

**SECTION 015136 - TEMPORARY WATER****PART 1.00 - GENERAL**

## 1.01 WORK INCLUDED

- A. All labor, materials and equipment for furnishing, installing and removing temporary water mains, services and fittings where new construction prohibits continuity of water service.
- B. Flushing and disinfection.

## 1.02 REFERENCE STANDARDS

Information and requirements contained in this Specification are based on the most recent version of the following standards:

- A. AWWA Standard C901 for Polyethylene (PE) Pressure Pipe and Tubing, ½-inch through 3-inch.
- B. AWWA Standard C651 for Disinfecting Water Mains.

## 1.03 SUBMITTALS

- A. (Not Used)

## 1.04 QUALITY ASSURANCE

- A. The Contractor shall be thoroughly trained and experienced in the skills and equipment required for installation of these items.
- B. The Contractor shall protect materials before, during and after installation. In the event of damage, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.
- C. Upon direction of the Engineer, the Contractor shall remove, replace and/or rework all items that do not meet the requirements of this section. The Contractor shall perform all remedial measures at no additional cost to the Owner.

**PART 2.00 - PRODUCTS**

## 2.01 WATER PIPING

- A. Temporary water main and services shall be Class 200 (CL200) polyethylene (PE) tubing meeting the reference standard.
- B. All tubing shall be new and clean.
- C. Temporary pipe shall be adequately sized to provide a minimum of 20 psi at all service connections under peak demand conditions.

## 2.02 FITTINGS

- A. Contractor shall provide all necessary fittings, adapters and couplings for connecting existing water mains, temporary water mains, temporary water services and each existing building service.
- B. All fittings shall be clean and new.

## 2.03 VALVES

- A. Each temporary service shall be installed with a PVC ball valve.

- B. Pressure reducing valves (PRV) shall be installed on each temporary water main and set so that the water pressure at the foundation wall of each customer being supplied from the temporary water system does not exceed 80 psi.

### **PART 3.00 - EXECUTION**

#### **3.01 GENERAL**

- A. In certain cases, it may be possible to make connections to the buildings through outside hose bibs or other above-grade connection. In other cases, this will not be possible, and other methods shall be used.
- B. Work associated with locating connection points, furnishing materials and installing mains, services and other branches, shall be the responsibility of the Contractor.
- C. Contractor shall install exterior hose bibs and modify plumbing as necessary to connect temporary water services. If existing hose bibs are vacuum breaker or backflow prevention type, the Contractor shall replace with standard hose bibs allowing supply of the plumbing system. Following construction, the hose bibs shall be restored to the original type, as necessary.

#### **3.02 NOTIFICATION**

- A. At least seven (7) days prior to beginning water line replacement work, the Contractor shall notify the Owner and Fire Department to allow preparation of fire protection measures and issuance of a boil water notice.
- B. Contractor shall provide the personnel to deliver a written notice to all water customers regarding any disruption in service related to the installation and removal of bypass and temporary service pipe. Notices shall be delivered forty-eight (48) hours in advance of work.

#### **3.03 PRODUCT STORAGE AND HANDLING**

- A. Handle and transport materials to insure they are in sound, undamaged condition and to prevent damage, in accordance with manufacturer's instructions.
- B. Examine all materials before installing. Defective or damaged materials shall be rejected.
- C. If defective or damaged materials are discovered after installation, the Contractor shall remove and replace the defective piece(s) at no additional cost to the Owner.

#### **3.04 INSTALLATION**

- A. Temporary service pipe shall be laid at the back edges of sidewalks or road shoulders.
- B. Install adequate thrust restraints as necessary.
- C. At driveways, pipe crossings shall be adequately protected. At street crossings, pipe shall be laid in shallow trench and covered with temporary surfacing.
- D. Care shall be exercised to avoid contamination of mains, house services, or the temporary service pipe.

#### **3.05 FLUSHING**

- A. All temporary water piping shall be flushed prior to disinfection at a minimum velocity of 2.5 feet per second. Care shall be taken to protect property from erosion or other damage during flushing operations. The Contractor shall make any necessary repairs to damaged property.

- B. No leaks shall be allowed.

### 3.06 DISINFECTION

- A. Disinfection of piping is required prior to being placed in service.
- B. Temporary water mains and services shall be dosed with chlorine, fed at a constant rate, such that the entire volume of water will have a concentration of not less than 25 mg/l free chlorine. Chlorine levels shall be confirmed by the Contractor with a field test kit.
- C. Disinfection operations shall not cease until the entire main is filled with heavily chlorinated water.
- D. The chlorinated water shall be retained for a minimum of 24 hours, during which all valves in the treated section shall be operated to ensure disinfection of appurtenances. The water in all portions of the main shall have a minimum residual of 10 mg/l of free chlorine after 24 hours.
- E. The Contractor shall prevent the introduction of heavily chlorinated water into any active portions of the water distribution system.
- F. At the end of the 24 hour period, the main shall be flushed with water from the distribution system until the discharge chlorine concentration is equal to that of the system or 1mg/l free chlorine.
- G. Flush service lines so that heavily chlorinated water does not enter the house service.
- H. The Contractor shall comply with all laws relevant to the discharge of chlorinated water. Water discharged directly or indirectly to water bodies shall not have a chlorine level greater than 0.1 ppm. Water bodies shall include all rivers, streams, creeks, brooks, reservoirs, ponds, lakes, springs, wetlands, and any body of surface water, artificial or natural.
- I. The Contractor shall supply all necessary dechlorination equipment, materials, chemicals and labor necessary to reduce the chlorine level prior to discharge.
- J. Any required permits for the discharge of chlorinated water (local or State), are the responsibility of the Contractor.

### 3.07 OPERATION

- A. The Contractor shall not activate the temporary service piping until after successful completion of the flushing and disinfection operations.
- B. The Contractor shall maintain the temporary water service piping throughout the course of the work. Any necessary repairs or leaks shall be immediately attended to.

### 3.08 REMOVAL

- A. The Contractor shall disconnect and remove all materials following successful completion and initiation of service of the permanent water system.
- B. The work area shall be returned to better than preconstruction conditions.

## END OF SECTION 015136

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**SECTION 015600 – PROTECTION AND REPAIR OF PROPERTY****PART 1.00 - GENERAL**

## 1.01 WORK INCLUDED

- A. All labor, materials, equipment and services necessary for protection and repair of property, as shown or specified.

## 1.02 REFERENCE STANDARDS

- A. (Not Used)

## 1.03 SUBMITTALS

- A. (Not Used)

## 1.04 QUALITY ASSURANCE

- A. (Not Used)

**PART 2.00 - PRODUCTS**

## 2.01 MATERIALS

- A. (Not Used)

**PART 3.00 - EXECUTION**

## 3.01 NOTIFICATION

- A. For the location of existing underground utilities, the following notifications shall be made by the Contractor prior to start of construction:
  - 1. "Dig Safe": 1-888-344-7233.
  - 2. Other utilities not contracted with "Dig Safe" may include, but are not limited to, local water, wastewater and stormwater authorities.
  - 3. Municipality owned utilities.
- B. The Contractor is responsible for location of all utilities, including primary and secondary services.
- C. For planned interruption of existing wastewater or water services, written notification shall be given to the Owner forty-eight (48) hours prior to the interruption.

## 3.02 PROTECTION AND REPAIR OF PROPERTY

- A. Protection, restoration and repair of property shall be included in the Contract price at no additional cost to the Owner.
- B. Contractor shall conduct the Work so as to interfere as little as possible with private business and public travel. The Contractor shall, at no additional cost to the Owner, wherever necessary or required, maintain fences, install shoring, provide security personnel, maintain barriers and post danger signs warning against hazards created by the construction Work. The Contractor shall also take such other precautions as may be necessary to protect life and property and shall be responsible for all damages

- occasioned in any way by any act or neglect or that of the Contractor's agents, employees, or workers.
- C. The Contractor shall be fully responsible and shall take all necessary precautions to protect all personnel, property, structures, buildings, trees, shrubs, plantings, gardens, fences, signs, guy wires, lawns, buried and overhead utilities, pipes, culverts, roads, streets, driveways, curbs, swales, rip-rap, sidewalks, paths, utility poles, light poles, property markers, mailboxes, manholes and covers, catch basins and grates, retaining walls, guideposts/rails and other features.
  - D. If gravel, silt or other debris caused by the Contractor's operation is deposited into existing facilities, structures, pipes or other site features, the sediment shall be thoroughly removed and the item completely cleaned, at no additional cost to the Owner.
  - E. If damage is caused to facilities or equipment, it shall be repaired or replaced at no additional cost to the Owner.
  - F. Items removed for construction shall be replaced in their original locations, unless directed otherwise by the Engineer, at no additional cost to the Owner.
  - G. Items not specified elsewhere in these Specifications that have been damaged during or removed for construction, shall be replaced "in kind".
  - H. All hazardous materials shall be stored and disposed of in accordance with Federal, State, or local codes, laws, ordinance or regulations.

### 3.03 PROTECTION AND REPAIR OF SURVEY AND BOUNDARY MARKERS

- A. Temporary benchmarks, control points and reference points shall be maintained and preserved throughout construction. If disturbed or destroyed, they shall be reestablished by the Contractor, at no additional cost to the Owner.
- B. Boundary markers, pins, pipes or monuments shall be protected and preserved throughout construction. If disturbed or destroyed, they shall be reestablished by a Licensed Land Surveyor hired by the Contractor, at no additional cost to the Owner.

### 3.04 TREE AND SHRUB PROTECTION

- A. Any tree or shrub which will not, in the opinion of the Engineer, hinder construction or landscaping, shall be preserved and protected.
- B. The Contractor shall construct a temporary barricade at the dripline of any trees or shrubs designated to be preserved and as indicated on the drawings, to prevent damage to any portion of the tree or shrub. The Contractor shall take special care in setting barricade posts to not damage tree or shrub roots.
- C. The Contractor shall not permit stockpiling of material or debris within the barricaded area, nor permit the earth surface to be changed in any way.
- D. The Contractor shall use necessary care to protect the roots, trunks and branches of all trees or shrubs not designated to be removed.
- E. If necessary to avoid undermining a tree or shrub during construction, trees designated to remain shall be protected with temporary shoring or sheeting. All temporary shoring or sheeting shall be removed when no longer necessary.

**3.05 TRIMMING OF TREES OR SHRUBS TO REMAIN**

- A. If necessary to trim selected trees or shrubs to allow the construction, the Contractor shall use proper tools and skilled workmen to achieve neat severance of tree or shrub limbs with the least possible damage to the tree or shrub. Cut limbs shall be appropriately sealed.
- B. If necessary to trim roots of selected trees or shrubs to allow the construction, the Contractor shall apply wet burlap to prevent drying of the severed root. Cut roots shall be appropriately sealed.

**3.06 PROTECTION AND REPAIR OF UTILITIES**

- A. The Drawings do not depict all utilities or exact positions of all utilities that may exist on the site. The Drawings show approximate information regarding the location of known utilities. This information has been obtained from records, information provided by others, surface observation, and/or field measurements, but is not guaranteed to be entirely accurate or complete.
- B. The Contractor shall provide his own detection equipment for accurately locating buried utilities approximately shown on the Drawings. The Contractor shall locate underground utilities in the work area by probing and/or other means as required. No extra payment will be allowed to the Contractor for repair of utilities shown on the Drawings, or accurately marked in the field prior to damage of the utility.
- C. If utilities are to remain, the Contractor shall provide adequate means of protection during earthwork operations.
- D. Should unmapped piping or other utilities be encountered during excavation, the Contractor shall consult with the utility owner immediately for directions. The Contractor shall cooperate with utility companies in keeping respective service and facilities to the satisfaction of the utility owner.
- E. The Contractor shall not intentionally interrupt utilities unless permitted in writing by the utility owner, and then only after arranging to provide temporary utility service to necessary facilities or users.
- F. Utilities damaged during construction shall be repaired and/or replaced with equal or better quality material as directed by the impacted utility.
- G. Repairs shall be inspected by the impacted utility prior to being backfilled. Repair of utilities and inspection by the utility shall be included in the Contract price at no additional cost to the Owner.

**3.07 PROTECTION AND REPAIR OF UTILITY POLES AND OVERHEAD WIRES**

- A. The Contractor shall coordinate, arrange, schedule, receive permission, and pay for supporting and/or temporarily or permanently relocating utility poles and/or wires that may be impacted by the project, with the appropriate utility(s), at no additional cost to the Owner.

**3.08 REPAIR OF WASTEWATER AND STORMWATER PIPE**

- A. The Owner shall be notified immediately if a wastewater or stormwater pipe is damaged during construction.

- B. Wastewater or stormwater pipes damaged during construction shall be immediately repaired.
- C. Wastewater or stormwater pipes damaged during construction shall be replaced for a minimum distance of 2-feet beyond either side of the damage, with a section of same size and material pipe, at no additional cost to the Owner.
- D. Wastewater or stormwater pipes damaged during construction and crossing water pipes shall be repaired in accordance with the water/sewer crossing notes on the Drawings.
- E. Connections shall be made with approved couplings. Adequate pipe bedding and compaction is mandatory under pipe repairs to prevent settlement.
- F. Repair of wastewater and stormwater pipes shall bear on undisturbed soil.
- G. One wastewater and one water service shall be assumed for each residence/business or building, unless shown otherwise on the Drawings.

### 3.09 REPAIR OF WATER MAINS AND SERVICES

- A. The Contractor shall become familiar with the location of water valves and curb stops, prior to the start of work, to facilitate emergency shutdown and repairs.
- B. The Owner shall be notified immediately if a water main or service is damaged during construction.
- C. Water mains damaged during construction shall be immediately repaired or replaced for a minimum distance of two feet (2') beyond either side of the damage, with a section of same size and material pipe, with approved couplings, and at no additional cost to the Owner. Adequate pipe bedding and compaction is mandatory under pipe repairs to prevent settlement.
- D. Water services damaged during construction shall be immediately repaired or replaced for a minimum distance of two feet (2') beyond either side of the damage, with a section of same size Type K copper water pipe, with approved compression fittings, couplings and adapters, and at no additional cost to the Owner. Adequate pipe bedding and compaction is mandatory under pipe repairs to prevent settlement.
- E. One water service shall be assumed for each residence/business or building, unless shown otherwise on the Drawings.

### 3.10 REPAIR OF LAWNS, GRASSES AND OTHER PLANTINGS

- A. Lawns and other grass areas shall be restored as required in Specification Section 329200.
- B. Plantings or gardens damaged or destroyed during construction shall be replaced "in kind".

### 3.11 REPAIR OF CURB AND SIDEWALK

- A. Curb and sidewalk shall be restored as required in Specification Section 321600.
- B. Curb and sidewalk dimensions and type shall match existing, unless indicated otherwise on the drawings.



- 3.12 REPAIR OF BITUMINOUS CONCRETE SURFACES
- A. Bituminous concrete surfaces including roads, streets, driveways, paths and walks shall be restored as required in Specification Section 321200.
- 3.13 FENCE, MAILBOX AND SIGN REMOVAL AND RESETTING
- A. Fences, mailboxes and signs in the way of construction shall be removed and reset in their original locations after construction in the immediate area has been completed, or prior to the end of the work day, whichever is sooner.
- B. Mailboxes shall be reset in accordance with USPS regulations. Generally, mailboxes shall be set 42" to 48" from the bottom of the mailbox to the ground and 6" to 9" from the front face of the mailbox to the curb or edge of roadway. Mailboxes shall be reset to conform to USPS regulations, even if they did not conform prior to disturbance.
- C. Mailboxes may be permanently relocated if acceptable to the property owner, and meeting USPS regulations.
- D. Mailboxes may be permanently relocated if they present a pedestrian or vehicle hazard, as determine by the Owner, and meeting USPS regulations.
- E. Fences, mailboxes, posts and signs damaged during construction shall be replaced "in kind" at no additional cost to the Owner.
- 3.14 GUIDEPOSTS / RAILS REMOVAL AND RESETTING
- A. Guideposts/rails in the way of construction shall be removed and reset in their original locations after construction in the immediate area has been completed or prior to the end of the work day, whichever is sooner.
- B. Guideposts/rails damaged during construction shall be replaced "in kind" at no additional cost to the Owner.
- 3.15 REPAIR OF CULVERTS
- A. Culverts damaged during construction shall be immediately repaired or replaced with the same size and type of culvert.
- B. Connections shall be made with approved couplings for the size and type of pipe.
- C. Adequate pipe bedding and compaction is mandatory under pipe repairs to prevent settlement.
- 3.16 PROTECTION FROM WEATHER
- A. In the event of temporary suspension of the Project, or during inclement weather, the Contractor shall, and will cause his Subcontractors to, protect the Project, work and materials against damage or injury from the weather. If in the opinion of the Engineer, the Project, work or materials are damaged or injured by reason of failure on the part of the Contractor to protect the Project, work or materials, such damaged items shall be removed and replaced at the expense of the Contractor.
- B. Protection shall include all erosion prevention and sediment control measures necessary to maintain the site in compliance with State and Federal regulations and permits.

**END OF SECTION 015600**

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**SECTION 026113 – EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL****PART 1.00 - GENERAL**

## 1.01 WORK INCLUDED

- A. Qualified labor, materials, equipment, services, consultants, and specialists required to work in contaminated soils, including but not limited to, installing piping systems and related work.
- B. All necessary items required for work in areas determined to contain contaminated soils and groundwater, and for completing the handling, removal, treatment and disposal of contaminated soils and groundwater.

