

Section 7 GENERAL SPECIFICATIONS

7.1 SPECIFICATIONS

7.1.1 SCOPE: The work covered by this specification concerns the furnishing of all labor, equipment and materials, and the performing of all operations generally encountered in construction of utilities streets in accordance with this specification and the Standard Design Drawings of Paragraph 7.4.

7.1.2 **DEFENITIONS:**

Accepted Engineering Requirements (or Practices). Those requirements or practices which are compatible with standards required by a registered professional engineer or other duly licensed or recognized authority.

Angle of Repose. The greatest angle above the horizontal plane at which a material will lie without sliding.

Bank. A mass of soil rising above the digging level.

Belled Excavation. A part of a shaft or footing excavation, usually near the bottom and belled-shaped; i.e., an enlargement of the cross section of the shaft.

Braces (trench). The horizontal members of the shoring system whose ends bear against the uprights or stringers.

Excavation. Any man-made cavity or depression in the earth's surface, including its sides, walls or faces, formed by earth removal and producing unsupported earth conditions by reasons of the excavation. If installed forms or similar structures increase the depth-to-width relationship, an excavation may become a trench.

Hard Compact Soil. All earth materials not classified as unstable.

Kickouts. Accidental release or failure of a shore or brace.

Sheet Pile. A pile, or sheeting, that may form one of a continuous interlocking line, or a row of timber, concrete, or steel piles driven in close contact to provide a tight wall to resist the lateral pressure of water, adjacent earth or other materials.

Sides, Walls, or Faces. The vertical or inclined earth surfaces formed as a result of excavation Work.

Slope. The angle with the horizontal at which a particular earth material will stand indefinitely without movement.

Stringers (wales). The horizontal members of a shoring system whose sides bear against the uprights or earth.

Trench. A narrow excavation made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench is not greater than fifteen (15) feet.

Trench Jack. Screw or hydraulic type jacks used as cross bracing in a trench shoring system.

Trench Shield. A shoring system composed of steel plates and bracing, welded or bolted together, which supports the walls of a trench from the ground level to the trench bottom, and which can be moved along as work progresses.

Unstable Soil. Earth material that, because of its nature or the influence of related conditions, cannot be depended upon to remain in place without extra support, such as would be furnished by a system of shoring.

Uprights. The vertical members of a shoring system.

7.2 GENERAL EXCAVATION AND TRENCHING

7.2.1 REQUIREMENTS: The Town Engineer shall be notified twenty- four (24) hours before the planned construction is to commence and also before starting up whenever construction is delayed for any reason. Paragraph 7.2.2 shall apply to the construction of all public improvements as applicable.

7.2.2 GENERAL EXCAVATION AND TRENCHING: All excavation work shall conform to Part 1518-Safety and Health Regulations for Construction; of the Federal Register, Volume 36, Number 75, Department of Labor, Bureau of Standards, April 17, 1971, or the latest revision. All subparts referred to in this section are documented in Part 1518 of the Federal Register, Subpart P-Excavation, Trenching and Shoring. Work shall be carried on in a manner that will cause the least possible interference with traffic.

1. Safety.

a. Walkways, runways, and sidewalks shall be kept clear of excavated material or other obstructions and no sidewalks shall

be undermined unless shored to carry a minimum live load of one-hundred and twenty-five (125) pounds per square foot.

- b. If planks are used for raised walkways, runways, or sidewalks, they shall be laid parallel to the length of the walk and fastened together against displacement.
- c. Planks shall be uniform in thickness and all exposed ends shall be provided with beveled cleats to prevent tripping.
- d. All employees shall be protected with personal protective equipment for the protection of head, eyes, respiratory organs, hands, feet and other parts of the body as set forth in Subpart "E" of Part 1518.
- e. Employees exposed to vehicular traffic shall be provided with and shall be instructed to wear warning vests marked with or made of reflectorized or high visibility material.
- f. Employees subject to hazardous dust, gases, fumes, mists or atmospheres deficient in oxygen, shall be protected with approved respiratory protection as set forth in Subpart "D" of Part 1518.
- g. No person shall be permitted under loads handled by power shovels, derricks or hoists. Employees shall be required to stand away from vehicles being loaded.
- h. Daily inspections of excavations shall be made by a competent person. If evidence of possible cave-ins or slides is apparent, all work in the excavation shall cease until the necessary precautions have been taken to safeguard the employees.
- i. Adequate barricades, signs and warning devices shall be placed and maintained during the progress of the work.

