contractor for review and approval from Construction Management Team.

Sieve	**Percent Passing**
6"	100
No. 4	20 - 60
No. 100	0 -12
No. 200	0 - 6

PART 3 - EXECUTION

3.1 PRECONSTRUCTION MATERIAL QUALIFICATION TESTING

A. General:

1. Sufficient size samples shall be obtained from the potential borrow source to allow completion of tests listed in paragraph B below. Samples may be obtained from test borings, test pits, or from borrow pit faces provided that surficial dry or wet soil is removed to expose undisturbed earth. Tests listed below shall be performed on each sample obtained. A minimum of three (3) representative samples from each potential borrow source shall be furnished to the testing laboratory for prequalification testing.

B. Material Tests:

1. Particle Size Analysis:

a. Method: ASTM D422

b. Number of Tests: One (1) per sample; three (3) per potential source.

c. Acceptance Criteria: Gradation within specified limits.

2. Maximum Density Determination:

a. Method: ASTM D1557 - Modified Proctor

b. Number of Tests: One (1) per sample; three (3) per potential source.

3. Re-establish gradation and maximum density of fill material if source is changed during construction.

3.2 PREPARATION

A. Establish required lines, levels, contours and datum.

B. Maintain benchmarks and other elevation control points; re-establish if disturbed or destroyed, at no additional cost to the Owner.

C. Establish location and extent of existing utilities prior to commencement of excavation.

3.3 EXCAVATION

A. All excavation shall be made to such depth/width as required to provide suitable room for laying pipe and for sheeting, shoring, pumping and draining as necessary, and for removing peat, silt, or any other deleterious materials which the Construction Management Team may deem unsuitable. Hand trench excavation may be required to protect existing utilities and structures.

B. Trench excavation for pipes shall be made by open cut to accommodate the pipe or structure at the depths indicated on the Contract Drawings. Excavation shall be made to such a depth and to the width indicated on the Contract Drawings so as to allow a minimum of six (6) inches of select backfill / padding to be placed beneath and on the sides of all pipes installed unless otherwise specified on the drawings. A minimum of twelve (12) inches of select backfill/padding shall be placed above all pipes installed.

C. The bottom of the trench shall be accurately graded to provide a uniform layer of padding/bedding material, as required, for each section of pipe. Trim and shape trench bottoms and leave free of irregularities, lumps, and projections.

D. Stockpile excavated subsoil for reuse where directed or approved.

E. Over excavation/under cut: If, in the opinion of the Construction Management Team, existing material below the trench grade is unsuitable for properly placing select backfill/padding material and laying pipe, the Contractor shall excavate and remove the unsuitable material and replace the same with an approved select backfill/padding material properly compacted.

F. Stability of Excavation: Slope sides of excavations shall comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavation in safe condition until completion of backfilling.

G. Removal of materials beyond the indicated elevations, without authorization by the Construction Management Team, shall be classified as unauthorized excavation and shall be performed at no additional cost to the Owner.

H. If a trench excavation crosses a road, sidewalk, bike path, driveway, or other transportation facility, the Contractor shall arrange temporary facilities for ingress/egress of all pedestrians and vehicles. One lane of traffic shall be maintained at all times – refer to VTrans/Local permits for additional construction conditions and traffic management details.

3.4 DEWATERING

A. The Contractor shall remove all water from the excavation promptly and continuously throughout the progress of the work and shall keep the excavation dry at all times until the work is completed and excavation is backfilled or have sufficient weight to resist uplift pressures. Groundwater levels shall be depressed to a minimum of 2 feet below excavation subgrade. No pipe or structure is to be laid in water and water shall not be allowed to rise on or flow over any pipe or structure until such time as approved by the Construction Management Team.

B. Provide a suitable point of discharge from dewatering operations shall be conveyed in a non erosive manner satisfactory to the EPSC Specialist and Construction Management Team and all applicable environmental permit regulations.

C. Precautions shall be taken to protect uncompleted work from flooding during storms or from other causes. All pipe lines not stable against uplift during construction or prior to completion shall be thoroughly braced or otherwise protected to the satisfaction of the Construction Management Team.

3.5 BEDDING AND BACKFILLING

A. Contractor shall take all necessary precautions to ensure that backfill materials are kept free of all skids, stumps, welding rods, cans, bottles, trash and other deleterious debris.

B. Pipe supports may be installed in all locations prior to backfilling as an alternative to continuous pipe bedding for the entire width of the trench. However, areas around pipe shall still be padded with select backfill as shown on the contract drawings and explained in paragraph 3.3.b. above. Stacked sandbags, pipe pillows, or owner approved equal are acceptable methods. Spacing shall be per manufacturer recommendations, if a commercial product, or 15' maximum separation if sandbags.

C. Trench breakers shall be installed per construction plan details prior to backfilling operations begin.

D. All pipe trenches backfill (select backfill/padding, general backfill, subbase) shall be thoroughly compacted by mechanical means as follows:

1. Typical Cross-country areas: Thoroughly compacted by mechanical means to avoid any future trench settlement. ***Use of excavator buckets and equipment tracks is acceptable for compaction in these areas only.***

2. VELCO corridor: All backfill in pipe trenches in the VELCO corridor shall be compacted to a minimum of 90 percent of modified Proctor maximum dry density by installing 12-inch (maximum) loose lifts.

3. Existing and Proposed Road Areas (unpaved and paved): All backfill in pipe trenches in, or directly adjacent to (with 10' of edge of road surfaces – existing or proposed) road surfaces, shall be compacted to a minimum of 95 percent of modified Proctor maximum dry density. Backfill materials shall be placed with water content within plus or minus 3 percent of optimum moisture content per the modified Proctor method (ASTM D1557). Any water used for compaction shall be provided by the Contractor at their own expense. The Contractor is responsible for the repair of any trench settlement at no expense to the Owner for the period of one year after substantial completion of the project.