## 1.02 REFERENCE STANDARDS

Information and requirements contained in this Specification are based on the most recent version of the following standards:

- A. U.S. Department of Labor Occupational Safety & Health Administration (OSHA) Standards (29 CFR) for Hazardous Waste Operations and Emergency Response Regulation 1910.120, and related State of Vermont VOSHA regulations.
- B. Vermont Agency of Natural Resources (VTANR) "**Hazardous Waste Management Regulations**" (latest edition).
- C. Vermont Agency of Natural Resources (VTANR) Agency "**Guidelines for Petroleum Contaminated Soil and Debris**" (latest edition).
- D. Vermont Agency of Natural Resources (VTANR) Waste Management and Prevention Division (WMPD) "**Guidance for Construction of Public Works Project in Areas Where Contamination is Suspected or Known**" (latest edition).
- E. Vermont Agency of Natural Resources (VTANR) Waste Management and Prevention Division (WMPD), "**Investigation and Remediation of Contaminated Properties Procedure**", (latest edition).
- F. Vermont Agency of Natural Resources (VTANR) Waste Management and Prevention Division (WMPD), "**Procedures for Reimbursement from the Petroleum Cleanup Fund (PCF)**", (latest edition).
- G. Vermont Agency of Natural Resources (VTANR) Waste Management and Prevention Division (WMPD), "**Policy for Characterization and Disposal of Development Soils (Act 52)**", (latest edition).
- H. The State of Vermont documents noted above may be found at:  
<http://dec.vermont.gov/waste-management/contaminated-sites/guidance>

## 1.03 CONTAMINATED SOILS

- A. Contaminated Soils are those impacted by the presence of manmade chemicals in the natural soil environment typically resulting from industrial, agricultural, or commercial activity, or improper disposal of waste. The most common chemicals are petroleum hydrocarbons, polynuclear aromatic hydrocarbons, solvents, pesticides, lead, and other heavy metals.
- B. The most common type of soil contamination is petroleum contamination (ex. gasoline, diesel, fuel oil, kerosene), which may include visual sheens and oily appearance, dark-colored soil, and aromatic or pungent odors.
- C. Contaminated Soils requiring action under this specification are those exhibiting a volatile organic compound (VOC) concentration in excess of limits set by the State of Vermont, as defined in the Hazardous Waste Management Regulations (latest edition).

- D. Distinct zones of contaminated excavation shall be defined as those contaminated areas separated by more than five hundred feet of non-contaminated soils.

#### 1.04 SUBMITTALS

- A. The Contractor shall submit the name and qualifications of the Environmental and Safety Consultant (ESC) to be utilized for work outlined in this specification.
- B. The Contractor shall submit a project specific Health and Safety Plan (HASP), for the Owner's and Engineer's records.
- C. The Contractor shall submit a Management Plan and receive concurrence from WMPD prior to any work being performed in identified contaminated areas. The Contractor shall submit copies of WMPD concurrence/approvals of the Management Plan, for the Owner's and Engineer's records.
- D. The Contractor shall submit all Closure Documents and reports required by the State and Federal laws.
- E. The Contractor shall provide all applicable documentation necessary for the Owner's reimbursement request to WMPD's Petroleum Cleanup Fund (PCF).
- F. The Contractor shall submit manufacturer's certified data for each type of material substitution required due to the presence of contaminated soil, including: dimensions, specifications, and materials.

#### 1.05 QUALITY ASSURANCE

- A. The Contractor shall be thoroughly trained and experienced in the skills and equipment required for work in contaminated soils and groundwater.
- B. The Contractor shall hire an ESC which has documented direct experience with working with in the investigation and cleanup of contaminated properties, the VTANR PCE, and must be acceptable to WMPD.
- C. The ESC shall submit a Management Plan to the WMPD prior to starting work within areas identified as containing Contaminated Soils. The Management Plan shall be in accordance to WMPD guidance. The ESC shall be present on site during excavating, handling, and backfilling of contaminated soils to confirm the Contractor's compliance with the approved Plan.
- D. Upon direction of the Engineer, the Contractor shall remove, replace and/or rework all items that do not meet the requirements of this section. The Contractor shall perform all remedial measures at no additional cost to the Owner.

### **PART 2.00 - PRODUCTS**

#### 2.01 INITIAL SITE ASSESSMENT

- A. The Contractor's ESC shall complete an initial site assessment to determine the presence of contaminants within the zone of excavation, estimate the level of contamination utilizing a photoionization detector (PID), and estimate the quantity and extent of the zone of contamination within the excavation area. The Engineer shall be onsite during testing.
- B. The ESC shall provide an Initial Site Assessment to the Owner, Engineer, and WMPD for review and approval prior to proceeding with any subsequent phases of work.

#### 2.02 HEALTH AND SAFETY PLAN

- A. The Contractor shall develop a project specific Health and Safety Plan (HASP), should petroleum-based contamination be discovered. Contractor shall be aware of and

- abide by the recommendations of the HASP.
- B. The Health and Safety Plan shall be developed by a health and safety consultant or ESC retained by the Contractor. At a minimum, this plan shall encompass the following:
1. Screening of in-place soils for volatile organic compound (VOC) concentrations.
  2. Air quality monitoring within the breathing zone both above and within the pipe trench. Air quality data shall be reported to the Contractor's safety officer who shall direct the trench workers to take appropriate safety precautions.
  3. On-site training in the proper use of safety devices, equipment, and clothing required for work in contaminated soils. The HASP shall identify work methods, devices, equipment, clothing, and personnel necessary for the various work conditions indicated.
- C. Submission of a HASP does not relieve the Contractor from the safety obligations required as conditions of this Contract. Contractor has sole responsibility to maintain compliance with all OSHA/VOSHA/NIOSH standards for worker safety at all times.

### 2.03 MANAGEMENT PLAN

- A. The Contractor's ESC shall prepare a Management Plan (MP) for Contaminated Soils. The ESC's MP shall evaluate suspected contaminated soils, determine the level of contamination using a PID, visual, and olfactory senses, estimate the extent and volume of Contaminated Soils, identify the source(s) and pathways by which the contaminants are or could be conveyed to different environmental receptors, and determine how to properly handle the contaminated soils.
- B. As part of the MP, the ESC shall evaluate and present to WMPD, the Engineer, and the Owner the options for reuse of contaminated soils as onsite excavation backfill, and/or offsite treatment and disposal of contaminated soil not suitable for use as backfill.
1. For onsite use of contaminated soil for backfill, the ESC shall provide an evaluation of soils using PID, visual, and olfactory senses, and recommendations for its use. The evaluation shall be submitted to and approved by the WMPD.
  2. For offsite treatment/disposal, the offsite options are;
    - a. Disposal at an in-state, certified lined landfill (as waste or daily cover), following approval from the owner/operator of the landfill, the WMPD's Solid Waste Program, and the Sites Management Section (SMS). Approval to dispose of soils in-state must be granted by the SMS. The Contractor/ESC shall provide written proof that the soils were disposed of at such facilities, or
    - b. Disposal at an out-of-state approved asphalt batch or thermal desorption plant. Approval to dispose of soils out-of-state must be granted by the SMS. The Contractor/ESC shall provide written proof that the soils were disposed of at such facilities, or
    - c. Disposal at an out-of-state hazardous waste disposal facility. Approval to dispose of soils out-of-state must be granted by the SMS. The Contractor/ESC shall provide written proof that the soils were disposed of at such facilities.
- C. As part of the MP for Contaminated Soils, the Contractor's ESC shall evaluate the potential for encountering groundwater and develop a plan for sampling, handling, treatment, and disposal of contaminated groundwater. The evaluation shall be submitted to and approved by the SMS and WMPD.

## 2.04 END OF WORK SUMMARY REPORT

- A. The ESC shall prepare a Summary Report describing the degree and extent of contamination encountered, how contaminated soils and/or groundwater was handled and/or disposed of, sample results, worker protection levels used, and any other pertinent information. The evaluation shall be submitted to and approved by the WMPD.

## 2.05 PETROLEUM CLEAN-UP FUND REIMBURSEMENT DOCUMENTATION

- A. Prior to the start of work within the zone of contaminated soils, the ESC shall provide a preliminary cost estimate to the WMPD for eligibility review under the Petroleum Cleanup Fund (PCF) and WMPD's findings shall be reported to the Owner.
- B. The ESC shall submit claims, at the Owner's direction, for PCF reimbursable costs, on applicable forms and with supporting documentation, to the WMPD. Work shall be completed in conformance with WMPD's ***Procedures for Reimbursement from the Petroleum Cleanup Fund*** (latest edition).

## 2.06 PERSONNEL AND EQUIPMENT

- A. Contractor shall provide personnel appropriately equipped with personal protective equipment as necessary for the site conditions in accordance with OSHA Regulation 1910.120.
- B. Contractor shall supply all necessary safety devices, equipment, and clothing required for work in contaminated soils.
- C. Contractor shall hire an ESC to oversee operations within areas of contaminated soils. The Contractor's ESC shall have all the equipment and personnel necessary to assess the level of contamination encountered in the excavation in accordance with OSHA regulation 1910.120 and the VTANR WMPD guidance.
- D. Contractor shall supply trench ventilation equipment to provide air exchanges to the trench air necessary to meet air quality limits for safe working conditions.

## 2.07 MATERIAL SUBSTITUTIONS AND ADDITIONAL REQUIREMENTS

- A. If contaminated soils are encountered, the following material substitutions shall be made:
  - 1. Non-Ductile Iron Pipe shall be changed to Ductile Iron, meeting the appropriate piping specification unless otherwise required.
  - 2. Non-Copper Tubing shall be changed to Copper, meeting the appropriate piping specification unless otherwise required.
  - 3. Fluoroelastomer gaskets resistant to petrochemicals, and most chemicals and solvents shall be substituted for standard (butyl) gaskets for all pipe and fittings installed in petroleum contaminated soils. Fluoroelastomer gaskets shall be clearly labeled to differentiate them from standard gasket material.
  - 4. Manhole boots as well as other rubber or synthetic products adversely affected by installation in contaminated soils shall be replaced by similar items made of Nitrile or other products resistant to chemicals.
  - 5. Trench plugs shall be consist of Bentonite Clay installed at the limits of excavation in each area of contaminated earthwork. Bentonite trench plugs shall be the full trench width, one foot along the pipeline, one foot below the bottom of the regular trench and one foot above evidence of the seasonal high groundwater table.
- B. Material substitutions shall be submitted to the Design Engineer for review.

## 2.08 FEES AND PERMITS

- A. Contractor shall pay all fees and obtain all necessary permits associated with contaminated soil and water handling, removal, transport, treatment, and disposal.

## PART 3.00 - EXECUTION

### 3.01 NOTIFICATION

- A. Contractor shall stop excavation of soil and dewatering of site if olfactory, visual, or other indicators suggests that excavated soil or groundwater appears to be contaminated with petroleum or hazardous materials and notify the Engineer, and the Owner.
- B. Contractor shall promptly notify the WMPD, the Engineer, and the Owner, when contaminated soils are confirmed in locations within the project pay limits.

### 3.02 SEQUENCING

- A. Upon recognition/identification of the contaminated soils, the Contractor shall cease activities in the area and move operations to an unaffected portion of the project. Work in the contaminated area shall not continue until measures indicated in this Specification are implemented.
- B. The Contractor shall hire an Environmental and Safety Consultant(s) (ESC) to assess the environmental contamination and associated work safety conditions. These findings shall be provided to the WMPD, the Engineer and the Owner.
  - 1. The ESC shall complete an Initial Site Assessment to determine if the suspect soils are contaminated and provide evidence documenting contamination levels and type.
  - 2. The ESC shall prepare a project specific Health and Safety Plan, which defines the working conditions, and necessary oversight and monitor requirements for the Contractor's operations while working with contaminated soil and groundwater,
  - 3. The ESC shall prepare a project specific Contaminated Soils Management Plan and provide copies to the WMPD, the Engineer, and the Owner. Should the Contractor's ESC determine that Contaminated Groundwater will be encountered in volumes that are likely to require pumping and removal from the excavation, the ESC shall include a project specific dewatering plan.
- C. The WMPD, Project Engineer, and Owner shall review and approve the recommendations included in Management Plan, prior to the Contractor proceeding with work within contaminated areas.
- D. Upon approval of the Management Plan, the Contractor shall proceed with work in conformance with the HASP, Management Plan, and project documents. All work within contaminated areas shall be monitored by the Contractor's ESC and the Engineer.
- E. The Contractor's ESC shall prepare required reports and documentation as necessary for the reimbursement of expenses through the Vermont Petroleum Cleanup Fund program and submit all closure documents and reports to WMPD.

### 3.03 PROTECTION

- A. All work in and near contaminated soils shall be performed in strict accordance with

the project specific HASP, as well as OSHA and other safety guidelines regulating work in petroleum contaminated soils.

- B. Contractor has sole responsibility to maintain compliance with all OSHA/VOSHA standards for worker safety at all times.
- C. Contaminated Soils remaining on site shall be handled in compliance with the requirements of the Health and Safety Plan and the Management Plan.
- D. Contaminated Soils removed from the project site shall be loaded, transported, treated and disposed of in accordance with the Health and Safety Plan, the Management Plan, and all applicable environmental and safety regulations.

### 3.04 EXCAVATION

- A. The soil in the zone of excavation shall be tested by the ESC, using a photoionization device (PID) with bag headspace protocol or other approved screening methods. Soil that contains VOC concentrations less than ten parts per million (10 ppm) or have been permitted by the WMPD to be used as backfill shall be temporarily stockpiled for reuse as backfill, if the material meets the requirements for backfill indicated in Section 310000.
- B. Temporary stockpiles shall be in conformance with the requirements of the approved Management Plan and HASP.
- C. Excavated Contaminated Soils that may not be used as trench backfill shall be loaded and transported to the approved disposal/treatment area. The Contractor shall not temporarily stockpile Contaminated Soils that will not be used as backfill for future transport, without prior approval of the WMPD of the location, safety measures, and environmental protections to be implemented.

### 3.05 DEWATERING

- A. All efforts shall be made by the Contractor to contain groundwater within the trench by over excavation and use of stone bedding under the pipe. If groundwater is to be removed from the trench, the Contractor shall be responsible to remove, store and treat/dispose of contaminated groundwater in accordance with the recommendations of the ESC as approved by the WMPD and in conformance with applicable regulations.
- B. The Contractor's ESC shall monitor all contaminated groundwater handling, collecting, treatment and discharge.

### 3.06 REUSE OF CONTAMINATED SOILS

- A. Every effort shall be made to use contaminated soils as backfill at their location of excavation during construction as recommended in WMPD's ***Guidelines for Petroleum Contaminated Soil and Debris.***
  - 1. Soils with PID readings of 10 ppm or less may be backfilled subject to the recommendations of the ESC and approval of the SPS.
  - 2. Soils with PID readings greater than 10 ppm and less than 40 ppm shall be transported offsite for disposal of at a Certified Landfill subject to the recommendations of the ESC and approval of the SPS.
  - 3. Soils with PID readings greater than 40 ppm and less than 1,000 ppm shall be transported offsite for Thermal Treatment and Disposal subject to the recommendations of the ESC and approval of the SPS.
  - 4. Soils with PID readings greater than 1,000 ppm or soil saturated with free product subject to the recommendations of the ESC and approval of the SPS, may be accepted at a facility for Thermal Treatment and Disposal provided the



required laboratory analytical results are within the treatment facility's soil quality acceptance limits. Otherwise, the soils will be transported off-site for treatment and/or disposal as hazardous waste.

- B. Written approval of the Management Plan from WMPD is required prior to backfill or transport offsite.
- C. Regardless of material contamination, all backfill shall conform to the requirements of Section 310000 and Construction Details.
- D. The uppermost 18" of excavation shall be backfilled with uncontaminated material that meets the requirements for backfill indicated in Section 310000 and Construction Details.

### 3.07 OFFSITE DISPOSAL OF CONTAMINATED SOIL

- A. Contaminated Soils identified as not suitable for reuse as backfill shall be excavated, handled, and transported to an approved offsite disposal location as indicated in the approved Management Plan.
  - 1. Written documentation of contamination levels and treatment/disposal recommendations, consistent with the Management Plan shall be provided by the Contractor's ESC.
  - 2. Off-site Treatment and Disposal - Contaminated Soil identified for Treatment and Offsite Disposal shall be transported to the approved treatment and disposal location. The material shall be evaluated by the Contractor's ESC, prior to being shipped to its final approved location. Contractor shall provide disposal receipts documenting disposal location and material volume.
- B. The Contractor's ESC shall perform all necessary administrative and record keeping requirements in accordance with OSHA regulation 1910.120.
- C. The Contractor's ESC shall provide characterization and documentation in accordance with the WMPD's guidance documents, and all documentation necessary for reimbursement requests from the State of Vermont Petroleum Cleanup Fund (PCF).
- D. The Contractor's ESC shall prepare and submit all closure documents and summary reports required by State and Federal laws.

**END OF SECTION 026113**

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**SECTION 310000 - EARTHWORK****PART 1.00 - GENERAL**

## 1.01 WORK INCLUDED

- A. Excavating
- B. Pipe Bedding and Envelope
- C. Trenching
- D. Trench Backfilling
- E. Structure Bedding
- F. Structure Backfilling
- G. Filling
- H. Grading
- I. Subgrade preparation
- J. Geotextiles
- K. Embankments
- L. Subbase
- M. Base
- N. Compaction
- O. Dewatering
- P. This Section does NOT include Earthwork related to buildings, footings, foundations.

## 1.02 REFERENCE STANDARDS

- A. State of Vermont, Agency of Transportation (VTrans), "Standard Specifications for Construction", latest version.
- B. ASTM Standard Test Method D1557 for Laboratory Compaction Characteristics of Soil Using Modified Effort.
- C. ASTM Standard Test Method D2992 for Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth).
- D. AASHTO Test T96 for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- E. ASTM Standard Classification D2487 of Soils for Engineering Purposes (Unified Soil Classification System).
- F. AASHTO Standard M145 - Recommended Practice for Classification of Soils.
- G. State of Vermont, Agency of Natural Resources, Environmental Protection Rules-Chapter 1.
- H. ASTM Standard Test Method D 4632 for Grab Tensile Strength of Geotextiles.
- I. ASTM Standard Test Method D 3786 for Mullen Burst Strength of Geotextiles.
- J. ASTM Standard Test Method D 4533 for Trapezoidal Tear Strength of Geotextiles.
- K. ASTM Standard Test Method D 4833 for Puncture Strength of Geotextiles.
- L. ASTM Standard Test Method D 4355 for UV Deterioration of Geotextiles.
- M. ASTM Standard Test Method D 4751 for Apparent Opening Size of Geotextiles.
- N. ASTM Standard Test Method D 4491 for Flow Rate of Geotextiles.