2. Excavation.

- a. Prior to opening an excavation, every effort shall be made to determine whether underground installations, i.e., sewer, water, fuel, electric lines, etc., will be encountered, and if so, where such underground installations are located. When the excavation approaches the estimated location of such an installation, the exact location shall be determined by careful probing by hand digging, and when it is uncovered, proper supports shall be provided for the existing installation. Utility companies shall be contacted and advised of proposed work prior to the start of actual excavation.
- b. Trees, boulders and other surface encumbrances located so as to create a hazard to employees involved in excavation work or in the vicinity thereof, at any time during operations, shall be removed or made safe before excavating is begun.
- c. Excavations shall be inspected by a competent person after every rainstorm or other hazard-increasing occurrence, and the protection against slides and cave-ins shall be increased if necessary.

- d. The determination of the angle of repose and design of the supporting system shall be based on careful evaluation of pertinent factors such as: depth of cut; possible variation in water content of the material while the excavation is open; anticipated changes in materials from exposure to air, sun, water, or freezing; loading imposed by structures, equipment, overlying material, or stored material; and vibration from equipment, blasting, traffic or other sources.
- e. Supporting systems, i.e., piling, cribbing, shoring, etc., shall be designed by a qualified person and meet accepted engineering requirements. When tie rods are used to restrain the top of sheeting or other retaining systems, the rods shall be securely anchored well back of the angle of repose. When tight sheeting or sheet piling is used, full loading due to ground water table shall be assumed, unless prevented by weep holes or drains or other means. Additional stringers, ties and bracing shall be provided to allow for any necessary temporary removal of individual supports.
- f. All slopes shall be excavated to at least the angle of repose except for areas where solid rock allows for drilling or presplitting.
- g. The angle of repose shall be flattened when an excavation has water conditions, silty materials, loose boulders, and where erosion, deep frost action and slide planes appear.
- h. Excavated or other material shall not be stored nearer than four (4) feet from the edge of any excavation and shall be so stored and retained as to prevent its falling or sliding back into the excavation. Material shall be stored so as not to obstruct sidewalks or driveways and provide least possible interference with traffic.
- i. Slides, slopes and faces of all excavations shall meet accepted engineering requirement by scaling, benching, barricading, rock bolting, wire meshing, or other equally effective means. Special attention shall be given to slopes which may be adversely affected by weather or moisture content.
- j. Support systems shall be planned and designed by a qualified person when excavation is in excess of twenty (20) feet in depth, adjacent to structure or improvements, or subject to vibration or ground water.
- k. Materials used for sheeting, sheet piling, cribbing, bracing, shoring, and underpinning shall be in good serviceable condition, and timbers shall be sound, free from large or loose knots, and of proper dimension.
- l. Special precautions shall be taken in sloping or shoring the sides of excavations adjacent to a previously back-filled excavation or a fill, particularly when the separation is less than the depth of the excavation. Particular attention also shall be paid to joints and seams of material comprising a face and the slope of such seams and joints.