E. Provide uniform bearing and support for pipe in all locations, except where necessary to excavate for connections, tie-ins, and other required appurtenances. Dig no deeper, longer, or wider than needed to make the joint connection properly.

F. The bedding/padding material shall be placed to the full width of trench. The bedding material shall be placed evenly along the bottom of the trench to provide proper support of the pipe to the elevation shown on the Contract Drawings or directed by the Construction Management Team. . The backfill shall be placed on both sides of the pipe at the same time and to approximately the same elevation. Any pipe that is damaged or moved out of alignment, regardless of cause, shall be replaced or realigned at the Contractor's expense. Bedding/padding shall be thoroughly compacted by hand-tamping or mechanical means being careful not to damage the pipe. When the bedding/padding reaches one (1) foot over the top of the pipe, the entire surface shall be compacted by mechanical means.

3.6 PIPE STRINGING & LAYING

A. Pipe shall be installed per the depth, alignment, and coating type shown on the project design plans. Depth of cover shall be measured from top of pipe to finished/final grade (after site restoration). ***Horizontal tolerance for final location of installed pipe compared to design plans/survey layout shall be +/- 1.0'. Minimum depth of cover shall be strictly adhered to (no vertical tolerance for less cover than noted on plans).***

B. Stringing

1. No pipe shall be strung before the trench is excavated to full depth and accepted by the Owner to meet the requirements of this specification. Pipe shall not be placed directly on the ground, but on wooden skids with proper protective padding. The skids and protective padding material shall be subject to Construction Management Team approval. Dragging, skidding or dropping the pipe is not permitted. Wooden wedges shall be used to prevent movement of each strung pipe.

2. Where possible the skid elevations shall be planned such that minor differences between grade profile and bottom of trench profile (e.g. at locations where an increased trench depth is required) can be accommodated without an additional tie-in. The distance between the trench edge and the pipe string shall be planned such that safe working space is provided. Contractor shall follow applicable OSHA/VOSHA regulations.

3. Contractor shall be responsible for proper stringing and locating of the pipe by coating type.

4. Contractor shall string the pipe in such a manner so as to cause no interference with public roads, sidewalks, or bike paths. Suitable gaps shall be left at intervals as necessary to permit the passage of livestock and/or equipment across the right-of-way and as directed by the Construction Management Team.

5. Contractor shall layout and measure the pipes such that the number of pieces required to be cut-off with less than 5 feet in length is kept to a minimum.

6. Pipe shall be strung with the use of a spreader bar and two guide lines.

C. Bending - Contractor shall make all necessary field pipe bends required in construction of the pipeline. The Contractor shall be responsible for determining the degree of the field bend necessary where a change in direction is necessary.

1. All bending shall be completed using the cold smooth method using a bending machine, approved by the Construction Management Team. Wrinkle bends will not be acceptable. Welded longitudinal pipe seams shall be right angles (neutral axis) to the direction of the bend. The Contractor shall use an internal bending mandrel to achieve smooth and undistorted bends. Padded bending shoes are required for coated pipe. Heating the pipe for bending purposes is not allowable. Prior to beginning work, Contractor shall submit and demonstrate their bending procedure, which shall conform to the recommendations of the manufacture of the bending machine. This procedure shall be approved by the Construction Management Team prior to beginning work.

2. For field cold bends, the longitudinal axis shall not be deflected more than 1-1/2 degrees in any length along the pipe access equal to the diameter of the pipe. The maximum diametrical reduction in a pipe bend shall not exceed 2-1/2% of the nominal pipe diameter. There shall be no deviation from the above requirements without prior written approval from the Construction Management Team. Individual approvals shall be obtained for each application.

3. The distance between centerline of bending points shall be such that there will be no distortion of the pipe or of the bend previously made and in no event shall be closer than seven (7) feet to the end of the joint of the pipe. When pipe is double jointed before bending, the bend shall not be closer than three (3) feet to the butt (girth) weld.

4. Bends shall not be straightened under any circumstances.

5. Pipe that is buckled, wrinkled, flattened, egged or gouged, as determined by the Construction Management Team, by bending operations shall be cut out and replaced at the sole expense of the Contractor. Hammering, the use of jacks, or other mechanical machinery to repair bucked or deformed pipe is prohibited. A buckle shall be defined as any anomaly in the contour of a bend which, when measured with a six (6) inch metal straight edge oriented on the longitudinal axis, yields a depression or void beneath the straight edge equal to, or greater than, 0.06”.

6. For pipe line-up, the pipe shall be placed on skids with sufficient clearance between the bottom of the pipe and ground to accommodate the finishing weld. Pipe shall be handled in a manner to prevent damage to the pipe walls and shall be placed over or parallel to the ditch in such manner that when the pipe is lowered, the bends will rest in the ditch at the proper location. In the laying of the pipe other than seamless pipe, the longitudinal seams shall be offset by 20 degrees on adjoining pipes in the top 120 degrees of the pipe and welded sections shall be assembled and lowered into the trench so that the longitudinal seams will remain on the top 120 degrees of the pipe as laid. Exceptions shall be weld seams on side bends, which shall be located on top of the pipe, and weld seams on sag bends and over bends, which shall be located on either side of the pipe as laid.

7. Contractor shall make all necessary bends required for proper construction of the pipeline, following a trigonometric survey to establish the number and degree of bends required, to ensure that the installed pipe conforms to the contours of the excavated trench.

