

SECTION 800

SEWERS

SECTION 801 - SANITARY SEWERS

801-1 DESCRIPTION

This item shall consist of pipe of the types, classes, sizes, and dimensions required on the plans, furnished and installed at the places designated on the plans and profiles or by the ENGINEER in accordance with these specifications and with the lines and grades given.

The bid price per linear foot of pipe in place shall include the cost of excavation and backfill, the cost of furnishing and installing all trench bracing, all fittings required to complete the sewer pipe, as shown on the plans, and the material for and the making of all joints, including all connections to existing sewer pipe and manholes.

"Unstable," "Suitable," "Unsuitable," and "Unsatisfactory" soil or aggregate items shall be defined as stated in Section 202.1.

801-2 MATERIALS

801-2.1 GENERAL. The pipe shall be of the type selected by the CONTRACTOR and shall be in accordance with the following appropriate requirements unless otherwise specified.

801-2.2 CONCRETE SANITARY SEWER PIPE. Concrete sanitary sewer pipe, reinforced, shall conform to the requirements of ASTM C76.

801-2.3 POLYVINYL CHLORIDE SANITARY SEWER PIPE. Polyvinyl chloride sanitary sewer (PVC) pipe 15 inches or smaller shall conform to the requirements of ASTM D3034 for type PSM, PVC sewer pipe and fittings and shall have an SDR of 35, all of which shall be stamped on the pipe. Polyvinyl chloride sewer pipe 18" or larger shall conform to the requirements of ASTM F679-PS46. PVC sewer main line pipe and PVC sewer service pipe shall have the elastomeric gasket type joint providing a watertight seal. A solvent cement type joint will not be allowed. PVC Wye branches shall be of the "factory assembled type."

801-2.4 RUBBER GASKET JOINT FOR CONCRETE SANITARY SEWER PIPE. Rubber-type gaskets for concrete non-pressure pipe shall conform to the requirements of ASTM C443, or ASTM C361.

801-2.5 MORTAR. Mortar for connections to manholes shall be composed of one (1) part, by volume, of Portland Cement and two (2) parts of mortar sand. The Portland Cement shall conform to the requirements of subsection 501-2.2. The sand shall

conform to the requirements of subsection 501-2.5. Hydrated lime may be added to the mixture of sand and cement in an amount equal to 15% of the weight of cement used. The hydrated lime shall meet the requirements of ASTM C6.

801-2.6 PVC SEWER PIPE JOINT CEMENT. Use of PVC sewer pipe joint cement must be approved by the ENGINEER prior to construction. The polyvinyl chloride sewer pipe joint cement shall consist of a viscous brushable solution of polyvinyl chloride in suitable active solvents. The cement shall be purchased from the pipe manufacturer and used in accordance with the manufacturer's instructions. It shall produce a joint of sufficient strength to permit normal installation handling within 5 minutes after jointing when exercising reasonable care.

801-2.7 RUBBER GASKET JOINT FOR PVC SEWER PIPE. Rubber gaskets for PVC sewer pipe joints shall be of the elastomeric type providing a watertight seal and shall conform to ASTM D3212.

801-2.8 CONCRETE. Concrete for pipe cradles and saddles shall conform to the requirements of Section 501.

801-2.9 BEDDING MATERIAL. The bedding material shall consist of granular material in accordance with the requirements for gradation shown in the following table:

Square Mesh Sieve Size	Percent By Weight Passing
2"	100%
1"	90-100%
3/4"	80-100%
No. 4	30-90%
No. 30	10-60%
No. 100	0-15%

One gradation test shall be made for each source and change in material provided for each 500 tons of screened and/or blended material and for each 200 tons of non-screened or "bank run" material. Gradation testing shall be incidental to the pipe or other bid items.

The CONTRACTOR may provide a controlled density fill in lieu of the bedding material bed for underground pipe if approved by the ENGINEER prior to installation. The controlled density fill shall conform to Section 503.

If the controlled density fill is placed in the trench in a plastic state, the remaining backfill may not be completed for 48 hours. One compression test shall be made for each 60 C.Y. of control density fill or a minimum of 1 per day. A testing firm normally engaged in materials testing shall make the test at the expense of the CONTRACTOR. The CONTRACTOR shall remove and replace any material not meeting the requirements at CONTRACTOR's own expense. All controlled density fill shall be designed for easy

removeability should it become necessary to repair or remove the pipe in the future. The pipe shall be protected from floating to maintain line and grade.

Controlled density fill shall be paid as bedding material unless otherwise specified. Controlled density fill utilized on the remainder of the trench may be provided incidental if approved by the ENGINEER.

Bedding quantities are based on trench width in Section 801-3.2 Excavation and Preparation of Trench. Any additional bedding material due to a wider ditch shall be the responsibility of the CONTRACTOR.

801-2.10 SUBCUT GRAVEL. The subcut gravel shall consist of granular material in accordance with the requirements of gradation shown in the following table:

Square Mesh Sieve Size	Percent By Weight Passing
2"	100%
No. 4	0-10%

801-2.11 MARKING TAPE. The CONTRACTOR will be required to furnish and install marking tape located 2 feet above the top of all sanitary sewer mains installed under this contract. The tape shall be of the non-detectable type and shall have a minimum width of 5 inches. The tape shall be green in color with the words "CAUTION SEWER LINE BELOW" imprinted on the tape in black capital letters. The marking tape shall be equal to that manufactured by Griffolyn Company, Inc.

Cost of marking tape and installation shall be considered incidental to other items.

801-2.12 SANITARY SEWER FORCEMAIN MATERIALS. All materials for construction of sanitary sewer forcemains shall conform to Section 901 Watermains.

