TRENCHING AND BACKFILLING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:
1. Trench, backfill, and compact as specified herein and as needed for installation of underground utilities located 5' outside the buildings.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

B. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner.

C. Comply with all requirements of governmental agencies having jurisdiction.

PART 2 – PRODUCTS

2.01 SOIL MATERIALS

A. Fill and backfill materials:
1. Provide backfill materials free from organic matter and deleterious substances, containing no rocks or lumps over 6" in greatest dimension.
2. Fill material is subject to the approval of the Engineer, and is that material removed from excavations or imported from off-site borrow areas, predominantly granular, non-expansive soil free from roots and other deleterious matter.
3. Do not permit rocks having a dimension greater than 2" within 2' of the outside of pipe.
4. Cohesionless material used for backfill: Provide sand free from organic material and other foreign matter, and as approved by the Engineer.

PART 3 – EXECUTION

3.01 PROCEDURES

A. Existing Utilities:
1. Unless shown to be removed, protect active utility lines shown on the drawings or otherwise made known to the Contractor prior to trenching. If damaged, repair or replace at no additional cost to the Owner.
2. When existing underground utilities, which are not scheduled for removal or abandonment, are encountered in the excavation, they shall be adequately supported and protected from damage. Any damage to utilities shall be repaired promptly at no additional cost to the Owner.
3. If the service is interrupted as a result of work under this section, immediately restore service by repairing the damaged utility at no additional cost to the Owner.
4. If existing utilities are found to interfere with the permanent facilities being constructed under this section, immediately notify the Engineer and secure his instructions.
5. Do not proceed with permanent relocation of utilities until written instructions are received from the Engineer.

B. Protection of persons and property:
1. Barricade open holes and depressions occurring as part of the work, and post warning lights on property adjacent to or with public access.
2. Operate warning lights during hours from dusk to down each day and as otherwise required.
3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout, and other hazards created by operations under this section.

C. Dewatering: The Contractor, at all times, shall conduct his operations so as to prevent the accumulation of water, ice, and snow in excavations or in the vicinity of excavated areas, and to prevent water from interfering with the progress of quality of the work. Under no conditions shall water be allowed to rise in open trenches after pipe has been placed.

D. Accumulated water, ice, and snow shall be promptly removed and disposed of by pumping or other approved means. Disposal shall be carried out in a manner which will not create a hazard to public health, nor cause injury to public or private property, work completed or in progress, or public streets, nor cause any interference in the use of streets and road by the public. Pipes under construction shall not be used for drainage of excavations.

E. Maintain access to adjacent areas at all time.

3.02 TRENCHING

A. Care shall be exercised by the Contractor to avoid disrupting the operation of existing facilities without prior written approval of the Engineer.

B. Provide sheeting and shoring necessary for protection of the work and for the safety of personnel.
1. Sheeting and bracing required for trenches shall be removed to the elevation of the pipe, but no sheeting will be allowed to be pulled, removed, or disturbed below the pipe.

C. A trench shall be excavated to the required depth and to a width sufficient to allow for joining of the pipe and compaction of the bedding and backfill material under and around the pipe. Where feasible, trench walls shall be vertical.

D. The completed trench bottom shall be firm for its full length and width.

E. If indicated on the plans or directed by the Engineer, poor foundation material encountered below the normal grade of the pipe bed shall be removed and replaced with granular backfill.

F. Where pipes are to be placed in embankment fill, the excavation shall be made after the embankment has been completed to a height of 3 feet plus the diameter of the pipe above the designed grade of the pipe.

G. Excavating for appurtenances:
1. Excavate for manholes and similar structures to a distance sufficient to leave at least 12" clear between outer surfaces and the embankment or shoring that may be used to hold and protect the banks.
2. Over-depth excavation beyond such appurtenances that has not been directed will be considered unauthorized. Fill with sand, gravel, or lean concrete as directed by the Engineer, and at no additional cost to the Owner.

H. Excavation shall not interfere with normal 45° bearing splay of foundations.

I. All trenching shall be in accordance with the latest OSHA requirements.

J. Where utility runs traverse public property or are subject to governmental or utility company jurisdiction, provide depth, bedding, cover, and other requirements as set forth by legally constituted authority having jurisdiction, but in no case less than the depth shown in the Contract Documents.