- m. Except in hard rock, excavations below the level of the base of footing of any foundation or retaining wall shall not be permitted, unless the wall is underpinned and all other precautions taken to ensure the stability of the adjacent walls for the protection of employees involved in excavation work or in the vicinity thereof.
- n. If the stability of adjoining buildings or walls is endangered by excavations, shoring, bracing or underpinning shall be provided as necessary to ensure their safety. Such shoring, bracing or underpinning shall be inspected daily or more often, as conditions warrant, by a competent person and the protection effectively maintained.
- o. Diversion ditches, dikes, grading, or other suitable means shall be used to prevent surface water from entering an excavation and to provide adequate drainage of the area adjacent to the excavation. Water shall not be allowed to accumulate in an excavation.
- p. If it is necessary to place or operate power shovels, derricks, trucks, materials or other heavy objects on a level above and near an excavation, the side of the excavation shall be sheet-piled, shored and braced as necessary to resist the extra pressure due to such super-imposed loads.
- q. Blasting and the use of explosives shall be performed in accordance with the Subpart "U" of Part 1518 and Paragraph 7.2.4 of this manual.
- r. When mobile equipment is utilized or allowed adjacent to excavations, substantial stop logs or barricades shall be installed. If possible, the grade should be away from the excavation.
- s. Adequate barrier physical protection shall be provided at all excavations. All wells, pits, shafts, trenches, etc., shall be barricaded or covered. Upon completion of exploration and similar operations, temporary wells, pits, shafts, etc., shall be backfilled.
- t. If possible, dust conditions shall be kept to a minimum by the use of water, salt, calcium chloride, or other means.
- u. In locations where oxygen deficiency or gaseous conditions are possible, air in the excavation shall be tested. Controls, as set forth in Subparts "D" and "E" of Part 1518, shall be established to assure acceptable atmospheric conditions. When flammable gases are present, adequate ventilation shall be provided or sources of ignition shall be eliminated. Attended emergency rescue equipment, such as breathing apparatus, a safety harness and line, basket stretcher, etc., shall be readily available where adverse atmospheric conditions may exist or develop in an excavation.
- v. Where employees or equipment are required or permitted to cross over excavations, walkways or bridges with standard guardrails shall be provided.

- w. Where ramps are used for employees or equipment, they shall be designed and constructed by qualified persons in accordance with accepted engineering requirements.
 - x. All ladders used on excavation operations shall be in accordance with the requirements of Subpart "L" of Part 1518.
3. Trenching:
- a. Banks more than four (4) feet high shall be shored or sloped to the angle of repose where a danger of slides or cave-ins exists as a result of excavation.
 - b. Sides of trenches in unstable or soft material, four (4) feet or more in depth, shall be shored, sheeted, braced, sloped or otherwise supported by means of sufficient strength to protect the employees working within them.
 - c. Sides of trenches in hard or compact soil, including embankments, shall be shored or otherwise supported when the trench is more than four (4) feet in depth and eight (8) feet or more in length. In lieu of shoring, the sides of the trench above the four (4) foot level may be sloping to preclude collapse, but shall not be steeper than a one (1) foot rise to each one-half (1/2) foot horizontal. When the outside diameter of a pipe is greater than six (6) feet, a bench of four (4) foot minimum shall be provided at the toe of the sloped portion.
 - d. Materials used for sheeting and sheet piling bracing, shoring and underpinning, shall be in good serviceable condition and timbers used shall be sound and free from large or loose knots, and shall be designed and installed so as to be effective to the bottom of the excavation.
 - e. Additional precautions by way of shoring and bracing shall be taken to prevent slides or cave-ins when excavations or trenches are made in locations adjacent to backfilled. eExcavations or where excavations are subjected to vibrations from railroad or highway traffic, the operation of machinery or any other source.
 - f. Employees entering bell-bottom pier holes shall be protected by the installation of a remove able-type casing of sufficient strength to resist shifting of the surrounding earth. Such temporary protection shall be provided for the full depth of that part of each pier hole, which is above the bell. A lifeline, suitable for instant rescue and securely fastened to a shoulder harness, shall be worn by each employee entering the shafts. This lifeline shall be individually manned and separate from any line used to remove materials excavated from the bell footing.
 - g. Where employees are required to be in trenches three (3) feet deep or more, ladders, extending from the floor of the trench excavation to at least three (3) feet above the top of the excavation, shall be provided and so located as to provide means of exit without more than twenty-five (25) feet of lateral travel.

- h. Bracing and shoring of trenches shall be carried along with the excavation.
- i. Cross branches or trench jacks shall be placed in true horizontal position, be spaced vertically and be secured to prevent sliding, falling or kick-outs.
- j. Portable trench boxes or sliding trench shields may be used for the protection of employees only. Trench boxes or shields shall be designed, constructed and maintained to meet acceptable engineering standards.
- k. Backfilling and removal of trench supports shall progress together from the bottom of the trench. Jacks or braces shall be released slowly and in unstable soil, ropes shall be used to pull out the jacks or braces from above after employees have cleared the trench.
- l. The Developer shall, for a period of one (1) year after completion and acceptance of trench work, maintain and repair any trench settlement which may occur and shall make suitable repairs to any pavement, sidewalks or other structures which may be damaged as a result of backfill settlement. When the developer is notified by the Town that any backfill is hazardous he shall correct such hazardous condition at once or the Town may choose to make the repairs and bill the Developer for the work performed.