801-3 CONSTRUCTION REQUIREMENTS

801-3.1 EQUIPMENT. All equipment necessary and required for the proper construction of sanitary sewers shall be on the project in first-class working condition and approved by the ENGINEER before construction is permitted to start.

The CONTRACTOR shall handle the pipe while unloading and placing it in its final position without damage to the pipe.

The CONTRACTOR shall provide methods and mean to obtain the required compaction of the pipe bed and the backfill as specified.

The CONTRACTOR shall provide a sufficient number of watertight sewer plugs to prevent infiltration of water and any other foreign material from entering the existing sewer system and the newly constructed sewer lines.

801-3.2 EXCAVATION AND PREPARATION OF TRENCH. The trench shall be dug to the alignment and depth required and only so far in advance of pipe laying as the ENGINEER may permit. The discharge from pumps shall be led to natural drainage channels, drains, or storm sewer.

The trench width may vary depending upon the depth of the trench and the nature of the excavated material, but in any case shall be of ample width to permit the pipe to be laid and joined properly and the backfill to be placed and compacted to the required density. The maximum width of trench for calculating bedding material quantities shall not be more than 48 inches, and for pipe 15 inches or larger no more than 36 inches greater than the outside diameter of the pipe barrel.

The trench shall be excavated below the required grade so that the pipe may be laid on 4 inches of bedding material.

Where the bottom of the trench uncovered at subgrade is unsuitable and in the opinion of the ENGINEER cannot support the pipe, further depth and/or width shall be excavated and refilled to the pipe foundation grade with subcut gravel thoroughly compacted. In this instance, subcut gravel shall be considered a pay item.

If other approved means shall be adopted to assure a firm foundation for the pipe, the CONTRACTOR will be allowed extra compensation. Extra compensation shall not be allowed for extra excavation and gravel used for seepage and ground water control.

If ordered in writing by the ENGINEER, the CONTRACTOR will be paid for any sheathing that the ENGINEER orders left in the trench in order to protect existing utilities or other items. The price to be paid for such sheathing material will be the current invoice price of said materials or such lesser price as the CONTRACTOR and the ENGINEER may agree that the material is worth at the time it is left in the trench.

All broken pavement or sidewalks shall be removed from the site of the work and deposited at a place selected by the ENGINEER. It shall be the responsibility of the CONTRACTOR to remove and replace at its own expense all sidewalk, curb, and gutter necessary for the installation of the pipe and manholes as shown on the plans and as directed by the ENGINEER, unless items are noted on plans. The removal shall be complete to the nearest joint in order that the replacement might be made in a workmanlike manner. No additional compensation will be allowed for this work and shall be included in the price bid for pipe or manhole installation.

All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Gutters shall be kept clean or otherwise satisfactory provisions made for street drainage.

The use of trench digging machinery will be permitted except in places where operation of same will cause damage to trees, building or existing structures above or below ground, in which case hand methods shall be employed.

The CONTRACTOR is assumed to be familiar with all federal, state and local laws, codes, ordinances, and regulations which in any manner affect those engaged or employed in the work, the material, or equipment used in or upon the site, or in any way affect the conduct of the work. No pleas of misunderstanding or ignorance on the part of the CONTRACTOR will, in any way, serve to modify the provisions of the contract. The CONTRACTOR shall provide and maintain on a 24-hour basis all necessary safeguards such as watchmen, traffic control devices, and night lights at CONTRACTOR's own expense in accordance with subsection 124.

Excavation for pipe laying operations shall be conducted in a manner to cause the least interruption to traffic. Where traffic must cross open trenches, the CONTRACTOR shall provide suitable bridges at street intersections and driveways. Hydrants under pressure, valve boxes, curb stop boxes, and other utility controls shall be left unobstructed and accessible during the construction period.

Adequate provisions shall be made for the flow of sewers, drains, and water courses encountered during construction, and the structures which may have been disturbed shall be satisfactorily restored upon completion of the work.

Prior to making any connections to the existing sewer system, the CONTRACTOR shall furnish and install watertight plugs in such a manner as to prevent infiltration and foreign material from entering the existing sewer system. The plugs shall be installed so as to not disrupt existing sewage flow and shall remain in place until the construction has been accepted by the ENGINEER.

Trees, fences, poles, and all other property shall be protected unless their removal is authorized by the ENGINEER, and any property damages shall be satisfactorily restored by the CONTRACTOR. The cost of removal shall be included in the price bid per linear foot of sewer pipe in place unless listed separately in the proposal. Tree removal and root cutting shall be in conformance with Section 201.

801-3.3 ROCK EXCAVATION. All rock found in the trench area shall be classified as solid rock and measured for payment if each individual rock, boulder, or continuous slab of ledge rock is 1 cubic foot or more in content. Solid rock shall be measured for payment on the basis of and limited to the maximum trench width allowed under subsection 801-3.2, "Excavation and Preparation of Trench." If solid rock extends below the necessary depth of excavation, it shall be measured for payment to a horizontal plane 6 inches below the bottom of the pipe. All rocks smaller in volume than 1 cubic foot shall not be classified as solid rock, but may be used in backfilling as directed by the ENGINEER.

Blasting for excavation will be permitted only after securing the approval of the ENGINEER, and only when proper precautions are taken for the protection of person and property. The hours of blasting will be fixed by the ENGINEER, and any damage caused by blasting shall be repaired by the CONTRACTOR at its own expense. The

CONTRACTOR's methods of procedure relative to blasting shall conform to local and state laws and municipal ordinances.