K. Where trenching occurs in existing lawns, remove turf in sections and keep damp. Replace turf upon completion of the backfilling.

3.03 BEDDING

A. Pipe Bedding Area: Prior to laying pipe, bedding material shall be placed to the limits of the excavation and to a depth beneath the pipe as specified. This material shall be either sand, gravel, or crushed stone and shall not contain large lumps and stones over one inch in diameter. As the pipe is laid, bedding material shall be extended to 6" above the pipe and leveled along the width of the trench.

3.04 BACKFILLING

A. Backfilling shall not be done in freezing weather, with frozen materials, or when materials already placed are frozen.

B. Unless otherwise specified or indicated on the plans, material used for backfilling trenches above the bedding area shall be suitable material which was removed during excavation or obtained from borrow and when compacted shall make a dense stable fill. The material shall not contain vegetation, porous matter, masses of roots, individual roots more than 18 inches long or 1/2 inch thick, or stones greater than 50 pounds or larger than six inches in the widest dimension.

C. If additional material is required, it shall be furnished from approved sources.

D. Backfill material shall be evenly spread and compacted in lifts not more than 12 inches thick or as approved by the Engineer. Previously placed or new materials shall be moistened by sprinkling, if required, to ensure proper bond and compaction.

E. Reopen trenches which have been improperly backfilled, to a depth as required for proper compaction. Refill and compact as specified, or otherwise correct to the approval of the Engineer.

F. Should any of the work be so enclosed or covered up before it has been approved, uncover all such work and, after approvals have been made, refill and compact as specified, all at no additional cost to the Owner.

G. Take special care in backfilling and bedding operations to not damage pipe and pipe coatings.

H. No compacting shall be done when the material is too wet to be compacted properly. At such times the work shall be suspended until the previously placed and new materials have dried out sufficiently to permit proper compaction, or such other precautions are taken as may be necessary to obtain proper compaction.

I. Backfill material shall be compacted to the following percentages of maximum dry density and the in-place moisture content shall not be more than 2% above the optimum moisture content, as determined by Standard Proctor ASTM D698.
1. Around all structures, under roadway paving, shoulder and embankments – 95%.
2. All other areas – 90%.

3.05 TEST FOR DISPLACEMENT OF SEWERS AND STORMDRAINS

A. Check sewers and stormdrains to determine whether displacement has occurred after the trench has been backfilled to above the pipe and has been compacted as specified.

B. Flash a light between manholes or, if the manholes have not yet been constructed, between the locations of the manholes, by means of a flashlight or by reflecting sunlight with a mirror.

C. If the illuminated interior of the pipe line shows poor alignment, displaced pipes, or any other defects, correct the defects to the specified conditions and at no additional cost to the Owner.

PUMP STATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:
1. Excavation and backfilling required for the complete construction of a sanitary sewer pump station. This shall include all pumping units and appurtenances, pipes, valves and structures necessary to complete the system as indicated on the drawings.

B. Related Sections:
1. Utility Trenching and Backfilling
2. Sanitary Sewer System

1.02 SUBMITTALS

A. Shop drawings shall be submitted to the Engineer for approval prior to any equipment being delivered to the site. Shop drawings shall include all structural, mechanical and electrical components with detailed dimensions and specifications.

B. Two complete operation and maintenance manuals shall be provided prior to final acceptance of the pump station by the Engineer.

1.03 QUALITY ASSURANCE

A. All materials and construction of same shall be as shown on the Contract Plans and shall meet the requirements of the local municipality and Vermont Agency of Natural Resources, Department of Environmental Conservation.

B. A 4" non-clog pump station, as detailed on the Contract Plans, shall be supplied complete by an experienced pump station manufacturer.

C. All applicable regulations of the Occupational Health and Safety Administration should be followed when assembling, installing, or servicing this pump station. In particular, this pump station is a confined space, under no circumstances should it be entered without the required safety equipment and precautions.