## 1.03 SUBMITTALS

- A. The Contractor shall submit supplier's certified laboratory gradation curves and moisture-density compaction curves (modified proctor) for each imported material to be used on the project.
- B. The Contractor shall submit representative samples of each imported material to be

- used on the project, if requested by the Engineer.
- C. The Contractor shall submit certified laboratory gradation curves, moisture-density compaction curves (modified proctor) and ASTM D2487 Soil Classification or AASHTO M145 Soil Classification for each on-site material proposed for Fill or Backfill on the project.
  - D. The Contractor shall submit representative samples of each on-site material proposed for Fill or Backfill on the project, if requested by the Engineer.
  - E. The Contractor shall submit manufacturer's data for Subgrade Stabilization/Separation Fabric, Filter Fabric.

#### 1.04 QUALITY ASSURANCE

- A. The Contractor shall allow the Owner's testing agency to perform field quality control testing, including, but not limited to, in place compaction testing of Subgrade and each layer of Embankment, Subbase, Base, or Fill, at the discretion of the Engineer. The Contractor shall proceed with subsequent earthwork only after test results for previously completed work comply with requirements. Should any work not meet the testing requirements, all subsequent testing required by the Owner shall be paid for by the Contractor.
- B. When the testing agency reports that any area has not achieved the required level of compaction, the Contractor shall remove and replace, or uniformly moisten or scarify and aerate to obtain optimum moisture content, and then re-compact and retest until specified compaction is obtained. Reworking, replacement of material, re-compacting and retesting will be done at no additional expense to the Owner.
- C. Unless modified by the Engineer, compaction tests may be performed at the following frequencies:
  - 1. Pipe Bedding and Structure Bedding: one test for each 150 feet or less of trench length.
  - 2. Initial Backfill/Envelope: at least one test for each 150 feet or less of trench length.
  - 3. Trench or Structure Backfill: at least one test for each 150 feet or less of trench length and/or at least one test per vertical foot of trench depth.
  - 4. Subgrade: at least one test for every 2,000 square feet or less of Subgrade.
  - 5. Embankment, Subbase or Base: at least one test for every 2,000 square feet or less, and/or at least one test per vertical foot of depth.
  - 6. Gravel Roadway and Driveway, Gravel Shoulder, or Gravel Sidewalk: at least one test for every 2,000 square feet or less, and/or at least one test per vertical foot of depth.
  - 7. Fill: at least one test for every 2,000 square feet or less of Fill, and/or at least one test per vertical foot of depth.
- D. Do not place materials on surfaces that are muddy, frozen or contain frost or ice.
- E. Protect newly graded areas from traffic, freezing and erosion. Keep free of trash and debris.
- F. Repair and reestablish, to specified tolerances, areas where completed or partially completed surfaces become eroded, rutted, settled or where they lose compaction due to pumping, subsequent construction operations or weather conditions.
- G. Where settling occurs, the Contractor shall remove finished surface treatment, backfill with appropriate Base material, compact and replace surface treatment, all at no additional expense to the Owner. Restore appearance, quality and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to

- the greatest extent possible.
- H. The Contractor shall be thoroughly trained and experienced in the skills and equipment required for Earthwork.
  - I. The Contractor shall protect Earthwork materials and areas before, during and after installation. In the event of damage, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.
  - J. Upon direction of the Engineer, the Contractor shall remove and/or rework all areas which do not meet the requirements of this Section. The Contractor shall perform all remedial measures at no additional cost to the Owner.

#### 1.05 DEFINITIONS

- A. Backfill: materials used to fill an Excavation
  - 1. Initial Backfill/Envelope: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
  - 2. Trench Backfill: Backfill placed over Initial Backfill/Envelope to fill a trench Excavation.
- B. Base Course: layer placed between the Subbase Course and either bituminous concrete pavement, curb, sidewalk, or other surface treatment.
- C. Bedding: layer placed over the excavated Subgrade in a trench before placement of pipe or structure.
- D. Borrow: imported materials from off-site sources.
- E. Embankment: layer placed between Subgrade and Subbase.
- F. Excavation: removal of material encountered above Subgrade elevations.
- G. Fill: soil material used to raise existing grades in lawn and grass areas.
- H. Onsite material: soil material stockpiled from Excavations.
- I. Rock: refer to Section 312316.26.
- J. Structures: precast concrete wastewater and stormwater manholes, catch basins, storage tanks, pump stations, septic tanks, and vaults. "Structures" as discussed in this Specification does not include buildings, footings, foundations.
- K. Subbase Course: layer placed between the Embankment and Base Course, or between Subgrade and Base course if no Embankment.
- L. Subgrade: surface or elevation remaining after completing excavation; surface below Embankment or below Subbase or Bedding, if no Embankment.

### PART 2.00 - PRODUCTS

#### 2.01 BORROW MATERIALS

- A. General
  - 1. All Borrow materials shall be obtained from approved sources and be reasonably free from structurally weak pieces, thin or elongated pieces, silt, loam, topsoil, clay, organic or other deleterious material.
  - 2. All Borrow materials shall be uniformly graded from coarse to fine.
  - 3. All Borrow materials that include stone fractions shall be from rock types that are durable and resistant to weathering, and shall not be from sources that are primarily limestone or marble.
- B. Bank Run Sand
  - 1. Shall conform with Section 703.03 of the VTrans Standard Specifications for Construction.

2. Bank Run Sand shall meet the following gradation requirement:

| <u>Sieve No.</u> | <u>Percentage by Weight Passing</u><br><u>Square Mesh Sieve</u> |
|------------------|---|
| 2 inches         | 100   |
| 1-½ inches       | 90-100  |
| ½ inch           | 70-100  |
| No. 4            | 60-100  |
| No. 100          | 0-20  |
| No. 200          | 0-8   |

C. Screened Sand

1. Screened Sand shall meet the following gradation requirement:

| <u>Sieve No.</u> | <u>Percentage by Weight Passing</u><br><u>Square Mesh Sieve</u> |
|------------------|---|
| 1 inch           | 100   |
| ½ inch           | 70-100  |
| No. 4            | 60-100  |
| No. 100          | 0-20  |
| No. 200          | 0-6   |

D. Bank Run Gravel

1. Shall conform with Section 704.04 of the VTrans Standard Specifications for Construction.
2. The percent of wear of the gravel shall not be more than 50 when tested in accordance with AASHTO T 96.
3. The maximum size stone particle shall not exceed 67% of the thickness of the layer being placed.
4. Bank Run Gravel shall meet the following gradation requirement:

| <u>Sieve No.</u> | <u>Percentage by Weight Passing</u><br><u>Square Mesh Sieve</u> |
|------------------|---|
| 6 inches         | 100   |
| 1½ inches        | 60-100  |
| No. 4            | 20-60   |
| No. 100          | 0-12  |
| No. 200          | 0-6   |

- E. Coarse Crushed Gravel
1. Shall conform with Section 704.05 of the VTrans Standard Specifications for Construction.
  2. The percent of wear of the gravel shall not be more than 40 when tested in accordance with AASHTO T 96.
  3. At least 50 percent, by weight, of the material coarser than the No. 4 sieve shall have at least one fractured face.
  4. Coarse Crushed Gravel shall meet the following gradation requirement:

| <u>Sieve No.</u> | <u>Percentage by Weight Passing<br/>Square Mesh Sieve</u> |
|------------------|---|
| 4 inches         | 95-100  |
| No. 4            | 25-50   |
| No. 100          | 0-12  |
| No. 200          | 0-6   |

- F. Fine Crushed Gravel
1. Shall conform with Section 704.05 of the VTrans Standard Specifications for Construction.
  2. The percent of wear of the gravel shall not be more than 40 when tested in accordance with AASHTO T 96.
  3. At least 50 percent, by weight, of the material coarser than the No. 4 sieve shall have at least one fractured face.
  4. Fine Crushed Gravel shall meet the following gradation requirement:

| <u>Sieve No.</u> | <u>Percentage by Weight Passing<br/>Square Mesh Sieve</u> |
|------------------|---|
| 2 inches         | 100   |
| 1½ inches        | 90-100  |
| No. 4            | 30-60   |
| No. 100          | 0-12  |
| No. 200          | 0-6   |

- G. Plant Mixed Gravel
1. Shall consist of clean, hard, crushed stone or crushed gravel, mixed at the plant to give a specific gradation.
  2. When the Plant Mixed Gravel is composed of crushed stone or crushed gravel, the percent of wear of the aggregate shall not be more than 35 when tested in accordance with AASHTO T 96. When the Plant Mixed Gravel is composed of crushed igneous rock, the percent of wear of the aggregate shall not be more than 50 when tested in accordance with AASHTO T 96.
  3. When crushed gravel is used for the aggregate, at least 50 percent, by weight, of the material coarser than the No. 4 sieve shall have at least one fractured face.

4. The aggregate fractions shall be uniformly combined in such proportions that the resulting Plant Mixed Gravel gradation conforms to the following:

| <u>Sieve No.</u>                     | <u>Percentage by Weight Passing<br/>Square Mesh Sieve</u> |
|--------------------------------------|---|
| 1 <sup>3</sup> / <sub>4</sub> inches | 100   |
| 1 <sup>1</sup> / <sub>2</sub> inches | 95-100  |
| 1 inch                               | 60-85   |
| <sup>3</sup> / <sub>4</sub> inch     | 50-70   |
| <sup>1</sup> / <sub>2</sub> inch     | 40-60   |
| No. 4                                | 20-40   |
| No. 8                                | 15-30   |
| No. 200                              | 0-4   |

H. Aggregate for Surface Course and Shoulders

1. Shall conform with Section 704.12 of the VTrans Standard Specifications for Construction.
2. The percent of wear of the gravel when tested in accordance with AASHTO T 96 shall not be more than 40 for material used as Surface Course, or not more than 50 for material used as Shoulders.
3. Aggregate for Shoulders shall meet the following gradation requirement:

| <u>Sieve No.</u>                     | <u>Percentage by Weight Passing<br/>Square Mesh Sieve</u> |
|--------------------------------------|---|
| 1 <sup>1</sup> / <sub>2</sub> inches | 100   |
| 1 inch                               | 90-100  |
| No. 4                                | 45-65   |
| No. 100                              | 0-15  |
| No. 200                              | 0-12  |

4. Surface Course Gravel shall meet the following gradation requirement:

| <u>Sieve No.</u>                     | <u>Percentage by Weight Passing<br/>Square Mesh Sieve</u> |
|--------------------------------------|---|
| 1 <sup>1</sup> / <sub>2</sub> inches | 100   |
| 1 inch                               | 95-100  |
| No. 4                                | 45-65   |



|         |       |
|---------|-------|
| No. 100 | 10-15 |
| No. 200 | 8-12  |

## I. "Sur-Pak" Gravel

- "Sur-Pak" Gravel shall meet the following gradation requirements:

| <u>Sieve No.</u> | <u>Percentage by Weight Passing<br/>Square Mesh Sieve</u> |
|------------------|---|
| ¾ inch           | 100   |
| ½ inch           | 95-100  |
| ⅜ inch           | 80-95   |
| No. 4            | 50-70   |
| No. 8            | 30-50   |
| No. 16           | 20-40   |
| No. 30           | 15-35   |
| No. 50           | 10-30   |
| No. 100          | 5-20  |
| No. 200          | 2-10  |

## J. Dense Graded Crushed Stone

- Shall conform with Section 704.06 of the VTrans Standard Specifications for Construction.
- The percent of wear of the crushed stone shall not be more than 40 when tested in accordance with AASHTO T 96. The percent of wear shall not be more than 50 if crushed igneous rock is used.
- Dense Graded Crushed Stone shall meet the following gradation requirement:

| <u>Sieve No.</u> | <u>Percentage by Weight Passing<br/>Square Mesh Sieve</u> |
|------------------|---|
| 3½ inches        | 100   |
| 3 inches         | 90-100  |
| 2 inches         | 75-100  |
| 1 inch           | 50-80   |
| ½ inch           | 30-60   |
| No. 4            | 15-40   |
| No. 200          | 0-6   |

## K. Crushed Stone

1. Shall conform with Section 704.02 of the VTrans Standard Specifications for Construction.
2. When the aggregate is composed of crushed stone, the percent of wear of the aggregate shall not be more than 35 when tested in accordance with AASHTO T 96. When the aggregate is composed of crushed igneous rock, the percent of wear of the aggregate shall not be more than 50 when tested in accordance with AASHTO T 96.
3.  $\frac{3}{4}$ -inch Crushed Stone shall meet the following gradation requirement:

| <u>Sieve No.</u>   | <u>Percentage by Weight Passing<br/>Square Mesh Sieve</u> |
|--------------------|---|
| 1 inch             | 100   |
| $\frac{3}{4}$ inch | 90-100  |
| $\frac{3}{8}$ inch | 20-55   |
| No. 4              | 0-10  |
| No. 8              | 0-5   |

4.  $1\frac{1}{2}$ -inch Crushed Stone shall meet the following gradation requirement:

| <u>Sieve No.</u>      | <u>Percentage by Weight Passing<br/>Square Mesh Sieve</u> |
|-----------------------|---|
| 2 inches              | 100   |
| $1\frac{1}{2}$ inches | 95-100  |
| $\frac{3}{4}$ inch    | 35-70   |
| $\frac{3}{8}$ inch    | 10-30   |
| No. 4                 | 0-5   |

## L. Rip-Rap Systems

1. Shall conform with Section 706.04 of the VTrans Standard Specifications for Construction.
2. Stone for rip-rap systems shall be unhewn, rough quarry stone, as nearly rectangular in section as practicable. The stones shall be hard, sound and resistant to the action of water and weathering. Blast rock may only be used for rip-rap if approved by the Engineer. They shall be a rock type other than serpentine rock containing the fibrous variety chrysotile (asbestos). Rip-rap systems shall be of the following types:
  - a. Type I:
    - i. The longest dimension of stone shall vary from 1 to 12 inches, and at least 50 percent of the volume of stone in place shall have at least dimension of 4 inches.

- b. Type II:
    - i. The longest dimension of stone shall vary from 2 to 36 inches, and at least 50 percent of the volume of stone in place shall have at least dimension of 12 inches.
  - c. Type III:
    - i. The longest dimension of stone shall vary from 3 to 48 inches, and at least 50 percent of the volume of stone in place shall have at least dimension of 16 inches.
  - d. Type IV:
    - i. The longest dimension of stone shall vary from 3 to 60 inches, and at least 50 percent of the volume of stone in place shall have at least dimension of 20 inches.
  - e. Type V
    - i. The longest dimension of stone shall vary from 2 to 72 inches, and at least 50 percent of the volume of stone in place shall have at least dimension of 24 inches.
  - 3. Rounded, un-fractured or smooth rocks or quarry screenings or tailings shall not be acceptable rip-rap.
  - 4. Rock shall be gray or grayish-blue in color.
- M. Topsoil: refer to Specification Section 329200.
- N. Streambed Stone Fill
- 1. **Type E1** - The longest dimension of the stone shall be at least 18-inches, and at least 50% of the volume of the stone in place shall have a least dimension of 12-inches, and at least 25% of the material shall have a maximum dimension of 2-inches and be well graded material.
  - 2. **Type E2** - The longest dimension of the stone shall be at least 24-inches, and at least 50% of the volume of the stone in place shall have a least dimension of 18-inches, and at least 25% of the material shall have a maximum dimension of 2-inches and be well graded material.
  - 3. **Type E3** - The longest dimension of the stone shall be at least 36-inches, and at least 50% of the volume of the stone in place shall have a least dimension of 24-inches, and at least 25% of the material shall have a maximum dimension of 2-inches and be well graded material.
  - 4. **Type E4** - The longest dimension of the stone shall be at least 48-inches, and at least 50% of the volume of the stone in place shall have a least dimension of 36-inches, and at least 25% of the material shall have a maximum dimension of 2- inches and be well graded material.
  - 5. The streambed stone fill shall be hard, blasted, angular rock other than serpentine rock containing the fibrous variety chrysotile (asbestos). Similar sized river sediment is an acceptable alternative, as is a mixture of angular material and river sediment.
- O. Category I Imported Fill: shall conform to all the requirements for Category I Onsite Material.
- P. River Stone:
- 1. River stone shall be smooth, round, whole stones of the size and color as specified in the Drawings.
  - 2. River stone shall be clean, washed and contain at least 90% whole stones with less than 1% passing the No. 200 Sieve, by weight.

**2.02 ONSITE MATERIAL**

- A. Category I Onsite Material
  - 1. ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP and SM, or a combination of these group symbols, (See Table below).
  - 2. AASHTO M145 Soil Classification Groups A-1-a, A-1-b, A-3, A-2-4 and A-2-5, or a combination of these group symbols, (See Table below).
- B. Category II Onsite Material:
  - 1. ASTM D2487 Soil Classification Groups GC, SM-SC, SC, ML, CL, MH and CH, or a combination of these group symbols, (See Table below).
  - 2. AASHTO M145 Soil Classification Groups A-2-6, A-2-7, A-4, A-5, A-6 and A-7, or a combination of these group symbols, (See Table below).
- C. Unsuitable Onsite Material:
  - 1. ASTM D2487 Soil Classification Groups ML-CL, OL, OH and PT, or a combination of these group symbols, (See Table below).
  - 2. AASHTO M145 Soil Classification Group A-8, (See Table below).
  - 3. Debris, waste, trash, frozen materials, clumps, vegetation, roots, stumps, peat, organics, topsoil, boulders, pavement, concrete, muck, rocks over eight inches in dimension, and other deleterious material.
  - 4. Unsuitable Onsite Materials include Category I and Category II Onsite Materials which the Contractor is unable to compact to specified densities.
  - 5. Unsuitable Onsite Materials include Category I and Category II Onsite that include any of the items listed in 2.02 C. 3.
- D. Suitable Blast Rock:
  - 1. Shall consist of hard, angular blasted rock broken into various sizes. The longest dimension of the stone shall vary from one inch to eight inches, and at least 50 percent of the volume of the stone shall have a least dimension of four inches. The least dimension of the stone shall be greater than  $\frac{1}{3}$  of the longest dimension.
  - 2. Suitable Blast Rock shall be reasonably well graded from the smallest to the maximum size stone so as to form a compact mass without voids when in place.
  - 3. Shall be free from structurally weak pieces, silt, topsoil, clay, organic or other deleterious material.