D. Welding – Refer to Specification 137000

E. Coating Weld Joints and Fittings – Refer to Specification 138000

F. Lowering – Prior to lowering the pipe into the trench, the Contractor shall ensure that all water, debris, skids, rocks, welding rods and other foreign or deleterious material is removed from the trench. During lowering operations coated pipe shall be handled by use of adequately spaced lowering belts or cradles, as determined to be acceptable by the Construction Management Team, but shall be a maximum of 250'. At a minimum, belts shall be equal to the outside diameter of the pipe and shall be made of material that is free of protrusions that may cause damage to the protective coating. Roller cradles shall have nylon/neoprene roller wheels. The pipe shall be lowered into the trench in a manner that will allow proportional distribution of the total weight of the pipeline to all of the lifting points to prevent undue stress or strain on the pipe and to prevent damage to the pipe coating. The pipe shall not be dropped or subjected to jarring or impact. At water crossings or any other locations which may require pulling or dragging of the pipe into place, the coated pipe shall be properly protected from damage using wood lagging or rollers. ~~Welded pipe strings shall be lowered-in within 96 hours of completion of joint coating.~~

G. Holiday Inspection – Holiday inspection ("jeeping") shall be performed on all pipe and fittings with an electronic holiday detector, supplied by the Contractor and operated in such a manner to audibly and visually detect the presence of all holidays in the coatings. Jeeping shall be completed twice (minimum) – once when on skids adjacent to trench, and again as it is lowered into the ditch. Additional jeeping may be required as determined by the Construction Management Team. Refer to Coatings, Specification 138000 for additional jeeping requirements.

H. Rock Shield – Contractor shall furnish and install Tuff N Nuff 11 mm rockshield, or Construction Management Team approved equal, on the pipeline in areas of rock trench or as otherwise directed by Construction Management Team or utility inspector.

I. Trench Breakers – Trench breakers shall be installed as defined on the project design drawings.

J. Electrolysis Test Leads – Locations for test leads are determined on the project design drawings and shall be connected prior to backfilling operations – follow Cathodic Protection Details for installation. If an electrical continuity test fails after backfilling operations, Contractor shall excavate and replace test lead at no cost to the Owner. All test lead cables shall be continuous with without splices.

K. Drainage Tile Repair – Tiles within the limit of disturbance that are damaged shall be repaired by the Contractor.

1. The replacement tile shall be installed to the gradient and alignment of the previous tile. Tile shall be supported at trench crossings as necessary in order for the tile to maintain the gradient/alignment during backfilling operations.

2. Replacement tile materials shall be new. Reusing excavated existing drain tile is not acceptable.

3. Drain tile couplings shall be utilized to splice in new drain tile. Couplings shall be installed per the manufacturer's recommendations.

4. During backfilling operations, soil adjacent to and under tiles shall be compacted to eliminate future settlement.

5. In areas where the tile alignment is parallel and directly adjacent to the pipeline alignment, the tile will be moved/offset to the side of the pipeline alignment.

6. Tile and pipeline separation shall be a minimum of 12-inches.

7. Conditions in construction line list regarding existing and future tile locations shall be adhered to by the Contractor.

8. If directed by Construction Management Team, both existing and replacement tiles shall be inspected to ensure that tiles are not plugged, crushed, mis-aligned, or otherwise damaged. If damage is found, tile shall be repaired at no cost to the Owner.

L. Warning Tape – Contractor shall install Owner provided pipeline warning tape as indicated on project design drawings.

M. Pipeline Markers – After completion of backfilling operations, Contractor shall install Owner supplied pipeline markers as directed by Construction Management Team.

3.7 BACKFILLING AROUND STRUCTURES

A. The Contractor shall not place backfill against any structure without obtaining the approval of the Construction Management Team. No dumping shall be allowed where materials would flow against or around such structures. Backfill material shall be deposited in horizontal layers not exceeding 6 inches in loose thickness or as shown on the Contract Drawings and thoroughly compacted by hand or by mechanical means to the satisfaction of the Construction Management Team.

3.8 SUSPENSION OF WORK

A. Whenever the work is suspended, excavations shall be protected and the roadways, if any, left unobstructed. Within or adjacent to private property, material shall be stored at such locations as will not unduly interfere with traffic of any nature and in no case shall materials be stored in locations which will cause damage to existing improvements.

3.9 DISPOSAL OF MATERIAL

A. Excess and unsuitable materials shall be legally disposed of by the Contractor off site at the Contractor's expense unless otherwise approved by the Owner.

3.10 FIELD QUALITY CONTROL

A. Notify the Construction Management Team at least three (3) working days in advance of all phases of excavation and backfilling operations. The contractor shall not conduct backfilling operations unless the Construction Management Team is present for inspections. Backfilling operations shall commence as soon as possible after the pipe has been lowered into trench. The amount of lowered pipe that is not backfilled shall be kept at a minimum at all times. Contractor shall not backfill trench until the Owner's as-built survey crew has completed their necessary tasks.

B. In-place density testing at road crossings and VELCO corridor shall be performed to ascertain the compacted density of the fill and backfill materials in accordance with the following methods:

1. In-place relative density:

a. Method: AASHTO T238, Nuclear Method

C. Perform initial density testing to verify that contractors proposed compaction effort will obtain the minimum required densities.

D. In-place density tests on trench backfills shall be provided as follows:

1. Open-cut road crossings: One test per lift and at least once daily.
2. Cross-country areas: Visual only – subject to Construction Management Team approval.
3. VELCO corridor: Minimum of one every 500 cubic yards of fill, and not exceeding every 2 feet vertically, or once daily.

E. The Construction Management Team may direct additional tests to establish gradation, maximum density, and in-place density as required by working conditions.