D. Electrical Equipment: Electrical systems and components (e.g. motors, lights, cables, conduits, switchboxes, control circuits, etc.) shall comply with the National Electrical Code, latest edition. In addition, equipment located in the wet well shall be suitable for use under corrosive conditions.

1.04 WARRANTY

A. The pump station manufacturer will take full responsibility for startup and operator training. The pump station manufacturer will warranty the station as a unit against defects in material and workmanship for one year from the date of startup.

PART 2 – PRODUCTS

2.01 GENERAL

A. The Contractor shall provide all fittings, couplings and appurtenances to provide a complete and operable system.

2.02 PUMPS

A. Pumps shall be non-clog submersible effluent pumps as specified on the Contract Plans.

2.03 SLIDE RAIL SYSTEM

A. Each pump shall be equipped with a slide rail system to match the pumps being used. The system shall allow easy removal of the pump and should be securely fastened to the wet well as required by the manufacturer.

B. The slide rail pipe shall be 3/4" minimum Schedule 40 galvanized steel.

C. The slide rail upper support shall be constructed entirely of galvanized steel and shall be fixed to the concrete opening directly under the hatch with galvanized anchors. All set screws and other hardware shall be galvanized steel.

D. A 1/4" minimum galvanized lifting cable shall be attached to the guide plate with an eyebolt. The cable shall be at least 7' longer than necessary to reach the top of the wet well. The top of the cable shall be coiled and shall attach to a galvanized hook welded to the upper slide rail bracket.

2.04 FLOAT SWITCHES

A. The float switches shall be normally open mechanical type rated for 5 amps. Mercury type float switches shall not be considered equal. The float switch cord shall be 16 gauge, three conductor type SJOW-A. Each switch shall have a cable weight attached four inches from the float switch as a pivot point.

B. The float switches shall be suspended from a galvanized bracket as shown on the drawing. Pole mounted switches shall not be considered equal.

2.05 CONTROL PANEL

A. The pump station shall be supplied with a non-corrosive control panel meeting the requirements of NEMA 4. The panel shall be UL listed as an assembly. The panel shall be completely compatible with the pumps. A hinged locking cover shall be provided. Pumps shall be supplied with a Hands-off A switch and amber run light elapsed time meter, circuit breaker, lightning suppressor, phase loss circuitry, seal fail indicator light, and magnetic contactor. A convenience outlet shall be provided in the control panel. The panel shall have a weatherproof alarm light and horn mounted on the outside of the enclosure. The audio alarm shall have an automatically resetting manual silence switch. The panel shall have a main fused disconnect switch. The alarm shall activate at pump failure, high water, low water, and seal failure.

2.06 WET WELL

A. Wet well shall be 72" I.D. precase concrete with a monolithic base and shall conform to the latest version of ASTM Specification C478. The tank bottom shall extend past the walls so that the outside diameter is four inch (4") minimum larger in diameter than the outside diameter of the sidewalls.

B. Shelves shall be constructed with Class B concrete, as defined in Section 501 of the VAOT Standard Specifications.

C. All manholes are to be provided with copolymer polypropylene plastic rungs with steel reinforcement, 12 inches on center. When indicated on the plans, all manholes shall be provided with aluminum access hatches of the size and type shown as manufactured by the Bilco Company (or approved equals) and/or with rough, gray manhole frames and covers as shown on the plans. All hatches are to be cast-in-place by the concrete precaster. Hatches shall come equipped with a recessed locking hasp, inside-outside handles, brass hinges, an automatic galvanized hold-open arm with a pneumatic spring and cover release, and a minimum 1/4" thick one-piece aluminum frame incorporating a continuous concrete anchor. The door panels shall be minimum of 1/4" thick aluminum diamond plate. All hardware shall be galvanized.

D. The pipe opening in the precast manhole system shall have a cast-in-place flexible gasket or an equivalent system for pipe installation as approved by the Engineer. Joints between manhole risers shall be 1 inch minimum width with flexible gaskets. All manhole lift holes shall be grouted inside and out with expandable grout.