E. Table of ASTM D2487 Soil Classification Groups:

| Group Symbol | Description  | Range of max. dry densities, lbm/cf | Range of optimum moisture content, % | Onsite Material Category |
|--------------|--|-------------------------------------|--------------------------------------|--------------------------|
| GW           | well-graded, clean gravels, gravel-sand mixtures   | 125-135                             | 11-8                                 | I                        |
| GP           | poorly-graded, clean gravels, gravel-sand mixtures | 115-125                             | 14-11                                | I                        |
| GM           | silty gravels, poorly graded gravel-sand-silt      | 120-135                             | 12-8                                 | I                        |
| GC           | clayey gravels, poorly-graded gravel-sand-clay     | 115-130                             | 14-9                                 | II                       |
| SW           | well-graded clean sands, gravelly sands            | 110-130                             | 16-9                                 | I                        |
| SP           | poorly-graded clean sands, sand-gravel mix         | 100-120                             | 21-12                                | I                        |
| SM           | silty sands, poorly-graded sand-silt mix           | 110-125                             | 16-11                                | I                        |
| SM-SC        | sand-silt-clay mix with slightly plastic fines     | 110-130                             | 15-11                                | II                       |
| SC           | clayey sands, poorly-graded sand-clay mix          | 105-125                             | 19-11                                | II                       |
| ML           | inorganic silts and clayey soils                   | 95-120                              | 24-12                                | II                       |
| ML-CL        | mixture of organic silt and clay                   | 100-120                             | 22-12                                | U                        |
| CL           | inorganic clays of low-to-medium plasticity        | 95-120                              | 24-12                                | II                       |
| OL           | organic silts and silt-clays, low plasticity       | 80-100                              | 33-21                                | U                        |
| MH           | inorganic clayey silts, elastic silts              | 70-95                               | 40-24                                | II                       |
| CH           | inorganic clays of high plasticity                 | 75-105                              | 36-19                                | II                       |
| OH           | organic and silty clays                            | 65-100                              | 45-21                                | U                        |

F. Table of AASHTO M145 Soil Classification Groups:

|  | Granular materials (35% or less passing No. 200 sieve) |                               |                    |                                 |                    |                    |                    | silt-clay materials (35% or more passing No. 200 sieve) |                    |                    |                    | A-8                           |
|--|--|-------------------------------|--------------------|---------------------------------|--------------------|--------------------|--------------------|---|--------------------|--------------------|--------------------|-------------------------------|
|  | A-1  |                               | A-3                | A-2                             |                    |                    |                    | A-4   | A-5                | A-6                | A-7                |                               |
|  | A-1-a  | A-1-b                         |                    | A-2-4                           | A-2-5              | A-2-6              | A-2-7              |   |                    |                    |                    |                               |
| Sieve Analysis:<br>% passing<br>No. 10<br>No. 40<br>No. 200                    | 50 max.<br>30 max.<br>15 max.                          | 50 max.<br>50 max.<br>25 max. | 51 min.<br>10 max. | 35 max.                         | 35 max.            | 35 max.            | 35 max.            | 36 min.   | 36 min.            | 36 min.            | 36 min.            |                               |
| Characteristics of fraction passing No. 40<br>liquid limit<br>plasticity index | 6 max.   |                               | non-plastic        | 40 max.<br>10 max.              | 41 min.<br>10 max. | 40 max.<br>11 min. | 41 min.<br>11 min. | 40 max.<br>10 max.                                      | 41 min.<br>10 max. | 40 max.<br>11 min. | 41 min.<br>11 min. | peat,<br>highly organic soils |
| Usual types of significant constituents  | stone fragments<br>gravel and sand                     |                               | fine sand          | silty or clayey gravel and sand |                    |                    |                    | silty soils   |                    | clayey soils       |                    |                               |
| Onsite Material Category   | I  | I                             | I                  | I                               | I                  | II                 | II                 | II  | II                 | II                 | II                 | U                             |

- 2.03 SATISFACTORY PIPE BEDDING AND INITIAL BACKFILL/ENVELOPE MATERIALS SHALL BE ONE OF THE FOLLOWING, AS APPLICABLE:
- A. For ductile iron pipe:
    - 1. Dry trench bottom: Bank Run Sand, Screened Sand, Fine Crushed Gravel, Surface Course Gravel, Plant Mixed Gravel, ¾" Crushed Stone or Category I Onsite Material (1" stone maximum).
    - 2. Wet trench bottom: 1½" Crushed Stone.
  - B. For SDR 35 PVC pipe: ¾" Crushed Stone.
  - C. For SCH40 and SCH80 PVC pipe: ¾" Crushed Stone.
  - D. For C900, C905, CL160 or CL200 PVC pipe:
    - 1. Dry trench bottom: Bank Run Sand, Screened Sand, Fine Crushed Gravel, or ¾" Crushed Stone.
    - 2. Wet trench bottom: 1½" Crushed Stone.
  - E. For reinforced concrete pipe:
    - 1. Dry trench bottom: Bank Run Sand, Screened Sand, Fine Crushed Gravel, or ¾" Crushed Stone.
    - 2. Wet trench bottom: ¾" Crushed Stone.
  - F. For solid wall C906 HDPE pipe:
    - 1. Dry trench bottom: Bank Run Sand, Screened Sand, Fine Crushed Gravel, or ¾" Crushed Stone.
    - 2. Wet trench bottom: 1½" Crushed Stone.
  - G. For C901 HDPE tubing: Bank Run Sand, Screened Sand.
  - H. For corrugated HDPE pipe: ¾" Crushed Stone.
  - I. For corrugated metal pipe: ¾" Crushed Stone.
  - J. For copper pipe: Bank Run Sand, Screened Sand.
- 2.04 SATISFACTORY STRUCTURE BEDDING MATERIALS SHALL BE ONE OF THE FOLLOWING, AS APPLICABLE:
- A. Below precast concrete wastewater manholes, catch basins, stormwater manholes, storage tanks, septic tanks, pump stations, and vaults: ¾" or 1½" Crushed Stone.
- 2.05 SATISFACTORY TRENCH BACKFILL AND STRUCTURE BACKFILL MATERIALS SHALL BE ONE OF THE FOLLOWING, AS APPLICABLE:
- A. Below any surface treatment other than Lawn and Grass areas or when top edge of excavation is within five horizontal feet of any surface treatment other than Lawn and Grass areas (including, but not limited to, bituminous concrete pavement, curb, sidewalk, or other surface treatment):
    - 1. Bank Run Sand, Screened Sand, Bank Run Gravel, Coarse Crushed Gravel, Fine Crushed Gravel, Dense Graded Crushed Stone,
    - 2. Suitable Blast Rock - only if thickness of Initial Backfill/Envelope is doubled, at no additional cost to the Owner,
  - B. Below Lawn and Grass areas:
    - 1. Bank Run Sand, Screened Sand, Bank Run Gravel, Coarse Crushed Gravel, Fine Crushed Gravel, Dense Graded Crushed Stone,
    - 2. Suitable Blast Rock - only if thickness of Initial Backfill/Envelope is doubled, at no additional cost to the Owner,
    - 3. Category I Onsite Materials,
    - 4. Category II Onsite Materials,
    - 5. Category I Imported Fill.

- 2.06 SATISFACTORY FILL MATERIALS SHALL BE ONE OF THE FOLLOWING, AS APPLICABLE:
- A. Below Lawn and Grass Areas:
    - 1. Bank Run Sand, Screened Sand, Bank Run Gravel, Coarse Crushed Gravel, Fine Crushed Gravel, Dense Graded Crushed Stone,
    - 2. Suitable Blast Rock,
    - 3. Category I Onsite Materials,
    - 4. Category II Onsite Materials,
    - 5. Category I Imported Fill.
  - B. Below ALL other areas: refer to Embankment Materials or Subbase Materials.
- 2.07 SATISFACTORY EMBANKMENT MATERIALS SHALL BE ONE OF THE FOLLOWING:
- A. All Embankments: Bank Run Gravel, Coarse Crushed Gravel, Dense Graded Crushed Stone, Suitable Blast Rock.
- 2.08 SATISFACTORY SUBBASE MATERIALS SHALL BE ONE OF THE FOLLOWING, AS APPLICABLE:
- A. Below Bituminous Concrete Pavement: Bank Run Gravel, Coarse Crushed Gravel or Dense Graded Crushed Stone.
  - B. Below Cast in Place Concrete Curb: Bank Run Gravel, Coarse Crushed Gravel or Dense Graded Crushed Stone.
  - C. Below Cast in Place Concrete Sidewalk: Bank Run Gravel, Coarse Crushed Gravel or Dense Graded Crushed Stone.
  - D. Below Granite Curb: Bank Run Gravel, Coarse Crushed Gravel or Dense Graded Crushed Stone.
  - E. Below Gravel Roadway and Driveway: Bank Run Gravel, Coarse Crushed Gravel or Dense Graded Crushed Stone.
  - F. Below Gravel Shoulder: Bank Run Gravel, Coarse Crushed Gravel or Dense Graded Crushed Stone.
  - G. Below Gravel Sidewalk: Bank Run Gravel, Coarse Crushed Gravel or Dense Graded Crushed Stone.
- 2.09 SATISFACTORY BASE MATERIALS SHALL BE ONE OF THE FOLLOWING, AS APPLICABLE:
- A. Below Bituminous Concrete Pavement: Fine Crushed Gravel, Plant Mixed Gravel.
  - B. Below Cast in Place Concrete Curb: Fine Crushed Gravel, Plant Mixed Gravel.
  - C. Below Cast in Place Concrete Sidewalk: Fine Crushed Gravel, Plant Mixed Gravel.
  - D. Below Granite Curb: Fine Crushed Gravel, Plant Mixed Gravel.
  - E. Below Gravel Roadway and Driveway: Fine Crushed Gravel, Plant Mixed Gravel.
  - F. Below Gravel Shoulder: Fine Crushed Gravel, Plant Mixed Gravel.
  - G. Below Gravel Sidewalk: Fine Crushed Gravel, Plant Mixed Gravel.
- 2.10 SATISFACTORY SURFACE TREATMENT MATERIALS SHALL BE ONE OF THE FOLLOWING, AS APPLICABLE:
- A. Existing surfaces: if not indicated to be replaced otherwise, all disturbed surfaces shall be replaced with materials matching existing, including special finishes, colors, textures or material types.
  - B. Bituminous Concrete Pavement: refer to Section 321200.
  - C. Cast In Place Concrete Curb: refer to Section 321600.
  - D. Cast In Place Concrete Sidewalk: refer to Section 321600.
  - E. Granite Curb: refer to Section 321600.

- F. Gravel Roadway and Driveway: Surface Course Gravel.
- G. Gravel Shoulder: Surface Course Gravel.
- H. Gravel Sidewalk: "Sur-Pak" Gravel.
- I. Lawn and Grass areas: refer to Section 329200.

### 2.11 GEOTEXTILES

- A. Subgrade Stabilization Fabric: Shall be Mirafi® 500X woven polypropylene geotextile or approved equal, meeting the following minimum standards:

|                           | METRIC                   | ENGLISH                   |
|---------------------------|--------------------------|---------------------------|
| Grab Tensile Strength     | 0.89 kN                  | 200 lbs                   |
| Mullen Burst Strength     | 2756 kPa                 | 400 psi                   |
| Trapezoidal Tear Strength | 0.33 kN                  | 75 lbs                    |
| Puncture Strength         | 0.40 kN                  | 90 lbs                    |
| UV Deterioration          | 70% of Strength          | 70% of Strength           |
| Apparent Opening Size     | 0.300 mm                 | 50 (U.S. Sieve)           |
| Flow Rate                 | 200 l/min/m <sup>2</sup> | 5 gal/min/ft <sup>2</sup> |

- B. Filter Fabric: Shall be Mirafi® 140N non-woven polypropylene geotextile or approved equal, meeting the following minimum standards:

|                           | METRIC                    | ENGLISH                     |
|---------------------------|---------------------------|-----------------------------|
| Grab Tensile Strength     | 0.53 kN                   | 119 lbs.                    |
| Mullen Burst Strength     | 1654 kPa                  | 240 psi                     |
| Trapezoidal Tear Strength | 0.22 kN                   | 49 lbs.                     |
| Puncture Strength         | 0.31 kN                   | 70 lbs.                     |
| UV Deterioration          | 70% of Strength           | 70% of Strength             |
| Apparent Opening Size     | 0.212 mm                  | 60 (U.S. Sieve)             |
| Flow Rate                 | 5500 l/min/m <sup>2</sup> | 135 gal/min/ft <sup>2</sup> |

## PART 3.00 - EXECUTION

### 3.01 PROTECTION

- A. Protect buildings, structures, utilities, pipelines, sidewalks, plantings, pavement, and other facilities from damage caused by settlement, lateral movement, undermining, washout, subsidence due to lowering of groundwater and other hazards created by earthwork operations. The Contractor shall be responsible for any repairs or remedial work necessary, at no additional cost to the Owner.
- B. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil bearing water runoff or airborne dust.
- C. Provide all necessary excavation and trench support systems, materials and equipment necessary to comply with all Local, State and Federal Standards. Excavation and trench support systems shall be kept in place and maintained until no longer



required.

### 3.02 LAYOUT, LINES, GRADES, ELEVATIONS

- A. All layout shall be performed by the Contractor.
- B. Provide all qualified personnel and calibrated equipment necessary to establish and maintain all necessary controls for line, grade, elevation and location and to provide all construction layout.
- C. Preserve all monuments, pins, pipes and rods. If disturbed or lost, the Contractor shall immediately have them replaced or reset by a Licensed Surveyor, at no additional cost to the Owner.
- D. The Contractor shall be responsible for accurate placement of all work to the locations and elevations shown on the Drawings.
- E. Horizontal and vertical control lines and elevations shall be set by the Contractor based on reference information provided by the Engineer. From information provided, the Contractor shall verify bench marks and perform all surveys and layout necessary for the completion of work.
- F. The accuracy of the Contractor's survey and layout is the sole responsibility of the Contractor, and review of the survey and/or layout by the Engineer does not constitute a transfer of responsibility for accuracy.

### 3.03 DEWATERING

- A. Prevent surface water and groundwater from entering excavations, from ponding on prepared Subgrade, Embankment, Subbase, Base or Fill, and from flooding Project site and surrounding area.
- B. Provide all necessary pumps, well points and other equipment and materials necessary for control and removal of surface and groundwater. The Contractor may encounter surface and groundwater in excavations. Pricing shall include all dewatering operations. Additional compensation for such work, over and above the contract price, shall not be approved.
- C. Protect all surfaces from softening, undermining, washout and damage by rain or water accumulation. Reroute surface water runoff away from excavated areas. Do not use excavated trenches as temporary drainage ditches.
- D. Install a dewatering system(s) to keep Subgrade dry and convey groundwater away from excavations. Maintain until dewatering is no longer required.
- E. Water discharged from dewatering operations shall be directed to stable vegetated areas, properly sized dewatering silt capturing bag, or properly sized sedimentation pond. State Water Quality standards shall be maintained at all times.

### 3.04 EXCAVATING

- A. Excavate to grades, depths, elevations and dimensions as shown on Drawings, or as required, within a tolerance of plus or minus one inch.
- B. Do not disturb Subgrade.

### 3.05 UNAUTHORIZED EXCAVATIONS

- A. Fill unauthorized excavations with Bedding, Embankment or Subbase materials, as appropriate, at no additional cost to the Owner.

### 3.06 STORAGE OF MATERIAL

- A. Stockpile material without intermixing. Place, grade, and shape stockpiles to drain surface water.

- B. Cover stockpiles to prevent windblown dust if necessary.
  - C. Provide necessary erosion control measures to prevent migration of stockpiled materials.
  - D. Stockpile materials away from edge of excavations. Do not store within drip line of trees to remain.
- 3.07 DISPOSAL OF UNSUITABLE ONSITE MATERIAL, SURPLUS ONSITE MATERIAL AND WASTE MATERIAL
- A. Remove Unsuitable Onsite Material, surplus Onsite Material, waste material, trash and debris and legally dispose of it off the Owner's property.
  - B. If surplus material disposal site(s) are indicated on the Drawings, the Contractor shall transport materials to designated areas. Spread or stockpile materials as directed.
- 3.08 TRENCHING
- A. Excavate to indicated grades, depths, elevations and dimensions and to uniform widths to provide a working clearance on each side of pipe or Structure.
  - B. Excavate trenches to required depth below pipe or Structure elevation to allow proper depth and width of bedding course.
- 3.09 PIPE BEDDING AND STRUCTURE BEDDING
- A. Place required Bedding material to depth and width indicated. Shape Bedding course to provide continuous support for bells, joints and barrels of pipes, fittings and Structures. Care shall be taken to not have any part of the pipe or structure bearing on rocks. "Point contact" at fittings, joints or along the pipe length is not allowed.
  - B. If the Engineer determines that unsatisfactory or unstable Subgrade exists, continue excavation and replace with additional Bedding material.
  - C. Compact bedding material to density specified in Schedule below.
- 3.10 PIPE AND STRUCTURE INITIAL BACKFILL/ENVELOPE
- A. Place required Initial Backfill/Envelope material to depth and width indicated. Provide proper haunching and support for bells, joints and barrels of pipes and fittings. Bring Initial Backfill/Envelope material evenly up on sides and along full length of piping or Structure. Do not damage or displace pipe or Structure.
  - B. Compact Initial Backfill/Envelope material to density specified in Schedule below.
- 3.11 TRENCH BACKFILLING AND STRUCTURE BACKFILLING
- A. Place required Trench Backfill and Structure Backfill material in lifts evenly along full length of piping and evenly on all sides of Structure. Do not damage or displace pipe or Structure.
  - B. Compact each lift of Trench Backfill and Structure Backfill material to density specified in Schedule below.
  - C. As trench or excavation support system is removed, do not disturb Trench Backfill and Structure Backfill material.
  - D. Install warning tape directly above pipe at depth indicated on Drawings.
  - E. Continue backfilling and compacting to bottom of Embankment, Subbase or Base, as applicable.
- 3.12 SUBGRADE PREPARATION
- A. Notify the Engineer when excavations have reached required Subgrade.
  - B. Subgrade shall be crowned or sloped to shed groundwater as indicated on the

- Drawings, or directed by the Engineer.
- C. Proof roll Subgrade with loaded ten-wheel dump truck to identify soft, spongy or unstable areas or areas of excess yielding or shoving. Do not proof roll wet or saturated Subgrade. If the Engineer determines that unsatisfactory soil is present, continue excavation and replace with additional Bedding, Embankment or Subbase material, as appropriate.
  - D. Reconstruct Subgrade damaged by freezing temperatures, frost, rain, accumulated water or construction traffic or activities, as directed by the Engineer, at no additional cost to the Owner.
- 3.13 SUBGRADE STABILIZATION/SEPARATION GEOTEXTILE INSTALLATION
- A. Install specified Subgrade Stabilization/Separation Fabric on prepared Subgrade according to manufacturer's instructions. Fabric shall be rolled out flat and tight with no folds.
  - B. Fabric shall be overlapped a minimum of two feet at all seams.
  - C. Fabric shall be properly anchored as necessary.
  - D. Do not allow traffic or equipment to travel on fabric.
  - E. Protect fabric from damage and weather.
  - F. Any torn or damaged areas shall be replaced or overlaid with new sections of fabric.
  - G. All seams at replacement sections shall be overlapped a minimum of three feet.
- 3.14 EMBANKMENT INSTALLATION
- A. Place required Embankment material in lifts on prepared Subgrade, evenly across width and length.
  - B. Compact each lift of Embankment material to density specified in Schedule below.
  - C. Continue placing and compacting Embankment material in lifts to grades, elevations, thickness, dimensions, cross slope and cross section shown on the Drawings.
- 3.15 SUBBASE
- A. Place required Subbase material in lifts on prepared Embankment, or Subgrade if no Embankment, evenly across width and length.
  - B. Compact each lift of Subbase material to density specified in Schedule below.
  - C. Continue placing and compacting Subbase material in lifts to grades, elevations, thickness, dimensions, cross slope and cross section shown on the Drawings.
- 3.16 BASE
- A. Place required Base material in lifts on prepared Subbase, or Subgrade if no Subbase, evenly across width and length.
  - B. Compact each lift of Base material to density specified in Schedule below.
  - C. Continue placing and compacting Base material in lifts to grades, elevations, thickness, dimensions, cross slope and cross section shown on the Drawings.
- 3.17 FILLING AND GRADING
- A. Place required Fill material in lifts on prepared Subgrade evenly across width and length.
  - B. Compact each lift of Fill material to density specified in Schedule below.
  - C. Continue filling and compacting in lifts to grades, elevations and dimensions shown on the Drawings.