Whenever ledge rock is encountered, the CONTRACTOR shall strip from the same all overlying earth and he shall then notify the ENGINEER that the rock is ready for measurement. The ENGINEER may then take levels upon the rock or he may at his discretion defer measurement until after the excavation is completed. In any event, the CONTRACTOR shall not refill any trench where rock is encountered until notified by the ENGINEER that measurement has been made. Payment will not be allowed for any rock unless the same shall have been measured as herein provided. The rock shall be excavated to a depth of 6 inches below the bottom of the pipe, and the trench shall be refilled to the proper grade with bedding material.

All rock found in the trench having greater volume of 1 cubic foot shall not be used as backfill but shall be disposed of as directed by the ENGINEER.

801-3.4 PIPE LAYING. All water main and sanitary sewer crossings shall conform to the following policy:

1. Where both water and sewer are of new construction:
 - a. No additional protections needed if water main crosses at least 5 feet above the sewer.
 - b. If the water main crosses within 3 to 5 feet above the sewer, a full length of water main shall be centered over the sewer.
 - c. If the water main crosses within 3 feet above the sewer, a full length of water main shall be centered over the sewer and the sewer joints located within 10 feet of the crossing shall be able to withstand 25 psi internal pressure.
2. Where water main crosses over an existing sewer:
 - a. No additional protection needed if water main is at least 3 feet above the sewer. The intervening dirt must be left undisturbed.
 - b. If crossing is within 3 feet above sewer, a full length of water main must be centered over the sewer main.
3. Where water main crosses under the sewer:
 - a. In all cases, additional protection shall be provided by centering a full length of water main under the sewer main. All sewer joints located within 10 feet of the crossing shall be able to withstand 25 psi internal pressure.

Proper implements, tools, and equipment satisfactory to the ENGINEER shall be provided and used by the CONTRACTOR for the safe and convenient prosecution of

the work. All pipe and fittings shall be carefully lowered into the trench piece by piece by means of a derrick, ropes, or other suitable tools or equipment in such a manner as to prevent damage to the pipe. Under no circumstance shall pipe be dropped or dumped into the trench.

After the trench has been excavated to the proper grade, the first pipe at the outlet end of the sewer shall be bedded to the proper line and grade with the bell end upstream. All pipe shall be laid to line and grade. The pipe shall be held in place by backfilling along the bottom and sides of the pipe section with bedding material thoroughly tamped up to the centerline of the pipe and protected from movement.

During the pipe laying operation, the CONTRACTOR shall have a watertight plug available to install in the last pipe laid at the end of each work day or to install during the work day, to prevent water or other foreign material from entering the newly installed pipe.

The CONTRACTOR shall exercise due care, so as to prevent water and other foreign matter from entering the newly constructed sewer mains at new manhole locations.

All joints shall be installed in accordance with the pipe manufacturer's instructions.

Where polyvinyl chloride sewer pipe is installed in a vitrified clay sewer line, V.C. to P.V.C., adaptors shall be used at each junction. Adaptors shall be equal to those manufactured by Fernco Joint Sealer Company or approved equal.

The cost of adaptors shall be considered incidental to the unit price bid for polyvinyl chloride sewer pipe.

The interior of the pipe shall be cleaned as the work progresses. The manholes and sewer pipe shall be flushed with clean water after completion and prior to acceptance by the ENGINEER.

801-3.5 BACKFILLING OF PIPE TRENCH. After the pipe has been laid to line and grade, the trench shall be backfilled under and along the sides of the pipe up to the centerline of the pipe by thoroughly compacting bedding material into place so as to form a uniform bed for the pipe. The compaction may be obtained by any approved method or equipment which will produce a uniform density meeting the requirement to obtain not less than 85 percent maximum dry density at optimum moisture made in accordance with ASTM D1557. Care shall be exercised not to displace the pipe or injure the pipe during the compaction operations. If the material in the trench is sand or gravel and acceptable to the ENGINEER, it will not be necessary to furnish any other material than that found within the trench to backfill up to the centerline of the pipe. If sand or gravel is not found within the trench, the CONTRACTOR will be required to furnish bedding material. It will be required to keep the bedding completed within 3 lengths of the last pipe being laid and shall all be completed at the end of each day's work. After bedding operations, the trench shall be backfilled to a point two (2) feet above the top of the pipe by any approved method or equipment which will produce a

uniform density meeting the requirements to obtain not less than 80 percent of the maximum dry density at optimum moisture as determined by ASTM Compaction Control Test Designation D1557. The use of drop pile hammers, loaded or unloaded clam shells or backhoe buckets, or other similar equipment will not be permitted to obtain the required density below a point two (2) feet above the top of the pipe. The CONTRACTOR shall use specialized equipment or hand tamping around appurtenances such as manholes to insure proper density. The remaining trench shall be backfilled in accordance with the specifications for the class of backfill as set forth in subsection 801-3.6. The areas for each class of backfill specified shall be designated on the plans.

The CONTRACTOR shall engage an independent soils testing laboratory, approved by the ENGINEER, to determine the soil moisture density relationships and perform the required compaction testing to be determined by the ENGINEER.

The compaction control tests for this section are based on one individual compaction test per 300 feet of trench per 30 inches of backfill and a minimum of one (1) test per service line, 2 feet below finish grades or where directed. The CONTRACTOR shall be responsible for all retesting of failing tests and a proctor determination to represent each soil condition to be encountered on the project. The time, locations, depths, and frequency of compaction testing shall be at the discretion of the ENGINEER during construction. Should it become necessary to require an additional number of initial compaction tests, over and above the number specified for bidding purposes, the CITY OF MANDAN will assume the responsibility to perform said additional testing. The CONTRACTOR, however, will be required to assume the cost of all retesting of failing tests regardless of the total number required during construction.