F. Acceptance Criteria: The criteria for acceptability of in-place fill shall be both visual and in-situ dry density and moisture content. If a test fails to qualify, the fill shall be further compacted and re-tested/inspected. Subsequent test failures shall be followed by removal and replacement of the material, at no cost to the Owner. Minimum compaction of backfill materials noted in Section 3.5.D of this specification.

END OF SECTION

SECTION 312500 - EROSION PREVENTION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section covers work necessary for erosion prevention and sediment control (EPSC) during and after construction and land disturbing activities. The work shall include the furnishing of all labor, materials, tools, and equipment to perform the work and services necessary as herein specified and as indicated on the Drawings. This shall include installation, maintenance, and final removal of all temporary EPSC measures. All EPSC measures and devices used shall conform to the latest requirements imposed by federal, state and local authorities.

B. Comply with applicable environmental permits for stormwater discharges from construction activities and the EPSC Plans (or Drawings) prepared for the project.

C. Comply with the latest version of the Vermont Agency of Natural Resources, Department of Environmental Conservation construction-phase stormwater discharge guidelines.

D. The minimum areas requiring EPSC measures are indicated on the Drawings. The right is reserved to modify the use, location, and quantities of EPSC measures based on activities of the Contractor and as the Construction Management Team and/or On-Site Plan Coordinator (OSPC) and/or EPSC Specialist considers to be the best interest of the Owner.

E. The Contractor shall be responsible for repair of any damage caused and shall be financially responsible for any penalties imposed.

1.2 QUALITY ASSURANCE

A. EPSC measures shall be implemented in accordance with the requirements and procedures outlined in this specification, contract Drawings and documents, state standards or guidelines for EPSC, and all regulatory authorities having jurisdiction. Where conflicts between requirements exist, the more restrictive/stringent rules shall govern.

B. The Contractor shall provide all temporary EPSC measures shown on the Drawings, or as directed by the Owner, Owner's representative, OSPC or EPSC Specialist for the duration of the contract. EPSC Drawings are intended to be a guide to address the stages of work shown. Additional measures not specified on the Drawings may be necessary and shall be implemented to address intermediary stages of work and any conditions that may develop during construction at no cost to the Owner.

C. Temporary EPSC provisions shall be coordinated with permanent EPSC measures to the extent practical to assure economical, effective and continuous EPSC throughout the construction and post-construction period.

D. EPSC measures shall at all times be satisfactory to the Owner's Representative or EPSC Specialist. Owner's Representative or EPSC Specialist will inform the Contractor of unsatisfactory construction procedures and operations if observed. If the unsatisfactory construction procedures and operations are not responded to and corrected within 48 hours, the Owner's Representative or EPSC Specialist may suspend the performance of any or all other construction until the unsatisfactory condition has been corrected. Such suspension shall not be the basis of any claim by the Contractor for additional compensation nor for an extension of time to complete the work. Any complaints, fines, etc. relating to ineffective EPSC measures, shall be the sole responsibility of the Contractor.

E. The Contractor shall inspect all EPSC measures at least at the beginning and end of each day to ascertain that all devices are functioning properly during construction and as soon as possible during or immediately after a precipitation event (e.g., rainfall or snowmelt). Maintenance of all EPSC measures on the project site shall be the responsibility of the Contractor until final stabilization is complete (>70% uniform grass cover), and until the permanent soil erosion controls are established and in proper working condition. 70% cover shall be determined by the EPSC Specialist and/or the Vermont Department of Environmental Conservation.

F. The Contractor shall protect adjacent properties and watercourses from soil erosion and sediment damage throughout construction.

1.3 GENERAL

A. EPSC measures consist of the following elements:

1. Maintenance of existing permanent or temporary storm drainage piping and channel systems, as necessary.

2. Installation and maintenance of stabilized construction entrances/exits.

3. Construction of temporary storm drainage piping and channel systems, as necessary.

4. Installation of temporary EPSC measures such as silt fences, check dams, and other methods indicated on the EPSC Plans.

5. Topsoil and Seeding: Placement and maintenance of Temporary Seeding on all areas disturbed by construction. Placement of permanent topsoil, fertilizer, and seed, etc., in all areas not occupied by structures or pavement, unless shown otherwise. Topsoil, seeding, mulching and fertilizing shall be in accordance with project environmental permits and EPSC Plans.

B. The Contractor shall be responsible for phasing Work in areas allocated for his exclusive use during this Project, including any proposed stockpile areas, to restrict sediment transport. This will include installation of any temporary EPSC devices, ditches, or other facilities.

C. The areas set aside for the Contractor's use during the Project may be temporarily developed to provide satisfactory working, staging, and administrative areas for his exclusive use. Preparation of these areas shall be in accordance with other requirements contained within these Specifications and shall he done in a manner to both control all sediment transport away from the area in a contained and stabilized manner with installation of EPSC measures.

D. All permanent stockpiles shall be seeded with soil stabilization seed and protected by construction of silt fences completely surrounding stockpiles and located within 10 feet of' the toes of the stockpile slopes.

E. Sediment transport and erosion from working stockpiles shall be controlled and restricted from moving beyond the immediate stockpile area by construction of temporary toe-of-slope ditches and accompanying silt fences as necessary. The Contractor shall keep these temporary facilities in operational condition by regular cleaning, re-grading, and maintenance.

F. The Contractor shall maintain all elements of the EPSC Plans and EPSC facilities to be constructed during this Project for the duration of his activities on this Project.

G. Formal inspections made jointly by the Contractor and the Construction Management Team, Owner's representative, OSPC, and/or EPSC Specialist shall be conducted at intervals specified in the applicable environmental permits.