7.2.3 PROTECTION OF UTILITY LINES, STRUCTURES, AND PUBLIC AND PRIVATE INSTALLATIONS: The Contractor shall take proper precautions for the protection of utility lines, manholes, valve boxes, survey monuments and other structures, the presence of which are known or can be determined by examination of appropriate maps. He shall notify the Owner of the utility when working near a utility line or appurtenance or when the presence of these utilities is suspected in utilities or other structures. Should the Contractor in any way cause damage to utility lines, he shall be solely responsible for notifying the utility company involved and shall be liable for all costs involved in repairing the damaged line. All existing manholes and valve boxes shall be adjusted to final grade by the Contractor. Where spacer rings are installed, they shall have a wide slotted flange for support and be equal to Clay-Bailey #3100 or as approved by the Town representative. If any existing manhole rings and covers or valve boxes are found to be defective, they shall be replaced as directed by the Town representative.

The Contractor shall take proper precautions for the protection of and replacement or restoration of driveway culverts, street intersection culverts or gutter pans, storm drains or inlets, fences, irrigation ditches, crossings and diversion boxes, mail boxes, shrubbery, flowers, ornamental trees, driveway approaches and all other public or private installations that may be encountered during construction. He shall have the responsibility of providing each property with access during the time of construction. Existing driveways shall be cut, filled and graded as required or as

directed by the Town representative to provide permanent access. Existing driveways shall be resurfaced with the presently existing type of surfacing, whenever existing surfaces are destroyed.

7.2.4 EXPLOSIVES: Explosives may be used only after obtaining an explosive permit authorized by the Town Administrator, in conformance with Section 9-10 of the Lyons Municipal Code. Explosives shall be handled, used, and stored in accordance with all applicable regulations. The Town Administrator's approval of the use of explosives shall not relieve the contractor from his liability for claims caused by his blasting operations. All explosives shall be stored in a secure manner in compliance with all laws and ordinances, and all such storage places shall be clear marked. Where no local laws or ordinances apply, storage shall be provided satisfactory to the Town Engineer and in general no closer than 1,000 feet from the road or from any building or camping area or place of human occupancy.

The contractor shall be responsible for notifying each utility company having structures or other lines in proximity to the site of the work of his intention to use explosives. Such notice shall be given in writing a week in advance to enable the various companies to take such steps as they may deem necessary to protect their facilities from damage.

The contractor shall indemnify and save harmless the Town of Lyons, its officers and employees, from all suits, actions, claims, losses, or expenses of any character brought because of any injuries or damages alleged to have been received or sustained by any person, persons, or property on account of the operations of the contractor.

7.2.5 GENERAL PIPE INSTALLATION: Piping for storm drainage, irrigation lines, sanitary sewers, water systems, service lines and laterals, to be installed in easements or public right-of-way, under the jurisdiction of the Town, shall be excavated, bedded, backfilled and the trench resurfaced in accordance with approved engineered plans, and these specifications.

1. Separation of Water Mains and Sewers:
 - a. Water mains shall be laid at least ten (10) feet horizontally from any sanitary sewer, storm sewer or sewer manhole. The distance shall be measured edge-to-edge.
 - b. When local conditions prevent horizontal separation at ten feet, a water main may be laid closer to a storm or sanitary sewer provided that:
 - 1) The invert of the water main is at least eighteen (18) inches above the crown of the sewer main.
 - 2) If the invert of the water main is less than eighteen (18) inches above crown of the sewer main, the sewer shall be encased in concrete until there is a horizontal separation of ten feet on either side of the water main.