- D. The Contractor shall provide positive drainage at all finish surfaces.

### 3.18 SURFACE TREATMENT INSTALLATION

- A. Existing surfaces: unless indicated to be replaced otherwise, all disturbed surfaces shall be replaced to existing or better condition, location and elevation.
- B. Bituminous Concrete Pavement: refer to Section 321200.
- C. Cast In Place Concrete Curb: refer to Section 321600.
- D. Cast In Place Concrete Sidewalk: refer to Section 321600.
- E. Granite Curb: refer to Section 321600.
- F. Gravel Roadway and Driveway, Gravel Shoulder, Gravel Sidewalk:
  - 1. Place required material in lifts on prepared Subbase, or Base if no Subbase, evenly across width and length.
  - 2. Compact each lift of material to density specified in Schedule below.
  - 3. Continue placing and compacting material in lifts to grades, elevations, thickness, dimensions, cross slope and cross section shown on the Drawings.
- G. Lawn and Grass areas: refer to Section 329200.

### 3.19 SCHEDULE OF REQUIRED COMPACTION

- A. Material shall be compacted with appropriate equipment, at the optimum moisture content, to the following percentage of the maximum dry density of the material determined by ASTM Standard Method D1557 (modified proctor):
  - 1. Pipe Bedding and Initial Backfill/Envelope Materials: 95%.
  - 2. Trench Backfill and Structure Backfill Materials:
    - a. Below any surface treatment other than Lawn and Grass areas or when top edge of excavation is within five feet of any surface treatment other than Lawn and Grass areas (including, but not limited to, bituminous concrete pavement, curb, sidewalk, or other surface treatment): 90%.
    - b. Below Lawn and Grass areas: 85%.
  - 3. Fill Materials:
    - a. Lawn and Grass Areas: 85%.
    - b. All other areas: refer to Embankment Materials or Subbase Materials.
  - 4. Embankment Materials: 95%.
  - 5. Subbase Materials: 95%.
  - 6. Base Materials: 95%.
  - 7. Gravel Roadways and Driveways: 90%.
  - 8. Gravel Shoulders: 90%.
  - 9. Gravel Sidewalks: 90%.
- B. Jetting is not an acceptable method of compaction.

### 3.20 RIP-RAP INSTALLATION

- A. Rip Rap Systems shall be "Constructed" in such a manner that the end product will resemble the well blended and consolidated rock mass that is depicted in the Detail.
- B. "Dumping" rocks in a pile will not be an acceptable method of installation.

### END OF SECTION 310000

**SECTION 330507.13 – UTILITY DIRECTIONAL DRILLING****1.01 WORK INCLUDED**

- A. Furnish all labor, materials, equipment and incidentals required to install high density polyethylene (HDPE) pipe as shown on the Drawings and as specified herein complete, including, but not limited to, any necessary excavation to install the pipe; fittings and special materials/equipment of whatever nature required; provision and mixing of drilling fluid components including clean water; pumping and testing of drilling fluids; drilling of pilot hole; monitoring and guidance of pilot hole drill bit; back reaming, swabbing bore hole; pullback of carrier and/or casing pipe; disposal of slurry/cuttings mixture; provision for barricades and warning lights; temporary sheeting, bracing and supporting the adjoining ground or structures where necessary; welding of casing pipes if required to obtain the proper laying lengths; pumping groundwater from excavations, backfill, restoration of disturbed facilities, utilities and surfaces; repair of damaged facilities; disposal of all surplus excavation and discarded materials, construction stakes; testing and incidentals.
- B. It is the intent of this specification to define the acceptable methods and materials for installing water piping by the horizontal directional drilling (HDD) method and the requirements for high density polyethylene (HDPE) pipe installed by directional drilling or in open cut trenches.
- C. Reference shall be made to Sections 331400 and 333100 as applicable, for additional requirements.

**1.02 REFERENCE STANDARDS**

- A. Information and requirements contained in this Specification and based on the most recent version of the following standards:
  - 1. AWWA Standard C901 and C906 for Polyethylene (HDPE) Pressure Pipe and Fittings.
  - 2. ASTM F714 - Polyethylene (PE) Plastic Pipe (SDR-PR) based on outside diameter.

**1.03 SUBMITTALS**

- A. The Contractor shall provide the name and qualification of the proposed directional drilling subcontractor. The information shall include, at a minimum:
  - 1. The qualifications of the subcontractor and key personnel showing that all directional drilling operations will be performed by a competent drill contractor and crew with a minimum of five (5) years of relevant experience, at least as complex and of similar size as this project.
  - 2. Identification of key person(s) and contact information proposed for this project.
  - 3. Proof of existing and past active membership in the Northeast Trenchless Association or other equal trade association which requires continuing education for membership.
  - 4. A list of completed projects with details of the types of pipe installations including Owner and Engineer contact names and telephone numbers.
- B. The Contractor shall submit manufacturer's certified data for each pipe type to be used on the project, including dimensional information, specifications and pipe material, pipe class/pressure rating and all detailed information on all accessories.
- C. The Contractor shall provide a detailed work plan and schedule of activities proposed

to perform the work under this specification, including any proposed variation from the Drawings and Specifications. Information in this work plan shall include, but not be limited to, the following:

1. Method for directional drilling indicating the following:
  - a. Plan showing the work zone equipment configuration at the end of the bore(s), staging areas, storage areas and the location of slurry, cuttings and pit spoil handling areas.
  - b. Boring procedure, tooling for drilling, method to control slurry, design of entrance and exit pits and method to verify that installed utilities are acceptable.
  - c. Materials list including bentonite and bentonite additives proposed for use on the project along with product data sheets for all materials used on the site.
  - d. Steering and tracking equipment procedures and proposed locations of ground based coils or other equipment requiring surface or subsurface access.
2. Contingency Plans that address each of the following:
  - a. Inadvertent return, and/or spill of drilling fluids, hydraulic fluids, etc., including measures to contain and clean the affected area.
  - b. Clean up of surface seepage of drilling fluids and spoils.
  - c. Collapse of borehole.
3. Drilling Fluids Management Plan should address the following:
  - a. Identify all proposed drilling muds and additives to be used and provide the Engineer with the appropriate MSDA sheets.
  - b. Calculated hole volumes and drilling fluid volumes.
  - c. Source and amount of water required for drilling mud and all necessary approvals and permits.
  - d. Method of slurry containment and cleanup of all drilling fluid overflows or spills.
  - e. Method of recycling drilling fluid and spoils.
  - f. Method of transporting and disposing of drilling fluids and spoils including proof of approvals for same.
  - g. Allowable pull-back forces and stresses for pipes.
4. Time required for complete pipe installation.

#### 1.04 QUALITY ASSURANCE

- A. The directional drilling subcontractor shall be determined to be qualified by the Engineer based upon the Engineer's review of materials submitted under Item 1.03 above.
- B. The directional drilling subcontractor shall provide a full-time on-site representative thoroughly knowledgeable of the equipment, boring procedures, and available to address immediate concerns and emergency operations.
- C. The directional drilling subcontractor shall be thoroughly trained and experienced in the skills and equipment required for installation and testing of piping and appurtenances.
- D. The Contractor shall protect piping materials before, during and after installation. In the event of damage, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.

- E. Upon direction of the Engineer, the Contractor shall remove, replace and/or rework all piping that does not meet the requirements of this section. The Contractor shall perform all remedial measures at no additional cost to the Owner.
- F. All work shall be subject to applicable testing requirements of other Specification sections.

#### 1.05 WARRANTIES AND/OR GUARANTEES

- A. Contractor shall submit manufacturer's warranty against defects in material or workmanship for all piping and casing products. The warranty shall be submitted with the shop drawings for approval. The Contractor shall extend the factory warranty to one year from the date of acceptance and final approval from the Owner, and shall replace or repair, as directed by the Engineer, any defective product found to be such, at the expense of the Contractor.

### **PART 2.00 - PRODUCTS**

#### 2.01 GENERAL

- A. Refer to Drawings for locations and sizes of various piping required.
- B. High density polyethylene pipe in accordance to these specifications shall be used in HDD installations. All piping system components shall be the products of one manufacturer and shall conform to the latest edition of ASTM F714, AWWA C901/C906. Potable water pipe shall be NSF listed.

#### 2.02 PIPING

- A. Piping shall be extruded from a polyethylene compound and shall conform to the following requirements:
  - 1. The polyethylene resin shall meet or exceed the requirements of ASTM F714 for PE material having hydrostatic design basis of 1,600 psi.
  - 2. The polyethylene compound shall be suitably protected against degradation by ultraviolet light by means of carbon black, well dispersed by precompounding in a concentration of not less than 2 percent.
  - 3. Potable water piping shall be black. Sewer piping shall be green.
  - 4. Joining shall be performed by thermal butt-fusion in accordance with manufacturer's recommendations.
  - 5. HDPE pipe shall be as manufactured by Performance Pipe (Driscoplex™ 4000); J-M Manufacturing Company, or approved equal. All pipe shall be ductile iron pipe size (DIPS) pressure pipe. Pressure rating shall be as shown on the Drawings or specified in the applicable piping specification.

#### 2.03 FITTINGS

- A. Fittings joining to HDPE pipe shall be plain end butt fused fitting or electro fused fitting.
- B. Butt fused fittings shall be manufactured by Performance Pipe, Integrity Fusion Products, Inc. or approved equal.
- C. Electro fused fittings shall be manufactured by Central Plastic Company, Frialen® Safety Electrofusion Fitting, or approved equal.
- D. Mechanical Joint Adaptors shall have pre-installed stainless steel stiffeners and shall be manufactured by Central Plastic Company, Industrial Pipe Fittings, LLC, or approved equal.

**2.04 TRACER WIRE AND ACCESSORIES**

- A. Tracer wire and accessories are specified under Section 331400.

**2.05 DRILLING FLUIDS**

- A. Provide drilling fluids specifically suited for horizontal directional drilling and the site-specific soil/project conditions. Do not use any chemicals or polymer surfactants in the drilling fluid without written consent from the Engineer.
- B. Drilling fluids intended to provide support for pipe in a conduit or sleeve shall be selected to cure in such a manner to provide permanent protection and support of the pipe.

**2.06 WATER**

- A. The Owner will allow the Contractor to take water from the Owner's water system at Owner stipulated locations, if necessary. The Contractor shall provide all tools and trucking necessary to take and transport the water to the work site.

**PART 3.00 - EXECUTION****3.01 GENERAL**

- A. All HDPE pipes shall be cut, fabricated, and installed in strict conformance with the pipe manufacturer's recommendations. Joining, laying, and pulling of polyethylene pipe shall be accomplished by personnel experienced in working with polyethylene pipe. The pipe manufacturer shall certify in writing that the directional drilling subcontractor is qualified to join, lay, and pull the pipe or a representative of the pipe manufacturer shall be on site to oversee the pipe joining. Expense for the representative shall be paid for by the Contractor.

**3.02 STORAGE**

- A. Pipes shall be stored on level ground preferably turf or sand, free of sharp objects which could damage the pipe. Stacking of the HDPE pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions. Where necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such widths as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.

**3.03 HANDLING PIPES**

- A. The handling of the jointed pipeline shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. Ropes, fabric or rubber protected slings and straps shall be used when handling pipes. Chains, cables, or hooks inserted into the pipe ends shall not be used. Two slings appropriately spaced shall be used for lifting each length of pipe. Pipe or fittings shall not be dropped onto rocky or unprepared grounding. Slings for handling the pipeline shall not be positioned to butt-used joints. Sections of the pipes with cuts and gouges exceeding 5 percent of the pipe wall thickness or kinked sections shall be removed and the ends rejoined.
- B. The open ends of all sections of joined and/or installed pipe (not in service) shall be sealed at night to prevent foreign material from entering the pipe. Waterproof



nightcaps shall be constructed and secured to prevent the entrance of any type of infiltration into the pipe.

### 3.04 ELEVATION AND LINES

- A. All pipes shall be installed to lines and grades as shown on the drawings, or as specified herein. Provide horizontal and vertical record locations at 20 foot intervals or less as directed by the Engineer.

### 3.05 INSTALLATION

#### A. GENERAL

1. The Contractor shall notify the Engineer two (2) business days in advance of starting directional drilling work.
2. The directional drilling subcontractor shall install the pipelines by means of horizontal directional drilling. The directional drilling subcontractor shall assemble, support, and pretest the pipeline prior to installation in the directional drill tunnel.
3. Horizontal directional drilling shall consist of the drilling of a small diameter pilot hole from one end of the alignment to the other, followed by enlarging the hole diameter for the pipeline insertion. The exact method and techniques for completing the directionally drilled installation will be determined by the directional drilling subcontractor, subject to the requirements of these Specifications.
4. The Contractor shall prepare and submit a plan for insertion of the HDPE pipe into the opened bore hole. This plan shall indicate boring pits and receiving pits hydrostatic tests, dewatering, and purging. A copy of the plan shall be provided to the Engineer.
5. The required piping shall be assembled in a manner that does not obstruct access to roadways or public activities. The Contractor shall erect temporary fencing around all staging areas.

#### B. JOINING PIPE SECTIONS

1. Each length of pipe shall be inspected, and cleaned as necessary, to be free of debris immediately prior to joining.
2. Pipes shall be jointed to one another by means of thermal butt-fusion. Polyethylene pipe lengths to be joined by thermal butt-fusion shall be of the same type, grade, and class of polyethylene compound and supplied from the same material supplier.
3. Pipes shall be allowed to relax for a period of 24 hrs after installed by directional drilling before fusing additional pipe to the pulled pipe.
4. Mechanical connections of the polyethylene pipe to auxiliary equipment shall be through flanged connections which shall consist of the following:
  - a. A polyethylene "sub end" shall be thermally butt-fused to the ends of the pipe.
  - b. Provide a Ductile Iron backing flange as required by the manufacturer.
  - c. Stainless steel bolts and nuts of sufficient length to show a minimum of three complete threads when the joint is tightened to the manufacturer's standard. Retorque the nuts after 40 hours.
  - d. Butt-Fusion Joining: Butt-Fusion of pipes shall be performed in accordance with the manufacturer's recommendations as to equipment and technique. Butt-fusion joining shall be 100% efficient

offering a joint weld strength equal to or greater than the tensile strength of the pipe.

C. DRILLING OPERATIONS

1. The Contractor shall prepare a plan to be submitted for Engineer review which describes the noise reduction program, solids control plan, pilot hole drilling procedure, the reaming operation, and the pullback procedure. All drilling operations shall be performed by supervisors and personnel experienced in horizontal direction drilling. All required labor, equipment, materials and support services shall be provided by the Contractor.
2. Drill pipe shall be API steel drill pipe, Range 2, Premium Class or higher, Grade S-135 in a diameter sufficient for the torque and longitudinal loads and fluid capacities required for the work.
3. A smoothly drilled pilot hole shall follow the design centerline of the pipe profile and alignment described on the construction drawings.
4. The position of the drill string shall be monitored by the directional drilling subcontractor with the downhole survey instruments. The directional drilling subcontractor shall compute the position in the X, Y and Z axis relative to ground surface from downhole survey data, a minimum of once per length of each drilling pipe approximately 20 foot interval. Deviations from the acceptable tolerances described in the Specifications shall be documented and immediately brought to the attention of the Engineer for review and/or approval/rejection. The profile and alignment defined on the drawings for the bores define the required grade. The Contractor shall maintain and provide to the Engineer, upon request, the data generated by the downhole survey tools in a form suitable for independent calculation of the pilot hole profile.
5. Between the entry or exit point, the directional drilling subcontractor shall provide and use a separate steering system employing a ground survey grit system such as "TRU-TRACKER", or equal, wherever possible.
6. During the entire operation, waste and leftover drilling fluids from the pits and cuttings shall be dewatered and disposed of in accordance with all permits and regulatory agencies requirements. Remaining water shall be cleaned by Contractor to meet permit requirements.
7. The Owner retains the right to sample the monitor and waste drilling mud, cuttings and water.
8. At no point in the drilled profile shall the radius of curvature of the bore be less than 5,000 feet.