Compaction testing to determine densities may be accomplished with a nuclear density testing apparatus and/or the sand cone method. Should disputes arise concerning test results, they will be resolved by using the sand cone.

Written reports of all test results shall be supplied to the ENGINEER and the CONTRACTOR by the testing laboratory as soon as possible. To expedite construction progress, it is necessary that the CONTRACTOR and ENGINEER be furnished with the results of all tests as soon as testing is completed.

The availability of the independent testing laboratory when needed and speed of testing and reporting are to be considered the responsibility of the CONTRACTOR.

Compaction control tests as stated above shall be incidental to the price bid for 801-4 Sanitary Sewer Pipe.

All excess dirt and rock must be removed from the streets and disposed of at such places as the ENGINEER may direct.

The CONTRACTOR shall restore all shrubbery, fences, sod, or other surfaces disturbed to a condition equal to that before the work began, furnishing all labor and material

incidental thereto. If the area cannot be restored to the original line and cross section without the aid of grade stakes, they will be furnished by the ENGINEER at the CONTRACTOR'S expense.

Following the certification of completion by the ENGINEER, the CONTRACTOR shall maintain the surface of unpaved trenches, adjacent curbs and gutters, sidewalks, driveways, shrubbery, fences, sod, or other surfaces disturbed for a period of three months thereafter. All material and labor required for maintenance of the trenches and adjacent structures shall be supplied by the CONTRACTOR and the work done in a manner satisfactory to the ENGINEER. The cost of backfilling and cleanup shall be included in the price per linear foot of sewer pipe in place.

801-3.6 BACKFILL CLASSIFICATIONS. Moisture requirements for the top 4 feet of the trench (below final grade) for classifications AA, A, B, and C at the time of compaction shall not be less than 4 percentage points below the optimum moisture content and not more than that which will permit compaction to the required density. If the soil is unstable, as defined in section 801-1, when compacted to the required density, the soil shall be dried to obtain adequate stability. This may require drying below optimum moisture. The cost of such drying shall be incidental to the bid items.

(a) Class AA Backfill. Class AA backfill shall be used in areas where the trenches fall beneath special improved areas and under special conditions and these areas shall be indicated as class AA backfill and shown on the plans. Under class AA backfill all the excavated material shall be transported to another site and wasted in a workmanlike manner and selected material meeting bedding material specifications shall be imported to the site for backfill material.

After the pipe has been inspected and bedded with bedding material, and upon completion and approval for the initial backfill requirements specified under subsection 801-3.5, the remaining trench shall be backfilled in layers and compacted by any approved method or equipment which will produce a uniform density meeting the requirements to obtain not less than 95 percent maximum dry density at optimum moisture in accordance with ASTM D1557.

(b) Class A Backfill. Class A backfill shall be used in areas where trenches fall beneath improved areas or areas to be improved, and these areas shall be indicated as class A backfill and shown on the plans.

After the pipe has been inspected and bedded with bedding material, and upon completion and approval of the initial backfill requirements specified under subsection 801-3.5, the remaining trench shall be backfilled in layers and compacted by any approved method or equipment which will produce a uniform density meeting the requirement to obtain not less than 85 percent maximum dry density at optimum moisture made in accordance with ASTM D1557, except for the top 4 feet of the trench which shall meet the requirement to obtain not less than 90 percent at maximum dry density at optimum moisture made in accordance with ASTM D1557.

(c) Class B Backfill. Class B backfill shall be used in areas where the trenches fall beneath improved areas or areas to be improved, and these areas shall be indicated as class B backfill and shown on the plans.

After the pipe has been inspected and bedded with bedding material, and upon completion and approval of the initial backfill requirements specified under subsection 801-3.5, the remaining trench shall be backfilled in layers and compacted by any approved method or equipment which will produce a uniform density meeting the requirement to obtain not less than 80 percent of maximum dry density at optimum moisture made in accordance with ASTM D1557 except for the top 4 feet of trench which shall meet the requirement to obtain not less than 85 percent of maximum dry density at an optimum moisture in accordance with ASTM D1557.

(d) Class C Backfill. Class C backfill shall be used in areas where the trenches fall beneath improved areas or areas to be improved, and these areas shall be indicated as class C backfill and shown on the plans.

After the pipe has been inspected and bedded with bedding material, and upon completion and approval of the initial backfill requirements specified under subsection 801-3.5, the remaining trench shall be backfilled in layers and compacted by any approved method or equipment which will produce a uniform density equal to the adjacent undisturbed soil but not to exceed 85 percent of maximum dry density at optimum moisture made in accordance with ASTM D1557.

(e) Class D Backfill. Class D backfill shall be used in unimproved areas. These areas shall be indicated as class D backfill and shown on the plans. After the pipe has been inspected and bedded with bedding material and upon completion and approval of the initial backfill requirements specified under subsection 801-3.5, the remaining trench shall be backfilled in 24-inch to 36-inch layers compacted by any approved method or equipment which will obtain a uniform density.

801-3.7 Protecting Underground and Surface Structures. Temporary support, adequate protection and maintenance of all underground and surface structures, drains, sewers, watermains, service connections for both sewer and water, and other obstructions encountered in the progress of the work shall be furnished by the CONTRACTOR all at their own expense as approved by the ENGINEER.

(a) Deviations Occasioned by Other Utility Structures. Wherever existing utility structures or branch connections leading to main sewer or water mains or other conduits, ducts, pipes, or structures form obstructions to the grade and alignment of the sewer to be laid, they shall be permanently supported, removed, relocated, or reconstructed by the CONTRACTOR through cooperation with the Owner of the utility, structure, or obstruction involved. In those instances where their relocation or reconstruction is impracticable, a deviation from the line and grade will be ordered by the ENGINEER, and the change shall be made in the manner directed by the ENGINEER.