H. Replacement or repair of failed or overloaded EPSC measures e.g., silt fences, check dams, or other temporary erosion control devices shall be accomplished by the Contractor as soon as possible and no later than 24 hours after receiving written notice from the EPSC Specialist or the Owner's representative.

I. If the Contractor has not complied with any of the above maintenance efforts to the satisfaction of the Construction Management Team within 2 working days after receiving written notification from the Construction Management Team, the Owner shall have the prerogative of engaging others to perform any needed maintenance or cleanup, including removal of accumulated sediment at constructed erosion control facilities, and deduct from the Contractor's monthly partial payment the costs for such efforts in accordance with the General Condition of the Contract.

1.4 SUBMITTALS

A. Submittals shall he made in accordance with Section "Submittal Procedures"

B. Material Certificates signed by material producer and Contractor, certifying that each material item complies with or exceeds specified requirements.

C. Results of all tests and investigations, including recommendations.

D. Submit product data, samples, specifications and manufacturer's installation procedures for approval as directed by Construction Management Team prior to use.

PART 2 - PRODUCTS

2.1 GENERAL

A. Contractor shall provide all materials necessary to perform the work as shown on the Drawings, required by environmental permits, or specified herein.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall comply with and implement the EPSC requirements provided in the contract documents.

B. Review the EPSC Plans as they apply to current conditions. Minor deviations from the Drawings must be submitted for approval to the Construction Management Team at least 72 hours prior to commencing that work. Some deviations may require Vermont Agency of Natural Resources to review and approve and may take additional time.

C. Initial EPSC devices shall be in place prior to any land disturbing activity, in their proper sequence, and maintained until permanent protection is established. The only acceptable activities prior to EPSC measures installed are surveying/layout and clearing. Clearing contractors and crews shall follow the "Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont", 10th Printing, 2009.

D. The limit of the area of any earthwork operations in progress shall be commensurate with the Contractor's capability and progress in keeping the finished grading, mulching, seeding, and other such permanent EPSC measures current and in accordance with the accepted schedule for construction phasing. Should seasonal limitations make such coordination unrealistic, as determined by the Owner's Representative, temporary EPSC measures shall be provided immediately by the Contractor at no expense of the Owner.

E. Temporary EPSC measures shall be used to correct conditions which develop during construction that are needed prior to installation of permanent control features, or that are temporarily needed to prevent erosion and control sediment that develops during normal construction practices, but are not associated with permanent control features on the project.

F. The Contractor shall incorporate all permanent EPSC measures (e.g., stabilization) into the project at the earliest practical time to minimize the need for temporary controls.

G. A stabilized construction entrance/exit (SCE) shall be installed and maintained at any point where construction vehicles enter/exit a public right-to-way, street or parking area. The SCE shall be used to eliminate mud from the construction area onto public right-of-way. The SCE shall be constructed as shown on the Drawings. Any mud or debris tracked on streets shall be cleaned up immediately.

H. All existing storm drainage outlets must be stabilized prior to construction activities. Equip all inlets with inlet protection immediately upon construction.

I. Discharge from dewatering operations for the excavated areas shall remain within the Project right-of-way unless otherwise approved by the EPSC Specialist. Discharge from dewatering operations shall not be directed to surface waters without first properly removing the suspended sediment through filtration and/or settlement to turbidity levels that are below 25 NTU. The Contractor shall obtain any required permits associated with dewatering activities.

J. Silt fence shall be installed at locations, or as noted, on the Drawings and any additional locations necessary for proper sediment control. The Contractor shall maintain the silt fence until the project is stabilized.

K. EPSC measures shall include but not be limited to the approved measures on the Project Drawings. The Contractor shall be responsible for providing all additional measures that may be necessary to accomplish the intent of the Drawings.

L. Comply with all other requirements of authorities having jurisdiction.

END OF SECTION

SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes, but is not limited to, the following:

1. Shoring and bracing necessary to protect existing buildings, streets, walkways, utilities, and other improvements and excavation against loss of ground or caving embankments.

2. Maintenance of shoring and bracing.

3. Removal of shoring and bracing, as required.

B. The purpose of this work is to insure the safety of workmen and the public exposed to the hazard of falling or sliding material. It shall be the Contractor's responsibility to provide protection adequate for this purpose. Details of this sheeting must conform with the requirements of Title 29 Code of Federal Regulations, Part 1926, Safety and Health Regulations for Construction (OSHA). The Engineer shall reserve the right to increase the minimum requirements set forth therein, depending on the hazard.

1.2 PERFORMANCE REQUIREMENTS

A. Design**,** furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.

1. Delegated Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

2. Prevent surface water from entering excavations by grading, dikes, or other means.

3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.

4. Monitor vibrations, settlements, and movements.

1.3 SUBMITTALS

A. Delegated-Design Submittal: For excavation support and protection system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer, registered in the State where the work will be completed, responsible for their preparation.

B. Layout drawings for excavation support system and other data prepared by, or under the supervision of, a qualified professional engineer.

C. System design and calculations must be acceptable to local authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Engineer Qualifications: A professional engineer legally authorized to practice in jurisdiction where Project is located, and experienced in providing successful engineering services for excavation support systems similar in extent required for this Project.

B. Regulations: Comply with codes and ordinances of governing authorities having jurisdiction.

1.5 PROJECT CONDITIONS

A. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from the data

1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.

2. The geotechnical report is included elsewhere in the Project Manual.

B. Before starting work, verify governing dimensions and elevations. Verify condition of adjoining properties. Take photographs or video tape to record any existing settlement or cracking of structures, pavements, and other improvements. Prepare a list of such damages, verified by dated photographs or video tape, and signed by Contractor and others conducting investigation.