D. REAM AND PULLBACK

1. Reaming - Reaming operations shall be conducted to enlarge the pilot after acceptance of the pilot bore. The number and size of such reaming operations shall be conducted at the discretion of the directional drilling subcontractor.
2. Pulling Loads - The maximum allowable pull exerted on the HDPE pipelines shall be measured continuously and limited to the maximum allowed by the pipe manufacturer so that the pipe or joints are not overstressed.
3. Torsion and Stresses - A swivel shall be used to connect the pipeline to the drill pipe to prevent torsional stresses from occurring in the pipe.
4. The lead end of the pipe shall be closed during the pullback operation so as to preclude entry of soil or drilling muds.
5. Pipeline Support - The pipelines shall be adequately supported by rollers and side booms and monitored during installation so as to prevent overstressing or

- buckling during the pullback operation. Such support/rollers shall be spaced per manufacturer's recommendations. The rollers shall be comprised of a non-abrasive material arranged in a manner to provide support to the bottom and bottom quarter points of the pipeline allowing for free movement of the pipeline during pullback. Any surface damage shall be repaired by the Contractor before pulling operations may resume.
6. The directional drilling subcontractor shall, at all times, handle the HDPE pipe in a manner that does not overstress the pipe. Vertical and horizontal curves shall be limited so that wall stresses do not exceed 50 percent of yield stress for flexural bending of the HDPE pipe. If the pipe is buckled or otherwise damaged, the damaged section shall be removed and replaced at no expense to the Owner. The directional drilling subcontractor shall take appropriate steps during pullback to ensure that HDPE pipe will be installed without damage.
  7. Tracer wire shall be pulled back with pipe and brought to surface and connected to termination/access boxes at both ends.
- E. HANDLING DRILLING FLUIDS AND CUTTINGS
1. During the drilling, reaming, or pullback operations, the directional drilling subcontractor shall make adequate provisions for handling the drilling fluids, and cuttings at the entry and exit pits. These fluids must not be discharged into any waterway or stormwater system. When provisions for storage of the fluids or cuttings on site are exceeded, these materials shall be hauled away to a suitable legal disposal site. The directional drilling operation shall be conducted in such a manner that drilling fluids are not forced through the sub-bottom into any waterway. After completion of the directional drilling work, the entry and exit pit locations shall be restored to original conditions. The Contractor shall comply with all permit provisions.
  2. Pits constructed at the entry or exit point area shall be so constructed to completely contain the drill fluid and prevent its escape to any waterway. The directional drilling subcontractor shall utilize drilling tools and procedures which will minimize the discharge of any drill fluids. The Contractor shall comply with all mitigation measures indicated in the required permits and elsewhere in these Specifications.
  3. To the extent practical, a closed loop drilling fluid system shall be maintained.
  4. Drilling fluid disposal quantities shall be minimized by utilizing a drilling fluid cleaning system which allows the returned fluids to be used.
  5. As part of the installation plan specified herein before, the Contractor shall submit a drilling fluid plan which details types of drilling fluids, cleaning and recycling equipment, estimated flow rates, and procedures for minimizing drilling fluid escape.
- F. TOLERANCES
1. Pipe installed by the directional drilling method must be located as shown on the Drawings, both horizontally and in profile unless otherwise approved. The directional drilling subcontractor shall plot the actual horizontal and vertical alignment of the pilot bore at intervals not to exceed 20 feet. This "record plan" and profile shall be updated as the pilot bore is advanced. The Contractor shall, at all times, provide and maintain instrumentation that will accurately locate the pilot hole and measure drilling fluid flow and pressure. The Contractor shall provide the Engineer with access to all data and readouts

2. pertaining to the position of the bore head and the fluid pressures and flows. When requested, the Contractor shall provide explanations of this position monitoring and steering equipment and data. The directional drilling subcontractor shall employ experienced personnel to operate the directional drilling equipment and, in particular, the position monitoring and steering equipment. No information pertaining to the position or inclination of the pilot bores shall be withheld from the Engineer.
  3. The exit point shall fall within a rectangle 5 feet wide and 10 feet long centered on the planned exit point.
  4. Sags in the pipeline shall not exceed 2.5 percent of the nominal pipe diameter. The alignment of each pilot bore must be approved by the Engineer before pipe can be pulled. If the pilot bore fails to conform to the above tolerances, the Engineer may, at his option, require a new pilot boring to be made.
  5. After the pipe is in place, it shall be flushed, cleaned and disinfected. Refer to Sections 331400 and 333100 for requirements. After the cleaning operation, the Contractor shall provide and run a sizing pig to check for anomalies in the form of buckles, dents, excessive out-of-roundness, and any other deformations. The sizing pig run shall be considered acceptable if the survey results indicate that there are no sharper anomalies (e.g., dents, buckles, gouges, and internal obstruction) greater than 2 percent of the nominal pipe diameter, or excessive ovality greater than 5 percent of the nominal pipe diameter.
- G. TESTING
1. The pipe shall be hydrostatically tested at 1.5 times working pressure, but not less than 225 psig after joining into continuous lengths prior to installation and again after installation. Pressure and temperature shall be monitored with certified instruments during the test. After this test, the water shall be removed and disposed of in accordance with regulations. Procedures shall be as specified in Sections 331400 or 333100, as applicable.
- H. ENVIRONMENTAL PROVISIONS
1. The horizontal directional drilling operation is to be completed in a manner to prevent the discharge of water, drilling mud and cuttings to the adjacent stream, groundwater, or land areas involved during the construction process. Equipment and procedures shall maximize the reuse of drilling mud to minimize waste. All excavated pits used in the drilling operation shall be lined by the Contractor with heavy duty plastic sheeting with sealed joints to prevent the migration of drilling fluids.
  2. The Contractor and directional drilling subcontractor shall visit the site and must be aware of all structures and site limitations at the directional drilling crossing and provide the Engineer with a drilling plan outlining procedures to prevent drilling fluid from adversely affecting the surrounding area.
  3. The general work areas on the entry and exit ends of the drilling shall be enclosed by a berm to contain planned spills or discharge.
  4. Waste cuttings and drilling mud shall be processed through a solids control plant comprised at sumps, pumps, tanks, desalter/desander, centrifuges, material handlers, and/or handlers all in a quantity sufficient to perform the cleaning/separating operation without interference with the drilling program. The cutting and excess drilling fluids shall be dewatered and dried to the extent necessary for disposal in off site landfills. Water from the dewatering

**SECTION 330507.24 – CASING PIPING****PART 1.00 - GENERAL**

## 1.01 WORK INCLUDED

- A. All labor, materials, services and equipment for furnishing and installing casing(s) crossing under roadways, railways, rivers, etc., as shown or specified, and related work.

## 1.02 REFERENCE STANDARDS

Information and requirements contained in this Specification are based on the most recent version of the following standards:

- A. ASTM Standard Specification A-139 for Electric Fusion (Arc) Welded Steel Pipe.
- B. ASTM Standard Specifications 1248 and 3350 for PE3408 High Density Polyethylene (HDPE) Pressure Pipe, with a cell classification of 345434C.
- C. VTrans Standard Detail D-20 for Highway Crossing Sleeves for Underground Utilities.
- D. VTrans Standard Specification for Construction, Section 625, Sleeves for Utilities.
- E. American Railway Engineering and Maintenance-of-Way Association Section for Pipelines.

## 1.03 SUBMITTALS

- A. The Contractor shall submit manufacturer's data for each size and type of casing pipe, casing spacers and end seals to be used on the Project, including: dimensions, specifications of materials, class/pressure rating, and appurtenances.

## 1.04 QUALITY ASSURANCE

- A. The Contractor shall be thoroughly trained and experienced in the skills and equipment required for installation and testing of these items.
- B. The Contractor shall protect materials before, during and after installation. In the event of damage, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.
- C. Upon direction of the Engineer, the Contractor shall remove, replace and/or rework all items that do not meet the requirements of this section. The Contractor shall perform all remedial measures at no additional cost to the Owner.
- D. Casing work crossing under existing roadways and/or railways shall be performed without disturbing the road/rail bed and without disrupting highway traffic or rail service unless authorized by Engineer and applicable highway/railway officials.

**PART 2.00 - PRODUCTS**

## 2.01 STEEL CASING PIPE

- A. Material: Casings shall be uncoated, steel pipe conforming to ASTM Specification A-139, Grade B, with electric fusion arc welded joints. Hydrostatic pressure test is not required. Manufacturer shall be Pittsburgh Pipe, or approved equal. Casings shall be new and free of rust and scales.
- B. Casing Diameter: The inside diameter of casing pipe shall be at least twelve inches (12") larger than the largest outside diameter (including bells or mechanical joints) of the carrier pipe being installed.

- C. Casing Thickness: The minimum wall thickness for casing with a nominal diameter thirty inches (30") or less shall be 3/8-inch (0.375"), except it shall be 15/32-inch (0.469") for railway crossings. The minimum wall thickness for casing with a nominal diameter more than thirty inches (30"), but less than forty inches (40") shall be 1/2-inch (0.50"), except it shall be 19/32-inch (0.594") for railway crossings.
- D. Steel pipe shall have a specified minimum yield strength of at least 35,000 psi.

## 2.02 HIGH DENSITY POLYETHYLENE (HDPE) CASING PIPE

- A. Material: HDPE Casing Pipe shall meet the reference standards, with butt fusion type joints. Hydrostatic pressure test is not required. Manufacturer shall be CSR Polypipe, Flying W, Driscopipe, or approved equal.
- B. Casing Diameter: The inside diameter of casing pipe shall be at least twelve inches (12") larger than the largest outside diameter (including bells or mechanical joints) of the carrier pipe being installed, unless otherwise noted on the Drawings.
- C. Casing Thickness: Pipe shall have a minimum wall thickness meeting DR 17.
- D. HDPE casing is not acceptable for railway crossings.

## 2.03 CASING SPACERS

- A. Casing Spacers shall be one of the following, or approved equal:
  - 1. Cascade Waterworks Manufacturing Company Model "CCS", bolt-on style, with a shell of 14 gauge, T-304 stainless steel. Shell shall have a 0.090" thick PVC liner. All nuts and bolts shall be stainless steel. Runners shall be made of ultra-high molecular weight polymer or glass reinforced polyester with a low coefficient of friction.
  - 2. Pipeline Seal & Insulator, Inc. Style "Ranger II", all non-metallic, molded in segments for field assembly without special tools. Spacer segments shall be secured around carrier pipe with slide-lock. Casing spacer polymer shall have a minimum compressive strength of 3,000 psi and an impact strength of 1.5 ft.-lbs./inch.
  - 3. Wood skids are not an acceptable method of supporting the carrier pipe.
- B. Casing spacers are not required when the carrier pipe is HDPE.
- C. Height of the supports and runners combined shall be sufficient to keep the bells of the carrier pipe at least 0.75-inches from the casing pipe wall at all times.
- D. Width of the casing spacers shall exceed the manufacturer's recommendations for the carrier pipe being supported.
- E. Each spacer shall have integral skids extending beyond the outside diameter of the bell or mechanical joint of the carrier pipe.
- F. Casing spacers shall be properly sized and spaced for the casing and carrier pipe sizes, based on manufacturer's recommendations, and the following minimum standards:
  - 1. Pressure carrier pipe: Casing spacers shall be spaced a maximum of eight feet (8') apart along the length of the carrier pipe, with one casing spacer within two feet (2') of each side each pipe joint, with the rest evenly spaced.
  - 2. Gravity carrier pipe: Casing spacers shall be spaced a maximum of six feet (6') apart along the length of the carrier pipe, with one casing spacer within two feet (2') of each side each pipe joint, with the rest evenly spaced.
  - 3. Casing spacers shall be installed within two feet (2') of each end of the casing pipe.

- G. Runner height variations shall be provided as required to provide proper slope of gravity flow carrier pipe within the casing.
  - H. Runner heights shall be provided as required to provide restraint of pressurized carrier pipe.
- 2.04 CASING END SEALS
- A. Casing end seals shall be "Model DU" or "Model KT" by Pipeline Seal & Insulator, Inc., "Style CCES" by Cascade Waterworks Manufacturing Company, or approved equal. Casing end seals shall be "seamless" slide on type. Field jointed "wrap around" type casing end seals are not acceptable.
  - B. End seals shall be 1/8-inch thick synthetic rubber, with stainless steel bands for compressing the seal around the carrier and casing pipes.
  - C. Casing end seals shall be the correct diameters for the casing and carrier pipes.

### **PART 3.00 - EXECUTION**

#### 3.01 GENERAL

- A. Refer to Section 310000 for excavating, bedding, envelope, backfilling and compaction requirements.

#### 3.02 PRODUCT STORAGE AND HANDLING

- A. Handle and transport materials to insure they are in sound, undamaged condition and to prevent damage, in accordance with manufacturer's instructions.
- B. Examine all materials before installing. Defective or damaged materials shall be rejected.
- C. If defective or damaged materials are discovered after installation, the Contractor shall remove and replace the defective piece(s) at no additional cost to the Owner.

#### 3.03 PREPARATION

- A. Boring/drilling/jacking and receiving pits shall be excavated to required depth and dimensions as determined by the Contractor.
- B. The closest edge of boring/drilling/jacking and receiving pit excavations shall not be closer than five (5) feet from the outside edge of the road shoulder.
- C. The Contractor shall provide all necessary shoring, sheeting, dewatering and other provisions necessary for successful completion of the casing installation.

#### 3.04 INSTALLATION

- A. The casing shall be installed by boring, jacking or directional drilling methods, as appropriate, at the locations and elevations shown on the Drawings. If an installation method/technique is not indicated on the Drawings, or defined elsewhere in the Contract, the Contractor may select the method/technique.
- B. Each casing section shall be adequately welded to the other, full circumference, to form a continuous casing.
- C. Should there be a loss of material outside the casing during installation, grout shall be injected to fill in the void space between the outside of the casing and the surrounding material.
- D. Casing spacers shall be installed in sufficient number and at proper spacing, to support the weight of the carrier pipe when full of liquid, in accordance with

- manufacturer's recommendations, and the requirements of Subsection 2.03.
- E. The carrier pipe shall be installed such that the joints are always being compressed.
  - F. After insertion of the carrier pipe into the casing, the ends shall be closed by installing casing end seals. The casing end seals shall completely seal the carrier pipe to the casing to prevent migration of backfill material.
  - G. The annular space shall be left empty unless otherwise directed by the Engineer.

### 3.05 PROVISIONS FOR UNSUCCESSFUL CASING INSTALLATION

- A. Utilizing "open cut" excavated trench methods for the installation of the casings shall not be the option of the Contractor.
- B. Utilizing "open cut" excavated trench methods for the installation of the casing crossing shall only be considered where attempted boring/jacking/drilling fails or proves impractical due to soil or bedrock conditions, as determined by the Engineer and regulatory officials. Excavation for the crossing of railways is not an option. Failure of boring/jacking/drilling due to inadequate or improper effort, or inadequacy/failure of the Contractor's equipment or material shall not be justification for "open cutting" or justification for requesting payment for an unsuccessful attempt.
- C. If an "open cut" excavated trench is deemed necessary, Contract unit items shall be utilized for compensation of the necessary additional work.
- D. If a casing installation is unsuccessful (i.e., not all the way across), it shall be abandoned by completely filling the casing with flowable fill.

**END OF SECTION 330507.24**



**SECTION 331400 - WATER PIPING****PART 1.00 - GENERAL**

## 1.01 WORK INCLUDED

- A. Water mains, services and fittings.
- B. Fire hydrants and flushing hydrants.
- C. Gate valves and post indicator valves.
- D. Testing of water piping.

## 1.02 REFERENCE STANDARDS

Information and requirements contained in this Specification are based on the most recent version of the following standards:

- A. AWWA/ANSI Standard C104/A21.4 for Cement-Mortar Lining for Ductile Iron Pipe and Fittings.
- B. AWWA/ANSI Standard C111/A21.11 for Rubber Gasket Joints for Ductile Iron Pipe and Fittings.
- C. AWWA/ANSI Standard C150/A21.50 for the Thickness Design of Ductile Iron Pipe.
- D. AWWA/ANSI Standard C151/A21.51 for Ductile Iron Pipe, centrifugally cast.
- E. AWWA/ANSI Standard C153/A21.53 for Ductile Iron Compact Fittings.
- F. AWWA/ANSI Standard C600 for Installation of Ductile Iron Water Mains and their Appurtenances.
- G. AWWA/ANSI Standard C605 for Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
- H. AWWA Standard C509 for Resilient-Seated Gate Valves for Water and Sewerage Systems.
- I. AWWA Standard C515 for Reduced-Wall Resilient-Seated Gate Valves for Water and Sewerage Systems.
- J. AWWA/ANSI Standard C550 for Protective Epoxy Interior Coatings for Valves and Hydrants.
- K. AWWA/ANSI Standard C502 for Dry Barrel Fire Hydrants.
- L. AWWA Standard C651 for Disinfecting Water Mains.
- M. AWWA Standard C800 for Underground Service Line Valves and Fittings.
- N. ASTM Standard Specification B88 for Seamless Copper Water Tube.
- O. AWWA Standard C900 for Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch through 12-inch.
- P. AWWA Standard C905 for Polyvinyl Chloride (PVC) Pressure Pipe, 14-inch through 36-inch.
- Q. AWWA Standard C901 for Polyethylene (PE) Pressure Pipe and Tubing, ½-inch through 3-inch.
- R. AWWA Standard C906 for Polyethylene (HDPE) Pressure Pipe and Fittings, 4-inch through 54-inch.
- S. ASTM Standard Specifications 1248 and 3350 for PE3408 High Density Polyethylene (HDPE) Pressure Pipe, with a cell classification of 345434C.
- T. ASTM Standard Specification D2241 for SDR21 (CL200) Polyvinyl Chloride (PVC) Pressure Pipe.
- U. ASTM Standard Specification D1784 for SDR21 (CL200) Polyvinyl Chloride (PVC) Resin Compound.
- V. ASTM Standard Specification D1869 and F477 for SDR21 (CL200) Polyvinyl Chloride

- (PVC) Rubber Gaskets.
- W. NSF standards for all materials used in the production of potable water pipe.
  - X. State of Vermont's "Lead in Consumer Products Law", provisions of Act 193 (9 VSA 2470h(2)).
  - Y. Title XIV of the Public Health Service Act Safety of Public Water Systems (Safe Drinking Water Act), Section 1417(d)

### 1.03 SUBMITTALS

- A. The Contractor shall submit manufacturer's certified data for each pipe type to be used on the Project, including: dimensions, specifications of pipe material, gasket material, pipe class/pressure rating, coatings and linings.
- B. The Contractor shall submit manufacturer's certified data for each type of fitting, valve, post indicator valve, hydrant, flushing hydrant, tapping sleeve, corporation and curb stop to be used on the Project, including: dimensions, specifications of fitting material, gasket material, class/pressure rating, coatings, linings, joint restraints and appurtenances.