2.07 PIPE AND FITTINGS

A. The 4" discharge pipe shall be ductile iron Class 52 thickness per ANSI A21.10, A21.50, A21.51, AWWA C110, C150, C151. The lining shall be cement per ANSI A21.4, AWWA C104. Exterior coating to be bituminous 1 mil thickness.

B. Unifianges shall be used with the pipe as shown on the drawings. The unifianges shall be made of ductile iron ASTM A536. The gasket shall be BUNA-S. The set screws shall be stainless steel. Unifianges shall be capable of withstanding a hydrostatic test pressure of 600 psi.

C. The fittings shall be flanged cast iron per ANSI A21.10, AWWA C110. Flanges shall be 125 ANSI B16.1 faced and drilled. The fitting interior shall be cement lined with a bituminous exterior coating.

2.08 VALVES

A. The check valves shall be 4" flanged swing type. The pressure rating of the check valves shall be 175 psi minimum.

B. The gate valves shall be of the resilient wedge type with a stainless steel or bronze stem and nut. The valves shall be quarter turn with a 100 % full port opening. The pressure rating of the gate valves shall be 200 psi minimum. Each gate valve shall be fitted with a galvanized extended handle which rises to within 6" of the top of the valve pit. The handle shall be supported with a galvanized support.

2.09 SPARE PARTS

A. The following spare parts shall be included with the pump station:
1. Two complete sets of all seals, gaskets, and "O" rings for the pumps.
2. Two sets of slide rail "O" rings.
3. Two of each type of light bulb in the control panel.

PART 3 – EXECUTION

3.01 EXCAVATIONS

A. Excavations shall be made to a point at least 12 inches below the structures to accommodate the crushed stone bedding material. All excavations are to be kept dry throughout construction until the structures have been inspected by the Engineer and approval given to commence backfilling operations.

3.02 BACKFILL

A. Backfill shall consist of materials meeting the granular borrow requirements of Section 02210 – Site Earthwork.

3.03 FIELD TEST

A. Upon completion of installation, the Contractor shall conduct a field test in the presence of the Engineer to demonstrate that the pumping units and all appurtenances are properly installed and deliver the specified flow/head requirements. All necessary equipment and labor to perform the test shall be furnished by the Contractor.

3.04 EXFILTRATION LEAKAGE TEST

A. The exfiltration leakage allowance out of the wet well shall be no greater than 2 gallons per day per vertical foot. The wet well shall be filled with water to the top of the structure. A stabilization period of one hour shall be provided to allow for absorption. At the end of this period, the wet well shall be refilled to the top of the structure, if necessary, and the measuring time of at least 6 hours begun. In areas of high groundwater, there shall be no visible leakage due to high groundwater.

SANITARY SEWER SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:
1. Gravity Sewer Pipe
2. Force Main Installation
3. Manhole Structures and Appurtenances

B. Related Sections:
1. Section 02225 – Utility Trenching and Backfilling

1.02 SUBMITTALS

A. Product Data: Submit published data from manufacturers of products and accessories specified, indicating compliance with requirements.

1.03 QUALITY ASSURANCE

A. All sanitary sewer materials and construction of same shall be as shown on the Contract Plans and shall meet the requirements of the State of Vermont Agency of Natural Resources (Department of Environmental Conservation) and the Public Works Standards and Specifications of the local municipality.

PART 2 – PRODUCTS

2.01 GENERAL

A. Furnish ells, tees, reducing tees, wyes, couplings, increasers, crosses, transitions and end caps of the same type and class of material as the conduit, or of material having equal or superior physical and chemical properties as acceptable to the Engineer to provide a complete and operable system.

2.02 PVC GRAVITY SANITARY SEWER PIPE

A. PVC sewer pipe shall conform in all respects to the latest revision of ASTM Specifications D-3034 or F679, Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings, SDR 35 pipe. All pipe and fittings shall be clearly marked as follows:
- Manufacturer's Name and Trademark
- Nominal Pipe Size (as shown on plans)
- Material Designation 12454-C PVC
- Legend "Type PSM SDR 35 PVC Sewer Pipe" or "PS 46 PVC Sewer Pipe"
- Designation ASTM D-3034 or F679

B. Joints shall be push-on type using elastomeric gaskets and shall conform to ASTM D-3212. The gaskets shall be factory installed. The pipe shall be furnished in nominal 13 foot lengths. Sufficient numbers of short lengths and full machine fittings shall be provided for use at manholes and connections. All connections will require the use of manufactured fittings. Field fabricated, saddle-type connections will not be considered acceptable.