C. During excavation, resurvey benchmarks weekly, maintaining accurate log of surveyed elevations for comparison with original elevations. Promptly notify Construction Management Team if changes in elevations occur or if cracks, sags, or other damage is evident.

D. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Engineer if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

1.6 EXISTING UTILITIES

A. Call Dig Safe at 811 before starting any excavation or verify that a Dig Safe ticket exists and is valid for the area. Contractor shall maintain Dig Safe marks and follow all Dig Safe laws. Contractor is responsible for contacting and complying with municipal and private utilities that are not members of Dig Safe. Excavate with care to avoid damage to structures and utilities - excavations shall be completed by hand if necessary. Promptly report any damages to utilities to Utility Owner and Construction Management Team, do not attempt repairs without the Utility Owners consent.

B. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Construction Management Team and Owner no fewer than three working days in advance of proposed interruption of utility.

2. Do not proceed with interruption of utility without Construction Management Team's and Owner's written permission

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL

A. In general, this item will be required wherever an excavation exceeds five feet in depth and the side slopes are not laid back to a safe gradient as set forth in Title 29 Code of Federal Requirements, Part 1926, Safety and Health Regulations for Construction (OSHA).

B. Wherever shoring is required, locate the system to clear permanent construction and to permit forming and finishing of concrete surfaces. Provide shoring system adequately anchored and braced to resist earth and hydrostatic pressures.

3.2 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.

1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlaying construction and abandon remainder.

2. Fill voids immediately with approved backfill compacted to density specified in Section "Earth Moving" or “Trenching and Backfilling”.

3. Repair or replace, as approved by Construction Management Team adjacent work damaged or displaced by removing excavation support and protection systems.

END OF SECTION

SECTION 321116 - SUBBASE COURSES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes provisions for prepared subbase courses under pavements.

B. Proof rolling of subgrade for pavements is included in this Section.

C. Replacement of unsuitable subgrade materials is included in another Section.

D. Final grading of pavement subbase is specified in this Section.

1.2 REFERENCES

A. Vermont Agency of Transportation, Standard Specifications for Construction

B. "Standard Specifications for Highway Materials and Methods of Sampling and Testing, American Association of State Highway and Transportation Officials (AASHTO)."

C. "American Society for Testing and Materials (ASTM)."

1.3 SUBMITTALS

A. Source Quality Control Test Reports: Submit test reports directly to Construction Management Team from the testing agency with copy to Contractor.

B. Field Testing Reports: Submit results of field testing directly to Construction Management Team with copy to Contractor. Reference testing location to plan, and cross-reference to all retesting required to accept installed subbase material.

1. Note action taken next to all sub-standard test results.

1.4 QUALITY ASSURANCE

A. Testing Laboratory Qualifications: To qualify for acceptance, the soil testing laboratory must demonstrate to Construction Management Team's satisfaction, based on evaluation of laboratory-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct the required testing without delaying the progress of the Work.

B. Field Testing and Inspection Service: Owner shall retain the services of the same independent soil testing laboratory used for source qualification testing to provide soil testing during pavement subbase installation.

PART 2 - PRODUCTS

2.1 SOURCE QUALIFICATION TESTING

A. Contractor shall employ and pay for a qualified independent soil testing laboratory to perform soil testing services for source qualification.

1. Obtain a 100-pound minimum representative sample from each potential aggregate source. Obtain samples for each different material gradation known to exist in the pit. Mix each sample thoroughly in accordance with AASHTO T87, and submit to the testing laboratory for reduction to specimen size. The laboratory shall perform the following tests in the order shown. Each material shall pass all tests in order to qualify.

a. Particle Size Analysis:

Method:	ASTM D422
Number of Tests:	Two (2) per potential source.
Acceptance Criteria:	Gradation within specified limits.

b. Maximum Density Determination:

Method:	ASTM D1557 Modified Proctor
Number of Tests:	Two (2) per potential source.

Re-establish subbase material properties if source is changed during construction.

2.2 MATERIALS

A. Materials for subbase specified on project plans per VTrans Construction Specifications Section 704.04.

PART 3 - EXECUTION

3.1 PREPARATION

A. Establish required lines, levels, contours, and datum.

B. Maintain benchmarks and other elevation control points. Re-establish, if disturbed or destroyed, at no additional cost to Owner.

C. Proof-roll existing subgrade to the satisfaction of the Construction Management Team. Should the subbase course become unstable at any time prior to the placement of the overlying course(s), correct the unstable condition to the satisfaction of the Construction Management Team. Replace unstable or weak subgrade materials with suitable material as provided in the Specifications.

3.2 INSTALLATION

A. Place subbase material in uniform horizontal layers, with a maximum compacted thickness of 12 inches.

B. Place subbase in a manner to avoid segregation. Uncontrolled spreading shall not be permitted.

3.3 COMPACTION

A. Where subbase courses must be moisture-conditioned before compaction, uniformly apply water to the surface. Prevent free water from appearing on the surface during or subsequent to compaction operations.

B. Compact all portions of each layer to a density not less than 95 percent of the maximum dry density based on modified proctor.

C. Final tolerances for the top surface of the subbase course requires that the surface does not extend more than ¼ inch above nor more than ¼ inch below the specified grade at any location.

3.4 TRAFFIC ON SUBBASE

A. The movement of vehicular traffic over the final surface of the subbase may be permitted at locations designated by, and under such restrictions as ordered by the Construction Management Team, provided such movements take place prior to the final finishing of this course to the specified tolerance. The movement of construction equipment on this course may be permitted, at locations designated by and under such restrictions as ordered by the Construction Management Team at locations where permission is granted for such movement, the temporary surface of the course upon which the construction traffic is running, shall be placed and maintained for at least 2 inches above the final surface of this course. Just prior to paving, and after all construction traffic not required for the removal has ceased, remove the 2 inch protective layer, prepare the exposed surface of the course, and compact to the specified tolerance.