Wherever possible, all existing utility structures or branch connections leading therefrom will be located in advance of the excavation of the trench and properly marked. The CONTRACTOR shall not cut any existing utility lines unless it is determined by the ENGINEER that it is necessary in order to install the new sewer pipes. All utility lines that are cut by the CONTRACTOR with the approval of the ENGINEER shall be repaired or replaced by the CONTRACTOR as Extra Work. All utility lines that are damaged by the CONTRACTOR shall be repaired or replaced by the CONTRACTOR at the CONTRACTOR's expense.

Wherever the ENGINEER shall determine it is necessary to remove or relocate any existing utility in order to properly install the new sewer pipe, the change shall be made in a manner directed by the ENGINEER and for which extra compensation will be allowed the CONTRACTOR.

(b) DEVIATION WITHOUT ENGINEER'S CONSENT. No deviation shall be made from the required line and grade established by the ENGINEER without the consent of the ENGINEER.

(c) SUBSURFACE EXPLORATIONS. Whenever necessary to determine the location of existing pipes, valves, or other underground structures, the CONTRACTOR, after examination of available records and upon written order from the ENGINEER, shall make all exploration and excavations for such purpose for which the ENGINEER may allow extra compensation.

801-3.8 CIRCULAR DEFLECTION TEST. All fittings and plastic or HDPE pipe of 18 inches in diameter or larger shall be tested by the CONTRACTOR to ensure that circular deflections do not exceed the maximum allowable deflection. Maximum allowable deflections shall be governed by the mandrel requirements stated herein and shall nominally be 5 percent.

The maximum average inside diameter shall be equal to the average outside diameter per applicable ASTM Standards minus two minimum wall thicknesses per applicable ASTM Standards. Manufacturing and other tolerances shall not be considered for determining maximum allowable deflections.

Deflection tests shall be performed not sooner than 30 days after completion of the placement and compaction of the backfill. The pipe shall be clean and inspected for offsets and obstructions prior to testing.

The mandrel shall be pulled through the pipe by hand to ensure that maximum allowable deflections have not been exceeded. Prior to use, the mandrel shall be certified by the ENGINEER. If the mandrel fails to pass through the pipe, it will be deemed to be overdeflected.

Unless otherwise permitted by the ENGINEER, any overdeflected pipe shall be uncovered and, if not damaged, removed and reinstalled. Damaged pipe shall be removed from the work site and replaced with new pipe.

The mandrel shall be a rigid, nonadjustable, 9 leg minimum mandrel having an effective length not less than its nominal diameter. It shall have a minimum diameter, at any point along the full length, as specified by the ENGINEER. The mandrel shall be fabricated of steel and shall have pull rings at either end. The mandrel shall be stamped or engraved indicating the pipe material specification, nominal size and mandrel outside diameter. The maximum average inside diameter of the pipe shall be measured and calculated by the ENGINEER in the field prior to installation.

All costs incurred by the CONTRACTOR attributable to mandrel and deflection testing, including any delays and reinstallation of deflected pipe, shall be considered incidental to other bid items.

801-3.9 TELEWISE SEWER MAIN. When specified as a bid item or as incidental, after flushing the sewer main, under subsection 801-3.4, the CONTRACTOR shall have the sewer main televised and recorded by a firm normally engaged in such type of work. The CONTRACTOR shall provide high quality ½-inch VHS videotapes or discs along with a typed report for each section of sewer main televised. The recording shall be clearly marked as to the project number and recording number. The recording shall have an audio describing locations and conditions of the sewer and shall have a visual footage counter showing the distance of the camera from the manhole. After the CONTRACTOR has submitted the recordings and typed report, they will be viewed by the ENGINEER for acceptance.

801-3.10 CLEANOUT. Cleanouts shall be constructed in accordance with the standard detail.

801-3.11 SANITARY SEWER FORCEMAIN. The construction requirements for sanitary sewer forcemains shall comply with Section 901 Watermains, with the exception of the hydrostatic pressure tests, disinfection and bacteriological testing. The hydrostatic pressure test shall be the same as Section 901 Watermains, except the hydrostatic pressure test shall be 125 pounds per square inch and shall be held for two hours. No pipe disinfection or bacteriological testing shall be required.

801-3.12 CONNECTION TO EXISTING SEWER MAIN. Whenever a wye branch is not available for a sewer service connection, the connection to the sewer main shall consist of one of the following:

- (a) A "factory assembled" wye branch may be cut into an existing PVC sewer main using gasketed repair couplings to the existing PVC sewer main.
- (b) A "factory assembled" wye branch may be cut into an existing VC sewer main using Strong Back Fernco couplings, or an approved equal, to the existing VC sewer main.
- (c) PVC, VC, or RC sewer main may be connected to the existing VC sewer main service using an Inserta Tee as manufactured by Inserta Fittings Co. or an approved

equal.

801-4 MEASUREMENT AND PAYMENT

801-4.1 thru 4.15 (SIZE) INCH SANITARY SEWER PIPE.

Sanitary sewer pipe shall meet the requirements of Section 801-2.2 and 801-2.3. Sanitary sewer pipe shall be measured by the linear foot (LF) from the centerline of manhole to centerline of manhole and shall be paid for at the unit price bid for "(Size) Inch Sanitary Sewer Pipe" complete in place and accepted by the ENGINEER.