### 1.04 QUALITY ASSURANCE

- A. The Contractor shall be thoroughly trained and experienced in the skills and equipment required for installation and testing of water piping and appurtenances.
- B. The Contractor shall protect water piping materials before, during and after installation. In the event of damage, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.
- C. Upon direction of the Engineer, the Contractor shall remove, replace and/or rework all water piping that does not meet the requirements of this section. The Contractor shall perform all remedial measures at no additional cost to the Owner.
- D. Water System Pressure and Leakage Testing (Ductile Iron, PVC and Copper Pipe only).
  - 1. Engineer shall witness all testing.
  - 2. The maximum length of pipe to be pressure and leakage tested at one time shall not exceed 1,200 feet.
  - 3. Temporary provisions (caps, plugs, valves, etc.) shall be provided and installed by the Contractor as necessary to allow sections of differing pipe types to be isolated and tested independently, due to the differing testing methodologies.
  - 4. The Contractor shall provide all necessary temporary connections, valves and piping to allow proper expulsion of air and connection of test equipment, at no additional cost to the Owner.
  - 5. Flush all piping and exhaust all air from the test section prior to performing pressure and leakage testing.
  - 6. Provide proper temporary or permanent (as applicable) thrust restraints for all system components.
  - 7. Pneumatic (compressed air or gas) testing shall not be allowed, under any circumstances, due to the severe explosive risk danger.
  - 8. Test equipment shall have pressure relief valves so that water system components are not over-pressurized.
  - 9. The pressure and leakage test shall include all services and branch lines. The Contractor shall provide temporary "tails" as necessary to allow air to be bled from each service or branch to above grade. After the system has passed the necessary tests and prior to weather below freezing temperatures, the

Contractor shall dig up each service, and as appropriate for the project, either connect the new service to the existing service, or turn off the curb stop and install a short stub of service piping out of the curb stop with a compression cap, minimum 5½ feet below grade.

10. The pressure and leakage tests shall be performed as a combined hydrostatic test with duration of two hours at 150% of the normal operating pressure in the piping at the lowest elevation or 200 psi, whichever is greater. The test pressure shall not exceed manufacturer's recommendations for any portion of the system.
  11. No water system components within the test section will be accepted if the test pressure cannot be maintained within 5 psi of the required pressure for the entire test period. During the test period, the Contractor may repeatedly pump up the test section to maintain the test pressure within 5 psi of the required test pressure, however the total volume of water added shall be logged to compare against the allowable leakage defined below.
  12. Leakage is defined as the quantity of water that must be supplied into the piping to maintain the test pressure after the pipe has been filled with water and the air expelled. The total volume of water added to bring the pressure back up to the test pressure shall be compared to the allowable leakage, even if the pressure drop is less than 5 psi during the test period.
  13. No water system components within the test section shall be accepted if the leakage is greater than that determined by the formula:  
$$L = (S \times D \times \sqrt{P}) / (148,000)$$

L = the allowable leakage, in gallons per hour  
S = the length of pipe being tested, in feet  
D = the nominal diameter of the pipe, in inches  
P = the average test pressure, in psi (gauge)
  14. The test section must pass both the pressure test and the leakage test.
  15. The Contractor shall make all repairs or replacements necessary to obtain passing test results, at no additional expense to the Owner.
- E. Water System Pressure and Leakage Testing (HDPE pipe only)
1. Engineer shall witness all testing.
  2. The maximum length of pipe to be pressure and leakage tested at one time shall not exceed 1,200 feet.
  3. Temporary provisions (caps, plugs, valves, etc.) shall be provided and installed by the Contractor as necessary to allow sections of differing pipe types to be isolated and tested independently, due to the differing testing methodologies.
  4. The Contractor shall provide all necessary temporary connections, valves and piping to allow proper expulsion of air and connection of test equipment, at no additional cost to the Owner.
  5. Flush all piping and exhaust all air from the test section prior to performing pressure and leakage testing.
  6. Provide proper temporary or permanent (as applicable) thrust restraints for all system components.
  7. Pneumatic (compressed air or gas) testing shall not be allowed, under any circumstances, due to the severe explosive risk danger.
  8. Test equipment shall have pressure relief valves so that water system components are not over-pressurized.
  9. The pressure and leakage test shall include all services and branch lines. The

Contractor shall provide temporary "tails" as necessary to allow air to be bled from each service to above grade. After the system has passed the necessary tests and prior to weather below freezing temperatures, the Contractor shall dig up each service, and as appropriate for the project, either connect the new service to the existing service, or turn off the curb stop and install a short stub of service piping out of the curb stop with a compression cap, minimum 5½ feet below grade.

10. The HDPE pipe hydrostatic leak test procedure consists of filling, an initial expansion phase, a test period, and depressurizing.
11. Fill the restrained test section completely with water.
12. Initial Expansion Phase - Gradually pressurize the test section to test pressure, and maintain test pressure for the three (3) hour expansion phase. During the initial expansion phase, polyethylene pipe will expand slightly. Additional water will be required to maintain pressure. It is not necessary to monitor the amount of water added during the initial expansion phase.
13. Immediately following the initial expansion phase, monitor the amount of make-up water required to maintain within 5 psi of the required test pressure for the two (2) hour test period.
14. The pressure and leakage tests shall be performed as a combined hydrostatic test with duration of two hours at 150% of the normal operating pressure in the piping at the lowest elevation. The test pressure shall not exceed manufacturer's recommendations for any portion of the system.
15. No water system components within the test section will be accepted if the test pressure cannot be maintained within 5 psi of the required pressure for the entire test period. During the test period, the Contractor may repeatedly pump up the test section to maintain the test pressure within 5 psi of the required test pressure, however the total volume of water added shall be logged to compare against the allowance for expansion under test pressure defined below.
16. The maximum test duration is eight (8) hours including time to pressurize, time for initial expansion, time at test pressure, and time to depressurize the test section. If the test is not completed due to leakage, equipment failure, or for any other reason, depressurize the test section completely, and allow it to relax for at least eight (8) hours before pressurizing the test section again.
17. Leakage is defined as the quantity of water that must be supplied into the piping to maintain the test pressure after the pipe has been filled with water and the air expelled, after the expansion period. The total volume of water added to bring the pressure back up to the test pressure shall be compared to the allowance for expansion under test pressure, even if the pressure drop is less than 5 psi during the test period.
18. No water system components within the test section shall be accepted if the total volume of water added to bring the pressure back up to the test pressure is greater than allowance for expansion under test pressure determined from the following table:

Table of Allowance for Expansion Under Test Pressure (HDPE Pipe)

| Nominal Pipe size (in.) | 2-Hour Test (Gal/100 ft of pipe) |
|-------------------------|----------------------------------|
| 2                       | 0.11                             |
| 3                       | 0.15                             |
| 4                       | 0.25                             |
| 6                       | 0.60                             |
| 8                       | 1.0                              |
| 10                      | 1.0                              |
| 12                      | 2.3                              |
| 14                      | 2.7                              |
| 16                      | 3.3                              |
| 18                      | 4.3                              |
| 20                      | 5.5                              |
| 22                      | 7.0                              |
| 24                      | 8.9                              |

19. The test section must pass both the pressure test and the leakage test.
20. The Contractor shall make all repairs or replacements necessary to obtain passing test results, at no additional expense to the Owner.

F. Bacteriological Testing

1. After disinfection and final flushing, but before the water system components are activated, the first set of samples shall be taken from each sampling point on the new system. After 24 hours, the second set of samples shall be taken from each sampling point on the new system. The system shall not be flushed between the samples. Two consecutive samples, taken 24 hours apart, must be taken from each sampling point on the new system. Each sample shall be tested by an approved laboratory and determined to be absent of coliform bacteria. If one of the tests fails, the sequence shall be repeated until two (2) consecutive passing tests are obtained from each sample point.
2. There shall be one sampling point for every 1,200 feet of new water main, including one sampling point from each end of the main and a minimum of one sampling point from each branch.
3. Sample collection, delivery, preservation and holding times shall comply with the requirements of the laboratory, in accordance with Health Department and AWWA standards.
4. One sample shall be taken where the project involves Building Services only.
5. The Contractor is responsible for sample collection, delivery, analysis and all fees. If deemed necessary by the Engineer, the Engineer shall be allowed to take custody and deliver samples to the laboratory.

G. Tracer Wire Testing

1. Prior to acceptance of pressure pipe, the Contractor shall demonstrate that the locator tracer wire functions properly and is connected to all tracer wire boxes. During tracer wire testing, the Contractor shall use one of several commercially available utility locating instruments to energize and trace the locator wire for continuity. Direct signal locate method shall directly apply the current from transmitter to the tracer wire and the signal shall be detected and followed with a receiver. Engineer shall witness continuity test. If the trace wire is found to be not continuous after testing, Contractor shall repair or replace segment of the tracer wire at no additional cost to the Owner.

**PART 2.00 - PRODUCTS**

## 2.01 WATER PIPING

- A. Refer to Drawings for locations and sizes of various pipe types required.
- B. Ductile Iron (DI) Water Pipe shall meet the reference standards and the following requirements, as applicable:
  - 1. Pipe shall be Class 52, ductile iron O.D.
  - 2. Pipe shall be double cement mortar lined and seal coated.
  - 3. Pipe shall be coated on the outside with bituminous coating.
  - 4. Pipe joints shall be push-on bell and spigot type with rubber gaskets, where a different joint type is not indicated on the Drawings or Specifications.
  - 5. Where indicated on the Drawings, Pipe Joints shall be Restrained Mechanical Joint (MJ) type with "Mega-Lug Series 1100" mechanical joint restraint glands as manufactured by EBAA Iron Sales, Inc., "Uni-Flange Series 1400 Wedge Action" mechanical joint restraint glands as manufactured by Ford Meter Box Co., "One-Lok" mechanical joint restraint glands as manufactured by Sigma Corporation, "Tuf Grip" mechanical joint restraint glands as manufactured by Tyler Union, "RomaGrip" mechanical joint restraint glands as manufactured by Romac Industries, or approved equal, with T-bolts and rubber gaskets.
  - 6. Where indicated on the Drawings or in this Specification, Pipe Joints shall be "Field Lock" Gasket System restrained push-on bell and spigot joint type, as manufactured by U.S. Pipe & Foundry Co., or approved equal.
  - 7. Pipe shall be furnished in 18 to 20 foot laying lengths.
  - 8. Pipe shall be installed with two bronze conductivity wedges per joint for pipe diameters of 3 inches through 12 inches, and three conductivity wedges for pipe diameters greater than 14 inches.
  - 9. Pipe shall be manufactured by Atlantic States Pipe Company, Clow, U.S. Pipe, Griffin, McWane Pipe Company, or approved equal.
- C. FUSIBLE PVC C-900 Water Pipe shall meet the reference standards and the following requirements, as applicable:
  - 1. Fusible PVC C-900 Pipe shall be DR 14 (305 psi), Ductile Iron O.D. (DIPS).
  - 2. Fusible PVC C-900 pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.
  - 3. Fusible PVC C-900 pipe shall be manufactured in a standard 40' nominal length or custom lengths as specified.
  - 4. Fusible PVC C-900 pipe shall be blue in color for potable water use.
  - 5. Pipe shall be marked verifying suitability for potable water service per NSF-61.
  - 6. Unless otherwise specified, Fusible PVC C-900 pipe lengths shall be assembled in the field with butt-fused joints. The fusion technician shall follow the pipe supplier's guidelines for this procedure. All fusion joints shall be completed as described in this specification.
  - 7. Fusible PVC C-900 sweeps or bends shall conform to the same sizing convention, diameter, dimensional tolerances and pressure class of the pipe being joined by the sweep or bend.
  - 8. Fusible PVC C-900 sweeps or bends shall be manufactured from the same fusible polyvinyl chloride pipe being used for the installation, and shall have at least 2 feet of straight section on either end of the sweep or bend to allow for

- fusion of the sweep to the pipe installation. There shall be no gasketed connections utilized with a Fusible PVC C-900 sweep.
9. Standard Fusible PVC C-900 sweep or bend angles shall not be greater than 22.5 degrees, and shall be used in nominal diameters ranging from 4 inch through 16 inch.
  10. Pipe shall be manufactured by J-M, Scepter, Ipex, or approved equal.
- D. PVC C-900 Water Pipe shall meet the reference standards and the following requirements, as applicable:
1. Pipe shall be DR 14 (305 psi), ductile iron O.D.
  2. Pipe joints shall be push-on bell and spigot type with rubber gaskets.
  3. Bell end shall consist of an integral wall section with a locked-in, solid cross section elastomeric ring.
  4. Pipe shall be furnished in 20 foot laying lengths.
  5. Pipe shall be manufactured by J-M, Scepter, Ipex, or approved equal.
  6. Where indicated on the Drawings or in this Specification, pipe joints shall be split ring serrated bell joint restraint, as manufactured by Tyler Union, Sigma, EBAA Iron, Star Products, or approved equal.
- E. PVC C-905 Water Pipe shall meet the reference standards and the following requirements, as applicable:
1. Pipe shall be DR 25 (165 psi), ductile iron O.D.
  2. Pipe joints shall be push-on bell and spigot type with rubber gaskets.
  3. Bell end shall consist of an integral wall section with a locked-in, solid cross section elastomeric ring.
  4. Pipe shall be furnished in 20 foot laying lengths.
  5. Pipe shall be manufactured by J-M, Scepter, Ipex, or approved equal.
- F. PVC Class 200 (CL200) Water Pipe shall meet the reference standards and the following requirements, as applicable:
1. Pipe shall be SDR 21, Class 200, steel pipe O.D.
  2. Pipe joints shall be push-on bell and spigot type with rubber gaskets.
  3. Bell end shall consist of an integral wall section with a locked-in, solid cross section elastomeric ring.
  4. Pipe shall be furnished in 20 foot laying lengths.
  5. Pipe shall be manufactured by J-M, Scepter, Ipex, or approved equal.
- G. HDPE (PE4710) C-906 Water Pipe shall meet the reference standards and the following requirements, as applicable:
1. The Pressure Rating and Allowable Total Pressure During Surge for PE4710 Pipe at 80° F shall be DR 11 (200 psi).
  2. Pipe shall be "Bluestripe AWWA" with the same outside diameter as ductile iron pipe (DIPS).
  3. Pipe joints shall be butt fusion type.
  4. Pipe shall be furnished in 40 foot laying lengths.
  5. Pipe shall be manufactured by CSR Polypipe, Flying W, Driscopipe, or approved equal.
- H. HDPE (PE4710) C-901 Tubing Pipe shall meet the reference standards and the following requirements, as applicable:
1. The Pressure Rating and Allowable Total Pressure During Surge for PE4710 Pipe at 80° F shall be DR 9 250 psi.
  2. Pipe shall be supplied in copper tubing size (CTS) outside diameter.
  3. Pipe shall be produced with a solid blue exterior.

4. Pipe shall be furnished in coils.
  5. Pipe joints shall be made with Mueller "110", Ford "Quick Joint", or approved equal, compression fittings. Insert stiffeners are required for compression connections.
- I. Copper Tubing Pipe shall meet the reference standards and the following requirements, as applicable:
    1. Tubing shall be soft tempered, Type "K", Copper.
    2. Pipe shall be supplied in copper tubing size (CTS) outside diameter.
    3. Pipe shall be furnished in coils.
    4. Pipe joints shall be made with Mueller "110", Ford "Quick Joint", or approved equal, compression fittings.
  - J. Each pipe length shall be clearly marked with the manufacturer's name or trademark, nominal pipe size, material designation, pressure class, dimensional ratio (DR), quality control code and AWWA/ASTM designations.
  - K. Pipe Joint Restraints shall be furnished and installed for the required number of joints back from each fitting, as required by the Drawings and details, regardless of the pipe material type.
    1. For ductile iron pipe, Pipe Joint Restraints shall be "Field Lock Gasket System" restrained push-on joint type, as manufactured by U.S. Pipe & Foundry Co.; equivalent product by Tyler Union, or approved equal.
    2. For PVC pipe, Pipe Joint Restraints shall be "Tru-Dual Bell Restraint Harness" push-on joint type, as manufactured by EBAA Iron Sales, Inc., "PV-Lock" push-on joint type, as manufactured by Sigma Corporation; equivalent product by Tyler Union, or approved equal.

## 2.02 FITTINGS

- A. Ductile Iron fittings shall be Class 350 compact style with restrained mechanical joints with tee bolts as recommended by the manufacturer. Fittings, glands and gaskets shall be of appropriate style and size for the pipes being connected.
- B. Fittings shall be double cement mortar lined and seal coated.
- C. Fittings shall be coated on the outside with bituminous coating.
- D. All mechanical joint fittings for DI and PVC pipe shall have "Mega-Lug" mechanical joint restraints as manufactured by EBAA Iron Sales, Inc., "Uni-Flange Wedge Action" mechanical joint restraints as manufactured by Ford Meter Box Co., "One-Lok" mechanical joint restraints as manufactured by Sigma Corporation, "Tuf Grip" mechanical joint restraints as manufactured by Tyler Union, "RomaGrip" mechanical joint restraint glands as manufactured by Romac Industries, or approved equal, of the proper style for the pipe type being restrained.
- E. All mechanical joint fittings for HDPE pipe shall be connected to the HDPE pipe with a butt fusion HDPE restrained mechanical joint adaptor of the proper style for the pipe and fitting type being joined. Mechanical joint adaptors must be provided with a stainless steel stiffener that is included in the manufactured fitting.
- F. All mechanical joint fittings for existing cast iron pipe only shall have "Grip Ring" mechanical joint restraints, equivalent product by Griffin Pipe, or approved equal, of the proper style for the pipe type being restrained.
- G. All couplings shall be restrained mechanical joint solid sleeves with ductile iron long body and ductile iron glands. Sleeves, glands and gaskets shall be of appropriate style and size for the pipes being connected.