B. Should the subbase become mixed with the subgrade or any other material, through any cause whatsoever, remove such mixture and replace it with the specified subbase material.

3.5 FIELD QUALITY CONTROL

A. Notify the Construction Management Team at least three (3) working day in advance of all phases of subbase installation.

B. Comply with the requirements of this Section for in-place relative density testing.

1. In-place relative density:

Method:	AASHTO T238, Nuclear Method
Number of Tests:	One (1) per specified interval.
Acceptance Criteria:	± Two (2) percent of specified percent compactions.

2. Compaction tests shall be provided for each road crossing area. A minimum of one for each lift is required.

3. The Construction Management Team may direct additional tests to establish gradation, maximum density, and in-place density as required by working conditions.

4. Acceptance Criteria: The sole criterion for acceptability of in-place subbase shall be in situ dry density. Minimum dry density for all subbase shall be 95 percent of the maximum dry density. If a test fails to qualify, the fill shall be further compacted and re-tested. Subsequent test failures shall be followed by removal and replacement of the material.

END OF SECTION

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes provisions for hot-mixed asphalt concrete paving over prepared subbase.

B. This section includes provisions for replacing pavement removed during the course of the Work, or damaged resulting from Contractor's operations.

1.2 REFERENCES

A. Vermont Agency of Transportation, 2011 Standard Specifications for Construction

B. "Standard Specifications for Highway Materials and Methods of Sampling and Testing, American Association of State Highway and Transportation Officials (AASHTO)."

C. "American Society For Testing and Materials (ASTM)."

1.3 SUBMITTALS

A. Material Certificates signed by material producer and Contractor, certifying that each material item complies with or exceeds specified requirements.

B. Field Test Reports: Submit results of field testing directly to the Construction Management Team.

1.4 SITE CONDITIONS

A. Weather Limitations: VTrans Standard 406.04 shall apply.

B. Grade Control: Establish and maintain required lines and elevations.

C. In no instance shall the materials and thicknesses of pavement and subbase courses replaced be less than that removed, unless approved by the Construction Management Team.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate the placement of asphalt concrete pavement with the completion of underground work by other trades.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Asphalt concrete and all related items shall meet the requirements of VTrans Division 400.

B. Performance Graded Binder: PG 58-28**,** VTrans Specification 406

C. Base Course: VTrans Specification 406, Type I

D. Binder Course: VTrans Specification 406, Type II

E. Top Course: VTrans Specification 406, Type IV

F. Tack Coat: Emulsified asphalt shall meet VTrans 702.04

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. General: Remove loose material from compacted subbase surface immediately before commencing paving operations.

B. Proof-roll prepared subbase surface with a ten-ton static, steel-wheel roller to check for unstable areas and areas requiring additional compaction, witnessed by the Construction Management Team at least forty-eight (48) hours prior to scheduled paving operations. If there is precipitation after proof-rolling and prior to pavement installation, contractor shall conduct an additional proof-roll at no additional cost to the Owner.

C. Do not begin paving work until deficient subbase areas have been corrected and are ready to receive paving.

D. Herbicide Treatment: Apply chemical weed control agent in strict compliance with manufacturer's recommended dosages and application instructions. Apply to compacted, dry subbase.

E. Sawcut edges of existing pavement to achieve straight line transitions between old and new pavement. Make a second sawcut through the top course of existing pavement, 18 inches from the first cut to provide a staggered joint.

F. Tack Coat: Apply to contact surfaces of previously constructed asphalt or Portland cement concrete and surfaces abutting or projecting into asphalt concrete pavement. Distribute at rate of 0.03 to 0.07 gallons per square yard of surface.

G. Allow to dry until at proper condition to receive paving.

H. Exercise care in applying bituminous materials to avoid smearing of adjoining surfaces. Remove and clean damaged surfaces.

I. Do not commence pavement replacement operations until all buried work beneath pavement repair has been completed to the satisfaction of the Construction Management Team.

J. Where trench dimensions preclude the use of proof rolling equipment, demonstrate the stability of the subgrade and subbase through other means, as acceptable to the Construction Management Team.

3.2 PLACING AND COMPACTING MIX

A. General: Place and compact asphalt pavement courses in accordance with VTrans Division 400**,** unless otherwise specified.

B. Place inaccessible and small areas by hand, and compact with hot hand tampers or vibrating plate compactors.

C. Chamfer edges of walks at 45° angle where walks do not abut curb.

D. Joints: Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density, and smoothness as other sections of asphalt concrete course. Clean contact surfaces and apply tack coat.

E. Place tack coat between successive courses. Apply tack coat at a rate of 0.03 to 0.07 gallons per square yard of surface.

F. Compaction: Compact asphalt pavement courses with a static steel wheel roller only, unless otherwise approved by the Construction Management Team, based upon work conditions.

G. Remove and patch areas of any asphalt concrete course deemed unsatisfactory by the Construction Management Team, at the Contractor's expense. Remove hardened or set asphalt by saw cutting and/or scarifying.

H. Adhere to VTrans compaction requirements. This, however, shall not relieve the Contractor of his responsibility to provide a well densified pavement. It shall be the Contractor's obligation to recognize difficulties in compacting the mix, and to make appropriate corrections.

I. Roll and compact the asphalt concrete course until the finished surface is free from depressions, waves or other defects that would prevent proper drainage. The finished surface shall be uniform in texture and appearance.

J. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled to 140 degrees F and hardened. The use of water to cool pavement is not permitted.