801-4.50 thru 4.59 (SIZE) INCH WYE BRANCH. Wye branches shall be of the same material as the sewer pipe marked with a 2" x 2" x 4' stake placed perpendicular to the mainline sewer at the end of the Wye and measured on an individual unit basis (Ea.) and paid for at the unit price bid for "(Size) Inch Wye Branch" complete in place and accepted by the ENGINEER.

801-4.60 BEDDING MATERIAL. Bedding material gravel shall be measured by the ton and paid for at the unit price bid for "bedding material" complete in place and accepted by the ENGINEER.

801-4.61 SUBCUT GRAVEL. Subcut gravel shall be measured by the ton and paid for at the unit price for "subcut gravel" complete in place and accepted by the ENGINEER.

801-4.62 ROCK EXCAVATION. All rock found in the trench area greater than 1 cubic foot shall be classified as Rock Excavation, measured by the cubic yard (CY), and disposed of by the CONTRACTOR or as directed by the ENGINEER.

The CONTRACTOR shall place all rocks greater than 1 cubic foot and less than 1 cubic yard in a pile to be measured by the ENGINEER. The total volume of the stockpile shall be reduced by 25% to account for void in the rock stockpile.

All rocks greater than 1 cubic yard shall be individually measured by the ENGINEER.

Payment shall be made at the unit price bid per cubic yard (CY) for "Rock Excavation."

801-4.63 CONCRETE MANHOLES. Concrete manholes shall be measured and paid for under subsection 1205-4.1.

801-4.64 TELEWISE SEWER MAIN. Telewise Sewer main shall be measured by the linear foot (LF) from centerline of the manhole to centerline of the manhole or an end point and shall be paid for at the unit price bid for "Telewise Sewer main" complete and accepted by the ENGINEER.

801-4.65 thru 801-4.68 (SIZE) INCH CLEANOUT. Cleanouts shall meet the requirements of this section and the standard detail and shall be measured and paid for

per each (Ea.) "(Size) Inch Cleanout" complete in place and accepted by the ENGINEER.

SECTION 802 - STORM SEWERS

802-1 DESCRIPTION

This item shall consist of pipe and related items of the types, classes, sizes, and dimensions required on the plans, furnished and installed at the places designated on the plans and profiles, or by the ENGINEER, in accordance with these specifications and with the lines and grades given.

The bid price per linear foot of pipe in place shall include the cost of excavation and backfill, the cost of furnishing and installing all trench bracing, all fittings required to complete the pipe drain, as shown on the plans, and the material for and the making of all joints, including all connections to existing drainage pipe and manholes.

"Unstable," "Suitable," "Unsuitable," and "Unsatisfactory" soil or aggregate items shall be defined as stated in Section 202-1.

802-2 MATERIALS

802-2.1 GENERAL. The pipe shall be of the type called for on the plans or in the proposal and shall be in accordance with the following appropriate requirements.

802-2.2 REINFORCED CONCRETE STORM SEWER PIPE. Reinforced Concrete Storm Sewer Pipe shall conform to the requirements of ASTM C76.

Unless otherwise specified, all pipe shall be Class III for 24-inch and smaller and Class II for 27-inch and larger in accordance with ASTM C76, Wall B.

All pipe sections shall be cast in sections 8 feet, 6 feet, or 4 feet long, except that the variable length sections may be cast in order to match at manholes and inlets.

802-2.3 POLYVINYL CHLORIDE STORM SEWER PIPE. Polyvinyl chloride storm sewer (PVC) pipe-15 inches or smaller shall conform to the requirements of ASTM D3034 for type PSM, PVC sewer pipe and shall have an SDR of 35, all of which shall be stamped on the pipe. Polyvinyl chloride sewer pipe 18 inches or larger shall conform to the requirements of ASTM F679-PS46. PVC sewer shall have the elastomeric gasket type joint providing a watertight seal. May be used if approved by the ENGINEER.

802-2.4 CORRUGATED STEEL STORM SEWER PIPE. Corrugated Steel Storm Sewer Pipe shall have a zinc coating weight of 2 oz./sq. ft. and shall conform to the requirements of AASHTO M36. May be used if approved by the ENGINEER.

802-2.5 CORRUGATED POLYETHYLENE STORM SEWER PIPE. Corrugated Polyethylene Storm Sewer Pipe shall be of a quality to that manufactured by Hancor Sure-Lok F477 Pipe or an approved equal. The pipe shall have a smooth interior and annular exterior corrugations. Size 12" to 48" shall conform to AASHTO M294, Type S and 54" and 60" shall conform to AASHTO MP 7-97. The pipe shall be joined with a silt

tight and leak resistant joint in conformance with AASHTO M294 Type S or MP 7-97. Gaskets shall conform to ASTM F477. Pipe shall be provided to have slip joint connections to all structures or other pipe materials. May be used if approved by the ENGINEER.

802-2.6 RIBBED POLYVINYL CHLORIDE STORM SEWER PIPE. Ribbed Polyvinyl Chloride Storm Sewer Pipe shall be of a quality equal to that manufactured by Extrusion Technologies, Inc. Ultra-Rib or an approved equal. The pipe shall meet the requirements of ASTM F794 and shall have a smooth interior. The pipe shall have a bell end and a spigot end which shall be connected using elastomeric gaskets. The pipe stiffness shall be a minimum of 46 p.s.i. when tested at 5% deflection in accordance with ASTM D2412. May be used if approved by the ENGINEER.