- c. When water mains cross storm or sanitary sewers:
 - 1) The invert of the water main shall be at least eighteen (18) inches above the crown of the sewer main.
 - 2) If the invert of the water main is less than eighteen (18) inches above crown of the sewer main, the sewer shall be encased in concrete for a distance of ten (10) feet perpendicular to each side of water main. One full length of water main shall be centered on the sewer so that both joints will be as far from the sewer as possible.
- d. The minimum clearance between storm sewer and sanitary sewer, either above or below, shall be 12 inches. However, when a sanitary sewer main lies above a storm sewer, or within 18 inches below, the sanitary sewer shall be constructed of materials and with joints equivalent to water main standards or shall be encased in concrete for a minimum of 10 feet on each side of where the storm sewer crosses.
- e. All water and sewer main crossings shall be shown in plan and profile on the utility plans submitted to the Town for approval.
- f. Encasement shall be interpreted to mean placing concrete, on a prepared subgrade and between formed sides so as to encase the line a minimum of six (6) inches on all sides. Pipe shall be wrapped with 8 mil plastic prior to concrete placements.

Backfill along the sides and over the concrete encasement shall be a well-graded material, hand tamped to a 95% dry density, one (1) foot each side of the encasement. The trench shall then be backfilled to surface subgrade in accordance with Section 7.

- 2. Materials: Materials, other than pipe and fittings, which are to be placed within the trench limits and below finished grade, shall conform to the minimum standards hereinafter referred to. Specifications and detailed recommendations for acceptable practices set forth by the American Society for Testing Materials (ASTM), the American Association of State Highway Officials (AASHO) and the Colorado Department of Highways (CDH) are made a part of these specifications.
 - a. **Pipe Foundation Stabilizer** ¾ “ to 1-1/2” dense, durable rock with less than 15% passing the #4 sieve.
 - b. Pipe Bedding: Free draining material meeting the following general gradation:

<u>%Passing Designated Sieve</u>						
Sieve Structure Size	<u>Sand</u>	<u>Squee</u>	Crusher	<u>Fines</u>	Products <u>Base</u>	<u>Fill Sand</u>
<u>Backfill</u>						

2"						100
¾"				100		
½"				90-100		
3/8"	100		100	100	75-90	100
#4	95-100	40-90		95-100	55-75	65-90
#16	45-80					
#50	10-30					60 max.
#100	2-10					
#200		0-5		0-12	0-12	0-5
LL						35 max.
PI						6 max.

Note: (1) Shall only be used on flexible conduits 36" in diameter and larger.

c. Backfill:

Soils and soil aggregate mixtures classified in accordance with AASHMO M-145, Table 2, which also meets the categories hereinafter specified.

A Special Backfill Material

Gravel, Stone Fragments, Sands and Silty Soils					
Group Classification	A-1-a	A-1-b	A-3		
<u>A-2-4</u>					
Sieve Analysis-					
% Passing					
#10	50 max.				
#40	30 max.	50 max.	51 min.		
#200	15 max.	25 max.	10 max.	35	
max.					
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Characteristics of	L.L.		40		
max.					
Fractions (-#40 Sieve)	P.I.	6 max.	6 max.	N.P.	
10 max.					
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B Acceptable Backfill Material

<u>Silty or Light Clayed Gravel Sand and Soils</u>			
Group Classification	A-2-5	A-4	
<u>A-5</u>			
Sieve Analysis			
% Passing			
#200	35 max.	36 min.	36 min.
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Characteristics of Fraction	LL (- #40 Sieve)	41 min.	40 max.	41 min.
	PI	10 max.	10 max.	10 max.

C Generally Unacceptable Backfill Material

Heavy Clayey Gravels and Soils

Group Classification	A-2-6	A-2-7	A-6
A-7			
Sieve Analysis - % Passing			
#200 min.	35 max.	35 max.	36 min. 36
Characteristics of min.	L.L. 40 max.	41 min.	40 max. 41
Fractions (- #40 Sieve) min.	P.I. 11 min.	11 min.	11

Note: Material in Category “C” above shall be disposed of and replaced with acceptable material.