**2.03 GATE VALVES**

- A. All Gate Valves shall be epoxy coated, resilient wedge type, with non-rising stem, Mueller model "2360 series", Kennedy model "Ken-Seal II", or approved equal, with restrained mechanical joints.
- B. Valves shall be bubble tight, zero leakage at a minimum working pressure of 200 psi.
- C. All gate valves shall open counter-clockwise (left) with a two inch square operating nut. Opening directional arrow shall be cast into the valve body.
- D. Gate Valves shall have stainless steel (304) nuts and bolts.
- E. Gate Valves shall have a gate wrench extension stem with a centering ring installed when the valve depth exceeds six feet.
- F. Buried valves shall be equipped with an adjustable, flanged, 5-inch diameter, cast iron valve box with a flush cover marked "WATER". The box shall enclose the valve operating nut and stuffing box. Box length shall be adequate to allow a minimum of four inches of overlap of sections with top extended to final grade.
- G. Regardless of any named manufacturer, all water main valves shall be "Lead Free". "Lead Free" shall mean that the gate valve shall have a weighted average lead content of less than 0.25%. In addition, all gate valves shall be in compliance with Vermont's Lead in Consumer Products Law, provisions of Act 193.
- H. Buried valves shall be supplied with a High-Strength Plastic Box Seat, installed on the valve stem beneath the operating nut.

**2.04 FIRE HYDRANTS**

- A. All Hydrants shall be Mueller model "Super Centurion Figure A-423".
- B. Hydrants shall have two 2½- inch and one 4½-inch nozzles with National Standard Thread.
- C. Hydrants shall have 5¼-inch main valve opening.
- D. Hydrants shall open counter-clockwise (left).
- E. All hydrant drains shall be externally sealed by the manufacturer.
- F. Contractor shall provide hydrant assembly height appropriate for bury depth of main. Finish grade shall be within three inches of manufacturer's recommended bury line.
- G. Hydrants shall be installed with standard Hydrant Tee and gate valve.
- H. Hydrants shall have stainless steel (304) nuts and bolts.
- I. Hydrants shall be factory painted conforming to NFPA standards. Contractor shall apply one field finish coat of enamel paint, after hydrant installation. Before applying finish coat, contractor shall properly clean and wire brush hydrant to remove all rust and dirt. Finish coat shall have a minimum thickness of 2.5 mils, with no bare spots or dripping.

**2.05 FLUSHING HYDRANTS**

- A. All Flushing Hydrants shall be MainGuard Model No. 77, or approved equal.
- B. Flushing Hydrants shall have one 2½ inch outlet nozzle with National Standard Thread.
- C. Flushing Hydrants shall have a 2-inch female iron pipe thread size inlet.
- D. Flushing Hydrants shall open counter-clockwise (left).
- E. Contractor shall provide hydrant assembly height appropriate for bury depth of main. Finish grade shall be within three inches of manufacturer's recommended bury line.
- F. Flushing Hydrants shall have stainless steel (304) nuts and bolts.
- G. Flushing Hydrants shall be installed with isolation curb stop and box.
- H. Flushing Hydrants shall be provided with a locking cover over the operating nut.
- I. Flushing Hydrants shall be fully serviceable without excavating.

- J. Flushing Hydrants shall be factory painted conforming to NFPA standards. Contractor shall apply one field finish coat of enamel paint, after hydrant installation. Before applying finish coat, contractor shall properly clean and wire brush hydrant to remove all rust and dirt. Finish coat shall have a minimum thickness of 2.5 mils, with no bare spots or dripping.

#### 2.06 TAPPING SLEEVES

- A. Tapping Sleeve shall be suitable for direct taps on pressurized water mains.
- B. Tapping sleeves shall be furnished with a test port, and shall be pressure tested by the tapping contractor prior to tapping the pipe. The test shall be witnessed by the Engineer.
- C. Tapping sleeves shall be:
  - 1. Ductile iron, mechanical joint type (complying with 2.02) with a flange by mechanical joint gate valve that complies with Section 2.03.
  - 2. Stainless steel, model "3490MJ PowerMJ", as manufactured by Powerseal Pipeline Products Corp., or approved equal, with a mechanical joint gate valve that complies with Section 2.03.
    - a. Stainless Steel tapping sleeve shall have mechanical joint outlet. Stainless Steel tapping sleeve with flanged outlet shall not be acceptable.
    - b. Stainless Steel tapping sleeve shall have end rings/shoulders to prevent lateral blowout of gasket.
    - c. All materials of construction and hardware shall be stainless steel (304) construction.

#### 2.07 CORPORATIONS

- A. Corporations shall be open left, full flow, ball valve type as manufactured by Mueller, Ford, or approved equal.
- B. Corporations shall have AWWA/CC taper threads on the inlet Mueller "110", Ford "Quick Joint", or approved equal restrained compression fitting on the outlet.
- C. Services larger than 2-inch shall be installed utilizing an in-line tee (see Section 2.02 FITTINGS).
- D. Corporations tapped into any pipe type other than ductile iron CL 52 shall utilize a service saddle with double stainless steel straps and nuts, of the appropriate style for the pipe type. Service saddles with U-bolt type straps are unacceptable.
- E. Regardless of any named manufacturer, all corporations shall be Lead Free. Lead Free shall mean that the brass alloy used to manufacture the corporation shall have a lead level equal to or less than 0.1%. In addition, all corporations shall be in compliance with NSF-61, Section 8.

#### 2.08 CURB STOPS

- A. Curb Stops shall be open left, full flow, ball valve type as manufactured by Mueller, Ford, or approved equal.
- B. Curb Stops shall have Mueller "110", Ford "Quick Joint", or approved equal restrained compression fittings on the inlet and outlet.
- C. Services larger than 2-inch shall utilize gate valves (see Section 2.03 GATE VALVES).
- D. Curb Stops shall be equipped with a sliding adjustable, cast iron curb box with a two-hole cover or Mueller pentagon plug type marked "WATER". Where curb stop box is located in paved or concrete areas, cover shall be pentagon plug type. Where curb

stop box is installed along with utility tracer wire, the cover shall be Curb Box EM2-XX-5x-TW with optional tracer wire screw by the Ford Meter Box Company, Inc or approved equal. The box shall be arch-type so as to enclose the curb stop and rest on a concrete base pad and not transfer force to the service or curb stop. Boxes for curb stops larger than 1-inch shall have a heavy foot piece. Box length shall be adequate to allow a minimum of four inches of overlap of sections with top extended to final grade.

- E. A 30-inch long stainless steel stationary operating rod shall be affixed to the key of the curb stop with a stainless steel cotter pin.
- F. Regardless of any named manufacturer, all curb stops shall be Lead Free. Lead Free shall mean that the brass alloy used to manufacture the curb stops shall have a lead level equal to or less than 0.1%. In addition, all curb stops shall be in compliance with NSF-61, Section 8.
- G. The Contractor shall supply the Owner with quantity three (3) curb stop wrenches, prior to the start of construction.
- H. The Contractor shall supply the Owner with quantity three (3) Pentagon curb stop/meter keys, prior to the start of construction.

#### 2.09 UTILITY TRACER WIRE AND ACCESSORIES

- A. Tracer Wire shall be #12 AWG, steel core soft drawn wire with a blue 30-mil high molecular weight, high density polyethylene jacket with a tensile strength of 380 lbs. (for direct burial applications) or 1,150 lbs. (for directionally drilled applications) as manufactured by Copperhead Industries, Inc. or approved equal.
- B. The wire jacket shall read: "12 AWG - SOLID TRACER WIRE - 30-MIL HDPE - 30 VOLT" or "12 AWG - SOLID HORIZONTAL DIRECTIONAL DRILL TRACER WIRE - 45-MIL HDPE - 30 VOLT", as applicable, at a minimum of every two linear feet. Tracer wire jacket made of THHN is not allowed.
- C. Tracer Wire Connections shall be "DryConn" Direct Bury Lugs as manufactured by Copperhead Industries, Inc., 3M™ Direct Bury Splice Kit, or approved equal.
- D. Tracer Wire Access Boxes located in paved, graveled, or concrete areas, shall be "SnakePit Magnetized Roadway Box" as manufactured by Copperhead Industries, Inc., "Cathodic Protection Test Station - Heavy Duty" by Bingham & Taylor, or approved equal. Tracer Wire Access Boxes located in all other areas shall be "SnakePit Magnetized Lite Duty Box" manufactured by Copperhead Industries, Inc., or similar as manufactured by Valvco, Inc., "Cathodic Protection Test Station - Light Duty" by Bingham and Taylor, or approved equal.
- E. When all dead ends not brought to the surface, end of tracer wire shall be connected to an anode. Anode shall be Copperhead Grounding Anode manufactured by Copperhead Industries, Inc., or approved equal.

#### 2.10 PRODUCT STORAGE AND HANDLING

- A. Handle and transport pipe and fittings to insure they are in sound, undamaged condition and to prevent damage to coating and lining, in accordance with manufacturer's instructions.
- B. Furnish slings, straps and other devices to support pipe and fittings when lifted. Do not drop or drag pipe or fittings from trucks onto the ground or into the trench.
- C. Examine all pipe and fittings before installing. Defective or damaged materials shall be rejected.
- D. Pipe or fittings with damaged coatings and/or linings shall be rejected.

- E. Cracked or chipped pipe or fittings shall be rejected.
- F. If defective pipe or fittings are discovered after installation, the Contractor shall remove and replace the defective piece(s) at no additional cost to the Owner.

### **PART 3.00 - EXECUTION**

#### **3.01 GENERAL**

- A. Refer to Section 310000 for excavating, bedding, envelope, backfilling and compaction requirements.
- B. When cutting of pipe is required, the cutting shall be done with power saws. Cut ends shall be smooth and at right angles to the pipe. Cut pipe ends shall be beveled and de-burred on interior and exterior.

#### **3.02 INSTALLATION**

- A. Water mains, building services, and appurtenances shall be installed according to the Drawings.
- B. Pipe shall be laid accurately to the lines and grades indicated on the Drawings.
- C. Pipe shall be bedded uniformly throughout its length and care shall be taken to not have any part of the pipe bearing on rocks or stones. "Point contact" at fittings, joints or along the pipe length is not allowed.
- D. All field cut pipe ends shall be chamfered to avoid damage to the gasket and facilitate assembly.
- E. Push-on bell and spigot type joints shall be assembled per the manufacturer's recommendations.
- F. Deflection of push-on joint pipe shall not exceed manufacturer's recommended limits.
- G. Restrained Mechanical Joints shall be assembled per the manufacturer's recommendations.
- H. Butt fusion pipe and fitting joints shall be assembled per the manufacturer's recommendations. Fusible PVC C-900 pipe shall be fused by qualified fusion technicians holding current qualification credentials for the pipe size being fused, as documented by the pipe supplier. Pipe manufacturer's procedures shall be followed at all times during fusion operations. Each fusion joint shall be recorded and logged by an approved electronic monitoring device (data logger) connected to the fusion machine, which utilizes a current version of the pipe supplier's recommended and compatible software. Only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process. This includes requirements for safety, maintenance, and operation with modifications made for PVC. Fusible PVC C-900 pipe shall be installed in a manner so as not to exceed the recommended bending radius guidelines. Where fusible polyvinylchloride pipe is installed by pulling in tension, the recommended maximum safe pulling force, established by the pipe supplier, shall not be exceeded.
- I. Install two or three (depending on pipe diameter) bronze conductivity wedges, installed at "3-o'clock, 9-o'clock and 12-o'clock", per manufacturer's recommendations, at all ductile iron pipe joints.
- J. All fittings shall be adequately supported to prevent undue strain on the pipe, fittings, gaskets and bolts.
- K. Tracer Wire shall be installed on all non-metallic water mains, hydrant laterals and water services. The tracer wire shall be securely fixed to the pipe at 8-10-foot intervals and secured to the pipe at 2-o'clock or 10-o'clock. Tracer wire shall be continuous and

without any splices from each tracer wire access point. Tracer Wire Access Boxes shall be installed at a maximum distance of 500-foot linear feet, next to every valve box, behind each fire hydrant, and next to service curb stop box or a curb stop box with tracer wire connection. There shall be extra tracer wire coiled up in each tracer wire box to allow for removal of the cap and frost movement. Where there is a hydrant lateral, branch line, or service line, tracer wire shall be properly spliced to the main line tracer wire. The wires to be spliced are to be tied together using a square knot to prevent pull out. Where any approved spliced in connections, water tight connectors, or approved equal, shall be used to provide electrical continuity. At all main end caps, a minimum of 5-feet of tracer wire shall be coiled with a six pound zinc anode spliced to the wire. It shall be buried along the side of the water main for future connections.

- L. All hydrants, valves and curb stops shall be set plumb and in compliance with the Drawings.
- M. Valve and curb boxes shall be installed plumb with the covers level with final grades.
- N. Pipe Joint Restraints shall be installed for the required number of pipe joints back from each fitting, as required by the Drawings and details. Plant batched, poured in place, concrete thrust blocks shall be provided at all directional changes of the main, when restrained pipe joints cannot be used (i.e. connections to existing systems) in compliance with the Drawings. Thrust Blocks shall not be backfilled within 1/2 hour of being poured to allow sufficient time for setting of the concrete. Onsite mixed concrete, such as "Sakrete", is not acceptable.
- O. Plant batched, poured in place, concrete thrust blocks shall be provided at all directional changes of the main, in compliance with the Drawings. Thrust Blocks shall not be backfilled within 1/2 hour of being poured to allow sufficient time for setting of the concrete. Onsite mixed concrete, such as "Sakrete", is not acceptable.
- P. When pipe laying is not in progress, the open ends of the pipe shall be closed with a water tight plug.
- Q. Where water mains or building services cross within two feet of drainage pipe or site conditions do not allow the minimum 5½ foot cover, the Contractor shall install two inches thick, four foot wide, of rigid insulation, suitable for direct burial, for frost protection.
- R. Cover of less than 5½ feet, shall be approved by the Engineer prior to pipe installation. Under no circumstances shall water mains or building services have less than four feet of cover over the top of the pipe. Insulation shall be installed six inches above the pipe on compacted envelope material with care taken to not damage the sheets during trench backfill and compaction.
- S. Where water mains or building services are required to cross wastewater piping, the installation shall comply with the following requirements:
  - 1. Water and sewer mains or services which cross shall have a minimum vertical clearance of 18-inches.
  - 2. Water and sewer pipe joints shall be located as far apart as possible.
  - 3. The Contractor shall provide structural support for exposed water and sewer pipes.
  - 4. For Parallel Installation, there shall be a horizontal separation of 10 feet between water mains and sanitary sewer, and a separation of 5 feet between water mains and storm sewers.
  - 5. In the event 18 inches of vertical clearance (water over sewer) or 10 feet of horizontal separation cannot be achieved or in all cases where sewer is over water (regardless of vertical separation distance), the sanitary sewer pipe must

be constructed to water main standards (CL52 D.I. or C-900 PVC) for a minimum of 10 feet in each direction as measured perpendicular to the water main. Connections at each end shall be made with "Fernco" style couplings.

### 3.03 FLUSHING

- A. All Water Piping shall be flushed at a minimum velocity of 2.5 feet per second. All pipes shall be flushed prior to Leakage and Pressure Testing, Disinfection and Bacteriological Testing.
- B. Care shall be taken to protect property from erosion or other damage during flushing operations.
- C. The flushing operation shall include all services. The Contractor shall provide temporary "tails" as necessary to flush through each service to above grade. After the system has passed the necessary tests and prior to weather below freezing temperatures, the Contractor shall dig up each service, and as appropriate for the project, either connect the new service to the existing service, or turn off the curb stop and install a short stub of service piping out of the curb stop with a compression cap, minimum 5½ feet below grade.

### 3.04 DISINFECTION

- A. At a point not more than ten feet downstream from the beginning of a new main, water entering the main shall be dosed with chlorine, fed at a constant rate, such that the entire volume of water will have a concentration of not less than 25 mg/l free chlorine. Chlorine levels shall be confirmed with a test kit, however, the following table is provided as a general guide to estimate the volume of chlorine required.

| <u>PIPE SIZE (IN.)</u> | <u>1% CHLORINE SOLUTION (GAL.)</u> |
|------------------------|------------------------------------|
| 4                      | 0.16                               |
| 6                      | 0.36                               |
| 8                      | 0.65                               |
| 10                     | 1.01                               |
| 12                     | 1.44                               |

Chlorine required to produce 25 mg/l concentration in 100 feet of pipe, by pipe diameter.

- B. Disinfection operations shall not cease until the entire main is filled with heavily chlorinated water.
- C. The disinfection operation shall include all services. The Contractor shall provide temporary "tails" as necessary to disinfect each service to above grade. After the system has passed the necessary tests and prior to weather below freezing temperatures, the Contractor shall dig up each service, and as appropriate for the project, either connect the new service to the existing service, or turn off the curb stop and install a short stub of service piping out of the curb stop with a compression cap, minimum 5½ feet below grade.
- D. The Chlorinated water shall be retained for a minimum of 24 hours, during which all curb stops, valves and hydrants in the treated section shall be operated to ensure disinfection of appurtenances. The water in all portions of the main shall have a minimum residual of 10 mg/l of free chlorine after 24 hours.

- E. The Contractor shall prevent the introduction of heavily chlorinated water into any active portions of the water distribution system.
- F. At the end of the 24 hour period, the main shall be flushed with water from the distribution system until the discharge chlorine concentration is equal to that of the system or 1mg/l free chlorine.
- G. The Contractor shall comply with all laws relevant to the discharge of chlorinated water. Water discharged directly or indirectly to water bodies shall not have a chlorine level greater than 0.1 ppm. Water bodies shall include all rivers, streams, creeks, brooks, reservoirs, ponds, lakes, springs, wetlands, and any body of surface water, artificial or natural.
- H. The Contractor shall supply all necessary de-chlorination equipment, materials, chemicals and labor necessary to reduce the chlorine level prior to discharge.
- I. Any required permits for the discharge of chlorinated water (local or State), are the responsibility of the Contractor.

**END OF SECTION 331400**

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