802-2.7 CORRUGATED POLYVINYL CHLORIDE STORM SEWER PIPE. Corrugated Polyvinyl Chloride Storm Sewer Pipe shall be of a quality equal to that manufactured by Extrusion Technologies, Inc. Ultra-Corr or an approved equal. The pipe shall meet the requirements of ASTM F949 and shall have a smooth interior. The pipe shall have a bell end and a spigot end which shall be connected using elastomeric gaskets. The pipe stiffness shall be a minimum of 50 p.s.i. when tested at 5% deflection in accordance with ASTM D2412. May be used if approved by the ENGINEER.

802-2.8 PERFORATED STORM SEWER PIPE. Perforated Concrete Pipe in sizes 4 inches and above shall conform to the requirements of ASTM C444, Type 1 or 2. Corrugated HDPE Perforated Storm Sewer Pipe in sizes 3 inches to 6 inches shall conform to ASTM F405. Corrugated HDPE Perforated Storm Sewer Pipe in sizes 8 inches to 24 inches shall conform to ASTM F667. If PVC Perforated Storm Sewer Pipe is selected, it must meet the requirement of Section 801-2.6 or an approved equal. The above pipe shall be fitted with a knitted polyester Geotextile Fabric Sock. The knitted polyester geotextile fabric shall meet the following specifications:

Fiber --	Knitted Polyester
Weight (oz/yd ²) Applied – ASTM D3776 -	2.5-3.5
Thickness (Inches) -	0.04
Mullen Burst (PSI) – ASTM D3786 -	100
Air Permeability (ft ³ /ft ² /min) – ASTM D737 -	700
Water Flow Rate (gal/ft ² /min - 3" Head) -	700
Water Permeability (3 GPM, in/s)	0.12
AOS, US Sieve – ASTM D4751 -	30
UV Degradation – ASTM D4355 -	70

Should the geotextile fabric be damaged, the section shall be removed and replaced according to manufacturer's recommendations.

802-2.9 (TYPE OF PIPE) ARCH PIPE. Arch pipe shall conform to the same requirements as listed for standard pipe of like material.

802-2.10 (TYPE OF PIPE) FLARED END SECTION. Flared End Sections shall conform to the same requirements as listed for standard pipe and arch pipe of like material.

802-2.11 CONCRETE MANHOLES AND INLETS. Concrete manholes and inlets shall conform, in all respects, to Section 1205.

802-2.12 MORTAR. Mortar for pipe joints and connections to other drainage structures shall be composed of 1 part, by volume, of portland cement and 2 parts of mortar sand. The portland cement shall conform to the requirements of Subsection 501-2.2. The sand shall conform to the requirements of Subsection 501-2.5. Hydrated lime may be added to the mixture of sand and cement in an amount equal to 15% of the weight of cement used. The hydrated lime shall meet the requirements of ASTM C6.

802-2.13 CONCRETE. Concrete for pipe cradles shall conform to the requirements of Section 501.

802-2.14 CONCRETE PIPE JOINTS. Concrete Pipe Joints for non-pressure pipe shall be sealed with a butyl joint mastic. Butyl joint mastic shall be equal to EZ-STIK as manufactured by the Press-Seal Gasket Corporation or an approved equal. The CONTRACTOR shall use 1/2-inch butyl for 12-inch to 18-inch RCP, 3/4-inch for 21-inch to 36-inch RCP, 1-inch for 42-inch to 66-inch RCP, and 1½-inch for 72-inch to 120-inch RCP. Rubber-type gaskets for concrete low-head pressure pipe shall conform to the requirements of ASTM C443 ASTM 361 if specified.

802-2.15 GASKET JOINT FOR PVC STORM SEWER PIPE. Gaskets for PVC sewer pipe joints shall be of the elastomeric type providing a watertight seal.

802-2.16 BEDDING MATERIAL. The bedding material shall be defined as stated in Section 801-2.9.

802-2.17 SUBCUT GRAVEL. The subcut gravel shall be as defined in Section 801-2.10.

802-2.18 MARKING TAPE. The CONTRACTOR will be required to furnish and install marking tape located 2 feet above the top of all storm sewer mains installed under this contract. The tape shall be of the non-detectable type and shall have a minimum width of 5 inches. The tape shall be green in color with the words "CAUTION SEWER LINE BELOW" imprinted on the tape in black capital letters. The marking tape shall be equal to that manufactured by Griffolyn Company, Inc.

Cost of marking tape and installation shall be considered incidental to other items.

802-2.19 RIP RAP. Rock shall be hard, durable, angular in shape, and free from cracks, overburden, shale, and organic material. The width and the thickness of a single stone shall each be less than 1/3 the length of the stone. Rock shall not sustain a loss of more than 40 percent after 500 revolutions in an abrasion test conducted in

accordance with ASTM C535-69. Rock shall not sustain a loss of more than 10 percent after 12 cycles of freezing and thawing (AASHTO test 103 for ledge rock procedure A). Rock shall have a minimum specific gravity of 2.50.

CONTRACTOR shall be responsible for all costs of testing rock for compliance with these specifications. In lieu of testing proposed rock for compliance with these specifications, rock obtained from county or North Dakota Department of Transportation approved quarries may be used. All rock materials considered for use as rip rap shall have prior approved by the ENGINEER, before being placed.

Gradation for Type VL, L, M, H, and VH rip rap are as follows:

<u>Rip Rap Designation</u>	<u>% Smaller Than Given Size By Weight</u>	<u>Intermediate Rock Dimension (Inches)</u>	<u>(Inches)</u>
Type VL	70-100	12	
	50-70	9	
	35-50	6	6**
	2-10	2	
Type L	70-100	15	
	50-70	12	
	35-50	9	9**
	2-10	3	
Type M	70-100	21	
	50-70	18	
	35-50	12	12
	2-10	4	
Type H	100	30	
	50-70	24	
	35-50	18	18
	2-10	6	
Type VH	100	42	
	50-70	33	
	35-50	24	24
	2-10	9	

*d₅₀ = Mean particle size

**Bury types VL and L with native top soil and revegetate to protect from vandalism.

Filter fabric shall be used under the rip rap as bedding. The fabric shall have the same properties as, and be equal to, the nonwoven geotextile fabric Amoco 4551. Filter fabric

shall be installed in accordance with manufacturer's recommendations. All costs for providing and installing the filter fabric shall be incidental to the rip rap.