3. Construction:

- a. Excavation: The excavation shall be made to lines and grades shown on the plans and as established by the Engineer. All excavation shall be unclassified and the contractor shall be responsible for and take special precautions to prevent damage to all adjacent structures. Ground shall be excavated in open trenches, except where tunneling is called for in the plans or considered necessary or proper by the Town Inspector. Prior to excavating in hard surfaced areas, the outer limits of the trench shall be stringlined and the surfacing cut in a vertical plane by sawing or roller blade. Nominal trench width Limits at the surface, which shall be the width used in determining the quantity of resurfacing or patching for payment shall be three feet plus the outside diameter of the pipe, unless otherwise approved in by the Town Inspector. During construction, should the vertical asphalt edges ravel, they shall be trued to a vertical plane to a point six inches outside the limits of excavation prior to placing the

resurfacing material. Surfacing materials such as concrete and asphalt shall be removed to neat lines and disposed of independently of the underlying soil; base course and gravels are to be salvaged to stock-pile, protected from contamination and reused for special backfill.

Soils removed from the trench which meet the requirements for backfill materials, shall be stockpiled in a manner which will not endanger the performance of work, obstruct sidewalks or driveways and provide the least possible interference with traffic. Soils encountered which are unacceptable for use as backfill shall be disposed of by the contractor at his expense.

- b. Trenching: Trenches shall be excavated to the depth required for the bedding and foundations of the pipe and appurtenances. Where underdrains are to be installed, the trench shall be dug to the cross section shown on the Town of Lyons Standard Design Drawings, Figure 7-1.

The width of the trench shall be ample to permit the pipe to be laid and joined properly and the backfill to be placed and tamped. In order to prevent the application of superimposed loadings on pipe in excess of the designed and specified pipe strengths, the maximum width of the bottom portion of the pipe trench as dug (for a vertical distance above the pipe subgrade equal to the outside diameter of the pipe plus six (6) inches) shall not exceed the outside diameter of the pipe plus 24 inches. Where, because of caving, blasting or other causes, the trench width exceeds that allowed herein, the Contractor will be required to lay the pipe in a bedding of suitable selected granular material, or encase the pipe in concrete, to protect the pipe from excessive loading. Excavation will not be permitted to advance more than 150 feet ahead of pipe laying and 200 feet ahead of backfill operations. The contractor shall provide and maintain adequate equipment to properly remove and dispose of all surface or ground water entering the trench. The use of any pipe line under construction to dispose of trench water will not be permitted. The trench shall be dry at all times during pipe installation and so maintained until the jointing operation is complete.

Where soft unstable soils, dense shale, or rock is encountered at the normal trench bottom, the contractor shall undercut and dispose of such materials, to the limits established by the Town representative, and backfill the void thus created with pipe foundation stabilizer material and bedding material.

In dense shale or rock the undercutting shall be not less than 6 inches and in unstable soils to not less than 12 inches below the bottom of the pipe barrel and the void replaced to within three inches of the pipe with the stabilizer material.

- c. Bedding: All pipe, regardless of type or diameter, shall be installed on sufficient bedding material so as to provide a minimum of 3 inches separation between the subsoil and the pipe barrel, after consolidation. Where pipe collars, bells or flanges protrude in excess of 3 inches from the pipe barrel, the contractor shall hand excavate in these areas sufficiently to allow the pipe barrel to rest uniformly on the bedding material. Pipe being supported by the collars, bells or flanges on natural soils will not be allowed. Unauthorized and excessive trench depths shall be filled to bedding subgrade with foundation stabilizer material at the contractor's expense. Reuse of trench- excavated soils will not be permitted in the trench until the pipe and bedding materials have been properly installed.
- Pipe 16 inches and smaller in diameter, regardless of type, and all non-reinforced concrete, clay, asbestos cement, ductile iron, cast iron, CSP, PVC and steel pipe, regardless of diameter shall also be enveloped with consolidated bedding material between the trench banks and to a cover above the pipe of not less than 12 inches. French or perforated under-drains shall be fully embedded in pipe foundation stabilizer material to 6 inches each side of the pipe unless otherwise detailed on the drawings.
- Reinforced concrete and pre-stressed concrete cylinder pipe, 18 inches and larger in diameter, need only be encased to springline with consolidated bedding material between the trench banks.
- d. Bedding Installation: Pipe bedding material shall be placed in the trench to a loose depth of 4 inches and then fine graded along the pipe center line to a thickness of 3 inches. Special precautions shall be taken to remove sufficient bedding material at the point where the pipe bell, collar or flange will fall to insure a uniform bearing of the pipe barrel throughout its entire length.
- After the pipe is properly set and jointed to line and grade and inspected by the Town Inspector, a second loose lift of bedding material, not to exceed 8 inches, shall be placed along each side of the pipe and then consolidated by tamping or vibration until uniform support under the pipe haunch is obtained. All additional bedding shall be carefully placed to the limits specified and consolidated by a combination of tamping and vibrating. At all times special precautions shall be taken to prevent displacement of or damage to the pipe. No pipe shall be covered before being inspected by the Town Inspector. Bedding material shall be compacted to 95 percent of Standard Proctor when tested in accordance with AASHTO T99.
- e. Underdrains: Underdrains shall be installed where shown on the approved plans. Where excessive ground water is encountered, the Town Engineer may also require construction of gravel or piped