2.03 PVC PRESSURE PIPE

A. PVC Pipe shall conform in all respects to the latest revisions of ASTM SpecificationsD-2241. All pipe and fittings shall be SDR 26 clearly marked as follows:

- Manufacturer's Name and Trademark
- Nominal Pipe Size (as shown on plans)
- Material Designation 12454-A PVC ASTM D-1784

B. Joints shall be push on type using elastomeric gaskets factory installed conforming to ASTM Specification D-3212.

2.04 CLEANOUTS

A. Cleanouts for gravity sewers and force mains shall be provided at locations indicated on the plans or as directed by the Engineer. Cleanout frames and covers shall be of tough gray cast iron. Castings shall be true to pattern and free from flaws. The bearing surface of cleanout frames and covers against each other shall be machined to give continuous contact throughout their circumference.

2.05 MANHOLES

A. Manholes shall be sized as indicated on the plan and shall be precast concrete with a monolithic base and shall conform to the latest version of ASTM Specification C478.

B. Shelves shall be constructed with concrete having a minimum compressive strength of 3,000 psi at 28 days. Inverts for sewer manholes shall be as shown on the plans and details and shall be constructed with concrete or brick, as per the local municipality's standards. Inverts shall have the exact shape of the sewer to which they are connected, and any change in size of direction shall be gradual and even.

C. All manholes are to be provided with copolymer polypropylene plastic steps with steel reinforcement 12 inches on center.

D. All manholes shall be provided with rough, gray, cast iron manhole frames and covers. All iron castings shall be thoroughly cleaned and then coated with hot tar before being delivered. Frames and covers shall be LeBaron LC 266, or an approved equal, and have a minimum weight of 400 pounds.

E. Precast risers and bases for manholes shall conform to ASTM Specification C-478. The pipe opening in the precast manhole system shall have a cast-in-place flexible gasket or an equivalent system for pipe installation as approved by the Engineer. Joints between manhole risers shall be 1" minimum width flexible gasket or approved equals.

PART 3 – EXECUTION

3.01 GENERAL

A. Care shall be exercised by the Contractor to avoid disrupting the operation of existing sanitary sewer facilities without prior written approval of the Engineer.

B. When existing underground utilities not scheduled for removal or abandonment are encountered in the excavation, they shall be adequately supported and protected from damage. Any damage to utilities shall be repaired promptly at no additional cost to the Owner.

C. Installation of pipe shall be in accordance with Section 02225 – Utility Trenching and Backfilling and as specified by this section.

3.02 BEDDING FOR PIPE

A. The bedding material shall be shaped to fit the pipe for a depth of not less than 10 percent of its total height and shall have recesses to receive the bell.

3.03 LAYING PIPE

A. In general, sewer pipe shall be installed in accordance with the latest detailed instructions of the manufacturer.

B. The laying shall begin at the outlet end and the lower segment of the pipe shall be in contact with the shaped bedding throughout its full length. Bell or grooved ends of rigid pipes and the circumferential laps of flexible pipe shall be placed facing upstream.

C. All pipe and fittings shall be carefully examined for defects and no pipe or fittings shall be laid which are known to be defective. If any defective piece is discovered after laying, it shall be removed and replaced at the Contractor's expense. All pipes and fittings shall be cleaned before they are laid and shall be kept clean until accepted in the completed work.

D. The pipe shall be laid to conform to the lines and grades indicated on the drawings or given by the Engineer. Each pipe shall be so laid as to form a close joint with the next adjoining pipe and to bring the inverts continuously to the required grade.

E. The Contractor shall take all necessary precautions to prevent flotation of the pipe in the trench.

F. When pipe laying is not in progress, the open ends of the pipe shall be closed with temporary watertight plugs. If water is in the trench when work is resumed, the plug shall not be removed until all danger of water entering the pipe is eliminated.