3.3 FIELD QUALITY CONTROL

A. General: Testing in-place asphalt concrete courses for compliance with requirements for thickness and surface smoothness will be done by Owner's testing laboratory. Repair or remove and replace unacceptable paving as directed by Construction Management Team.

B. Thickness: In-place compacted thickness tested in accordance with ASTM D 3549 will not be acceptable if exceeding following allowable variations:

1. Base Course: Plus or minus 1/2 inch.

2. Binder and Surface Course: Plus or minus 1/4 inch.

3. Cumulative Thickness Tolerances: Plus or minus 1/4 inch for nominal cumulative thicknesses less than or equal to 4 inches. Plus or minus 1/2 inch for nominal cumulative thicknesses greater than 4 inches.

C. Surface Smoothness: Test finished surface of each asphalt concrete course for smoothness, using 10-foot straightedge applied parallel with and at right angles to centerline of paved area. Surfaces will not be acceptable if exceeding the following tolerances for smoothness:

1. Base and Binder Course Surfaces: 1/4 inch.

2. Wearing Course Surface: 3/16 inch.

3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

D. Check surface areas at intervals as directed by Construction Management Team.

E. Scuff Resistance: If, in the opinion of the Construction Management Team, the pavement does not demonstrate reasonable resistance to deformation by punching loads and scuffing under horizontally applied shearing loads, after the pavement has cooled and hardened, the Construction Management Team may require laboratory testing of cored pavement samples to determine the properties of the pavement; including aggregate gradation, asphalt content, air void ratio, density and any others deemed appropriate. If laboratory testing indicates that any parameters substantially deviate from the design mix tolerances specified by VTrans, replace the affected areas of pavement at no additional cost, and reimburse the Owner for all costs incurred in procurement and testing of cores.

END OF SECTION

SECTION 321500 - CRUSHED STONE/GRAVEL SURFACING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the placement of crushed stone and gravel surface courses.

B. Place crushed stone and gravel in conformance with the lines, grades, thicknesses and typical sections as shown or detailed on the Drawings.

1.2 REFERENCES

A. "Standard Specifications for Highway Materials and Methods of Sampling and Testing, American Association of State Highway and Transportation Officials (AASHTO)."

B. "American Society for Testing and Materials (ASTM)."

C. Vermont Agency of Transportation, Standard Specifications for Construction

1.3 SUBMITTALS

A. Test Reports:

1. The Contractor shall submit written and certified test reports from the quarry regarding the gradation and moisture-density curves of the proposed products.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Bank Run Gravel Subbase Course: Material shall meet VTrans Specification 704.04, or approved equal.

B. Surface Course: Material shall meet VTrans Specification 704.12, or approved equal.

C. It shall be the Contractor's responsibility to provide a material which meets this specification and is within his capabilities to fine grade to the required tolerances. Should the subbase course become unstable at any time prior to the placement of the overlying course due to the gradation of the material furnished, the Contractor shall, at their expense, correct the unstable condition to the satisfaction of the Engineer.

D. All material shall meet the specified gradation prior to placement. All processing shall be completed at the source.

PART 3 - EXECUTION

3.1 PREPARATION

A. Establish required lines, levels, contours, and datum.

B. Maintain benchmarks and other elevation control points. Re-establish, if disturbed or destroyed at no additional cost to the Owner.

C. Place subbase only after subgrade has been proof-rolled and approved by the Construction Management Team. Unstable or weak subgrade materials shall be replaced with suitable material at the Contractor's expense.

3.2 PLACING

A. All subbase material shall be placed in uniform horizontal layers with a maximum compacted thickness of 12 inches.

B. Place the subbase in a manner to avoid segregation.

3.3 COMPACTION

A. Where subbase courses must be moisture-conditioned before compaction, uniformly apply water to the surface. Prevent free water from appearing on the surface during, or subsequent to, compaction operations.

B. All portions of each layer shall be compacted to a density not less than 95 percent of the maximum dry density.

C. After compaction, the top surface of the subbase course shall not extend more than 1 inch above nor more than 1 inch below the specified grade at any location.

3.4 TRAFFIC ON SUBBASE

A. The movement of traffic over the final surface of the subbase may be permitted at locations designated by, and under such restrictions as ordered by the Construction Management Team, provided such movements take place prior to the final finishing of this course to the specified tolerance. The movement of construction equipment on this course may be permitted, at locations designated by and under such restrictions, as ordered by the Construction Management Team. At locations where permission is granted for such movement, the temporary surface of the course, upon which the construction traffic is running, shall be placed and maintained at least 2 inches above the final surface of the course. Just prior to paving and after all construction traffic, not required for the removal, has ceased, the 2 inch protective layer shall be removed, and the exposed surface of the course prepared and compacted to the specified tolerance.

B. Should the subbase become mixed with the subgrade or any other material, through any cause whatsoever, the Contractor shall, at their expense, remove such mixture and replace it with the appropriate subbase material.

3.5 FIELD QUALITY CONTROL

A. Notify the Construction Management Team at least three (3) working days in advance of all phases of filling and backfilling operations.

B. Compaction testing shall be performed to ascertain the compacted dry density of the fill and backfill materials. Compaction testing shall be paid for by the Owner and coordinated by the Construction Management Team.

C. If deemed necessary by the Construction Management Team, compaction testing shall be conducted for each lift of fill at each site.

D. The Construction Management Team may direct additional tests to establish gradation, maximum density, and in-place density as required by working conditions. If the test results show that the installed material does not meet the specification, the Contractor shall remedy at their expense.

E. Acceptance Criteria: Minimum dry density for all subbase materials shall be 95 percent of the maximum dry density based on the modified proctor. If a test fails to qualify, the fill shall be further compacted and re-tested. Subsequent test failures shall be followed by removal and replacement of the material.

END OF SECTION