underdrains as necessary to reduce infiltration. Underdrains shall be daylighted to the nearest suitable point designated on the approved plans or by the Town Engineer. The trench shall be excavated to the required depth and width and backfilled with washed pipe stabilizer material as shown in Figure 7-1. Underdrain pipe shall be installed to a true line and grade and shall be provided with cleanouts within each manhole installed on the line. Underdrain pipe shall be continued under manholes by use of suitable bends and other fittings.

- f. Pipe Handling: Pipe shall be hauled, handled and lowered into the trench in such a manner as to insure against breakage, damage of interior and exterior coatings and the bell and spigot ends. All pipe delivered to job site is subject to Town inspection and may be rejected based on the Inspector's judgement. All pipe and fittings shall be carefully examined for cracks and other defects while suspended above the trench immediately before installation in final position. The groove in the bells of cast iron pipe shall be full and continuous or the pipe shall be removed from the job site within 24 hours. All foreign matter or dirt shall be removed from the interior and ends of pipe and accessories before they are lowered into position in the trench. Every precaution shall be taken to prevent foreign materials, including trench water, from entering the pipe.
- g. Alignment and Grade: Pipe shall be laid accurately to the line and grade indicated in the approved drawings by the use of grade bars (batter boards) or suitable surveying instruments operated continuously during construction. Determination of correct line and grade shall be made under the supervision of a registered engineer or land surveyor.
- h. Backfill and Compaction: After placing pipe and pipe bedding the open trench shall be backfilled to the level of the original ground surface as specified below.
 - 1) Around Pipe: Backfill material around non-bedded portion of pipe and manholes shall meet the pipe foundation stabilizer material specifications (Paragraph 7.2.5, Subparagraph 2a)
 - 2) Remainder of Backfill: The remainder of the backfill shall be the original excavated material consisting of clay, sand, gravel, soft shale or other material suitable to achieve proper compaction. The size and number of rocks or stones used in the backfill shall be such as not to interfere with proper compaction as determined by the Town Inspector. Backfill shall be placed in lifts of which the loose depth shall not exceed 18 inches. Original excavated material that is unacceptable for backfill shall be disposed of at the Contractor's expense and replaced with

acceptable backfill material specified in Paragraph 7.2.5 Subparagraph 2c.

- 3) No rocks or stones in excess of three (3) inches in diameter shall be included in the top one (1) foot of the trench. Where surfacing is to be placed over the trench, the six (6) inches shall be a select graded granular road base material as specified in Paragraph 3.2.3 Subparagraph 3 of this manual.
- 4) Compact fill materials to following densities at optimum moisture content:
 - a) Structural Fill. Under and adjacent to all concrete foundations, to 95% maximum density.
 - b) Granular Fill. 90% maximum density.
 - c) Unclassified Fill. Areas to receive pavements: 90% maximum density except top four (4) feet which shall be 95% maximum density. Overlot areas: to 90% maximum density.
 - d) Maximum density shall be defined by the ASTM Specification D698, otherwise known as Standard Proctor. The moisture content of the backfill material shall be such that the contractor is able to meet the specification.

If, in the judgment of the Town Inspector, optimum moisture is not present in backfill material, wetting will be allowed. Jetting or inundation will not be permitted.