3.04 GRAVITY SEWER PIPE TESTING

A. The Contractor shall provide all necessary equipment and instrumentation required for proper completion of the flushing and testing. Quality of water, test procedures, and method of disposal of water shall be approved by the Engineer. Prior to testing, flush with water to remove construction debris.

B. All tests shall be made in the presence of the Engineer. Preliminary tests made by the Contractor without being observed by the Engineer will not be accepted. The Engineer will be notified at least eight hours before any work is to be inspected or tested.

C. The maximum sewer length to be tested at one time shall be that length between any two manholes.

D. Air Testing: Low pressure air testing shall be conducted in accordance with the following procedures:
1. Each end of the test section shall be plugged, capped and braced. Necessary safety precautions shall be taken to prevent blowouts and possible injury.
2. An air hose shall be connected to a tapped plug used for an air inlet. The hose will be connected to the air control equipment, which shall include valves and pressure gauges. These shall allow air to enter the sewer test line, monitor air pressure in the sewer, shut off air, and provide pressure reduction and relief. The monitoring pressure gauge shall have a range of 0–10 psi with divisions of 0.10 psi and accuracy of 0.05 psig.
3. The air compressor and air supply shall be connected to the test line and the test section filled slowly, until a constant pressure of 4.0 psig is maintained.
4. A pressure above 3.0 psig shall be maintained for at least five minutes to allow the temperature to stabilize. A check for leaks shall be made and if any are found, the pressure shall be released and the fitting replaced or repaired.
5. After the stabilization period, the pressure shall be adjusted to 3.5 psig and the air supply disconnected.
6. Measure and record the time interval for the test line pressure to drop from 3.5 psig to 2.5 psig.
7. If the groundwater table is above the pipe, increase above test pressures 0.5 psig for each foot the groundwater is above the invert of the pipe.
8. The requirements of this specification shall be considered satisfied if the time required in seconds for the pressure to decrease from 3.5 to 2.5 psi greater than the average back pressure of any groundwater that may submerge the pipe is not less than that computed according to the following table:

Minimum Test Time for Various Pipe Sizes	
Diameter (inches)	Time (Sec./100 Ft.)
4	18
6	45
8	75
10	90
12	110

Minimum Test Period = 1 minute

3.05 MANHOLES

A. The excavation shall be to the depth indicated on the plans or ordered by the Engineer, and carefully shaped and graded.

B. Channels, inverts and floor areas for sewer manholes shall be constructed of brick and mortar or concrete. Inverts shall have the exact shape of the sewer to which they are connected and any change in size or direction shall be gradual and even. All construction of sewer manholes must be carried out to insure watertight work.

C. The cast iron frame shall be set as indicated on the plans in a full mortar bed. The grade or cover shall be properly placed in the frame.

3.06 MANHOLE TESTING

A. Manholes shall be tested separately by one of the following two procedures:
1. Exfiltration Leakage Test: All pipes and other openings into the manhole shall be suitably plugged and the plugs braced to prevent blowout.

   The manhole shall then be filled with water to the top of the cone section. A period of time may be permitted, if the Contractor so wishes, to allow for absorption. At the end of this period, the manhole shall be refilled to the top of the cone, if necessary, and the measuring time of at least four hours begun. At the end of the test period, the manhole shall be refilled to the top of the cone, measuring the volume of water added. This amount shall be converted to gallons per vertical foot depth for 24 hours. The leakage for each manhole shall not exceed one gallon/vertical foot/day. If leakage exceeds the allowable rate, repairs shall be made as approved by the Engineer and the manhole retested.

   If the Contractor elects to backfill prior to testing, the testing shall be at his own risk, and it shall be incumbent upon the Contractor to determine the reason for any failure of the test. No adjustment in the leakage allowance will be made for unknown causes such as leaking plugs, absorption, etc. It will be assumed that all loss of water during the test is a result of leaks through the joints or through the concrete. Furthermore, the Contractor shall take any steps necessary to assure the Engineer that the water table is below the bottom of the manhole throughout the test.

2. Vacuum Test: This method of testing manholes for leakage involves the use of a device for sealing the top of the manhole cone section and pumping the air out of the manhole, creating a vacuum and holding this vacuum for a prescribed period of time. The procedure for this test is as follows:
   a. All lifting holes and exterior joints shall be filled and painted with an approved non-shrinking mortar. The completed manhole shall not be backfilled prior to testing. Manholes which have been backfilled shall be excavated to expose the entire exterior prior to vacuum testing or the manhole shall be tested for leakage by means of the exfiltration leakage test.
   b. All pipes and other openings into the manhole shall be suitably plugged in a manner to prevent displacement.
   c. A plate with an inflatable rubber ring the size of the top of the manhole shall be installed by inflating the ring with air to pressure adequate to prevent leakage of air between the rubber ring and the manhole wall.
   d. Air shall then be pumped out of the manhole through an opening in the plate until a vacuum is created inside of the manhole equal to 10 inches of mercury on an approved vacuum gauge. The removal of air shall then be stopped and the test begun.
   e. The manhole shall pass this test if the vacuum holds at 10" Hg or drops no lower than 9" Hg within the following times:

Depth of 4' Manhole	Time Minutes	Time Seconds
0' – 10'	2	0
10' – 15'	2	30
15' – 20'	3	0
20' – 25'	3	30

   f. If the vacuum drop exceeds 1" Hg during the specified time periods, the manhole shall be resealed and Steps 2 through 5 above repeated until the vacuum holds for the specified time.
   g. After the manhole passes the vacuum test, it shall be backfilled carefully so that no leaks are created. If the manhole is disturbed in any way during backfill, it shall again be vacuum tested according to Steps 1 through 5 above. If the manhole fails the vacuum test, the Contractor shall test the manhole using the manhole exfiltration test.
   h. The Contractor shall provide the Engineer with a written log of each manhole leakage test result.
   i. Manholes shall be tested and accepted prior to building manhole inverts.

3.07 PRESSURE PIPE TESTING

A. General: All force mains shall pass the hydrostatic pressure test and leakage test described herein. Prior to testing, all anchors and braces shall be installed. All concrete thrust blocks and restraints shall be in place and cured at least seven days. All buried pipe shall be back-filled. Suitable test plugs shall be installed and air release valves shall be installed at the high points.

B. Hydrostatic Test: The following procedure shall be used:
1. All air release valves shall be opened and the pipe shall be filled with water at a rate not to exceed the venting capacity of the air release valves.
2. The water pressure shall be raised to 150 percent of the designed operating pressure or 60 psi minimum at the highest point.
3. Failure to hold the designated pressure within 5 psi of the specified test pressure for the two hour period constitutes a failure of the section tested.

C. Leakage Test: The following procedure shall be used:
1. Leakage shall be defined as the quantity of water that must be supplied into the pipe being tested to maintain pressure within 5 psi of the specified test pressure.
2. No pipe installation shall be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{ND\sqrt{(P)}}{7{,}400}$$

Whichever is less

$$L = \frac{SD\sqrt{(P)}}{133{,}100}$$

S = Length of Pipe Testing
L = Allowable Leakage in Gal/Hr
D = Nominal Diameter of Pipe (")
P = Average Test Pressure (psi)
N = Number of Joints in the Pipeline Tested

SITE ENGINEER:

CIVIL ENGINEERING ASSOCIATES, INC.
P.O. BOX 485 SHELBURNE, VT 05482
802-985-2333 FAX: 802-985-2277 web: www.cea-vt.com

DRAWN PJM
CHECKED BCE
APPROVED BCE

OWNER:

STATE OF VERMONT
VERMONT AGENCY OF TRANSPORTATION
MONTPELIER, VERMONT

PROJECT:

ST. JOHNSBURY GARAGE
ROUTE
ST. JOHNSBURY, VERMONT

DATE	CHECKED	REVISION
10/5/04	BCE	GENERAL REVISIONS.

SPECIFICATIONS

DATE JUNE, 2004
SCALE N.T.S.
PROJ. NO. 04128.01

DRAWING NUMBER C4