7.2.6 EXCAVATION IN EXISTING SURFACED STREETS: If for any reason whatsoever, any contractor, public or private utility, has to open up or otherwise perform any excavation in any street which is surfaced, the following requirements shall apply:

1. Notify the Town Clerk, Town of Lyons, at least forty-eight (48) hours in advance of the proposed work. Obtain a street cut permit. Only one side of a street may be closed at any one time.
2. Notify the public and/or private utility companies which could be involved.
3. The cutting of any existing bituminous or concrete surfaced street shall be accomplished by either wheel-cutting or saw-cutting only.
4. The replacement of the street pavement section shall comply with Paragraph 7.2.7.
5. Adequate barricades, signs, and warning devices shall be placed and maintained during the progress of the work.

7.2.7 RESURFACING: Paving, curb, gutters, sidewalk, improved surfaces, or other street improvements removed, damaged or destroyed during construction shall be replaced to the same elevation and alignment, equal to and consistent with the undisturbed portions of the improvements existing prior to trench excavation. Subgrade for all restored surfaces

shall be thoroughly compacted in accordance with Paragraph 7.2.5 Subparagraph 3h.

1. Materials:
 - a. Aggregate Base Course: Aggregate base course shall conform to Paragraph 3.2.3 Subparagraph 3 of this manual.
 - b. Bituminous Surfacing: Asphalt surfacing shall conform to Paragraph 3.2.3 Subparagraph 7.
2. Construction: Surface replacement shall be the placement of 6"-8" of concrete or 3" asphaltic concrete on six (6) inches of compacted base course, previously placed and compacted over a stabilized trench backfill subgrade. Method of installation shall conform with Section 3 of this manual.

Where gravel surfaces are to be replaced, the Contractor, prior to trench excavation, shall salvage all existing gravel surfacing by windrowing or any other method he may elect, so as to prevent contamination of the surfacing material.

Following compacting of the backfill to six (6) inches below natural grade and disposal of the surplus material from excavation, the Contractor shall top out the trench with a six (6) inch compacted layer of base course material. The salvaged gravel surfacing shall then be replaced and the street restored to equal or better condition than existed prior to starting construction.

7.2.8 CONCRETE: Unless otherwise noted, all concrete referred to in these specifications shall have a minimum compressive strength of 3000 psi in 28 days. The concrete mix shall have a maximum slump of four (4) inches.

7.2.9 WORK PROGRESS AND STREET MAINTENANCE DURING CONSTRUCTION: The complete backfilling operation to the finished grade and cleanup operation shall be prosecuted on a continuous basis and shall follow within 50 feet of the installation of the pipe. However, at the end of each working day, pipe backfill shall be completed to within 20 feet of the installation of the pipe.

During construction, trench backfill in existing streets shall be topped out with not less than nine (9) inches of aggregate base course and maintained free of chuckholes, ruts and loose rock, until asphalt surfacing is in place. Resurfacing of the street shall be accomplished in accordance with Paragraph 7.2.7 within 14 days of backfilling.

During cold weather, when the asphalt plants are closed, the contractor shall install and maintain 1-1/2 inches of temporary cold bituminous surfacing in a rut-free, smooth riding condition. In the spring the contractor shall remove the temporary surfacing and install surfacing in accordance with Paragraph 7.2.7.

Immediately following installation of the temporary or permanent asphalt surfacing, the entire width of the asphalt surface and concrete gutter, if in

place, shall be cleaned of all debris and maintained free of rock and debris throughout the construction period.

No separate payment will be made for installing and removing cold bituminous surfacing or base course, but will be considered a subsidiary obligation of the work.

7.3 TESTING

Compaction tests shall be the responsibility of the contractor and the test results supplied to the Town Inspector prior to final acceptance or use of the pipe line. The frequency of tests shall be as follows:

At least one compaction test for every 300 feet or less of pipe line installed. The depth and location at which the test is to be conducted shall be designated by the Town Inspector. This requirement can be relaxed at the discretion of the Inspector.

The compaction test shall be performed in the presence of the Town Inspector.

The tests will be conducted by a certified laboratory or signed by a professional engineer registered in the State of Colorado.

7.3 STANDARD DESIGN DRAWINGS

Figure 7-1 Underdrain Details