Hand placement of rip rap may be required to insure an acceptable gradation, uniform surface, and to fill gaps between larger rocks to cover any exposed filter fabric.

Because of this relatively small size and weight, Type VL rip rap and Type L rip rap shall be buried with topsoil and revegetated to protect the rock from vandalism. All items shall be considered incidental to the bid price for rip rap.

Rip rap shall be measured by the ton and paid for at the unit price bid for "Rip Rap - Type ()" complete and in place and accepted by the ENGINEER.

802-2.20 RIP RAP GROUT. Rip rap grout shall be installed on a 4-inch thick layer of granular material. The granular material shall be in accordance with 801-2.9 Bedding Material. The rip rap prior to the grout placement must be as clean as practical. The grout shall be delivered to the place of final deposit by means that will insure uniformity and prevent segregation of the grout. Placing of grout shall be obtained by pumping under pressure through a 2-inch maximum diameter hose to insure complete penetration of the grout into the rock layer. A vibrator is to be employed near the nozzle during placement to aid the flow of the grout. The excess grout must be removed immediately by washing to leave a clean rock face exposed. Grout shall fill the voids to within approximately 4 inches of the rip rap surface. The recommended minimum grout specifications include entrained air, a 28-day strength of at least 2,400 pounds per square inch, and a high slump (5-7 inches) in order to penetrate either the full depth of the rip rap layer or at least 2 feet where the rip rap layer is thicker than 2 feet. Concrete having maximum aggregate size of 3/4 inches may be substituted for grout when using Type M rip rap or larger.

802-3 CONSTRUCTION REQUIREMENTS

802-3.1 EQUIPMENT. All equipment necessary and required for the proper construction of storm sewers shall be on the project in first-class working condition and approved by the ENGINEER before construction is permitted to start.

The CONTRACTOR shall provide appropriate hoisting equipment to handle the pipe while unloading and placing it in its final position without damage to the pipe.

The CONTRACTOR shall provide method and means to obtain the required compaction of the pipe bed and the backfill as specified.

The CONTRACTOR shall provide a sufficient number of watertight sewer plugs to prevent infiltration of water and any other foreign material from entering the existing sewer system and the newly constructed sewer lines.

802-3.2 EXCAVATION AND PREPARATION OF TRENCH. The trench shall be dug to the alignment and depth required and only so far in advance of pipe laying as the

ENGINEER may permit. The trench shall be so braced and drained so that workmen may work there safely and efficiently. It is essential that the discharge from pumps be led to natural drainage channels, drains, or storm sewer.

The trench width may vary depending upon the depth of the trench and the nature of the excavated material, but in any case shall be of ample width to permit the pipe to be laid and joined properly and the backfill to be placed and compacted to the required density.

The maximum width of trench for calculating bedding material quantities shall not be more than 48 inches, and for pipe 15 inches or larger no more than 36 inches greater than the outside diameter of the pipe barrel. HDPE sewer pipe shall have bedding material installed to 6 inches over the top of the pipe. Bedding material from the center of the pipe to 6 inches over the pipe shall be considered incidental to the pipe items.

The trench shall be excavated below the required grade so that the pipe may be laid on 4 inches of bedding material. If perforated storm drain is installed, the fine aggregate shall conform to Section 501-2.5.

Where the bottom of the trench uncovered at subgrade is unsuitable, and in the opinion of the ENGINEER cannot support the pipe, further depth and/or width shall be excavated and refilled to the pipe foundation grade with subcut gravel thoroughly compacted. In this instance, subcut gravel shall be considered a pay item.,

If other approved means shall be adopted to assure a firm foundation for the pipe, the CONTRACTOR will be allowed extra compensation. Extra compensation shall not be allowed for extra excavation and gravel used for seepage and ground water control.

If ordered in writing by the ENGINEER, the CONTRACTOR will be paid for any sheathing that the ENGINEER orders left in the trench in order to protect existing utilities or other items. The price to be paid for such sheathing material will be the current invoice price of said materials or such lesser price as the CONTRACTOR and the ENGINEER may agree that the material is worth at the time it is left in the trench.

All broken pavement or sidewalks shall be removed from the site of the work and deposited at a place selected by the ENGINEER. It shall be the responsibility of the CONTRACTOR to remove and replace at its own expense all sidewalk, curb, and gutter necessary for the installation of the pipe and manholes as shown on the plans and as directed by the ENGINEER, unless items are noted on plans. The removal shall be complete to the nearest joint in order that the replacement might be made in a workmanlike manner. No additional compensation will be allowed for this work and shall be included in the price bid for pipe or manhole installation.

All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Gutters shall be kept clean or otherwise satisfactory provisions made for street drainage.

The use of trench digging machinery will be permitted except in places where operation of same will cause damage to trees, buildings, or existing structures above or below ground, in which case hand methods shall be employed.

The CONTRACTOR is assumed to be familiar with all federal, state, and local laws, codes, ordinances, and regulations which in any manner affect those engaged or employed in the work, the material, or equipment used in or upon the site, or in any way affect the conduct of the work. No pleas of misunderstanding or ignorance on the part of the CONTRACTOR will, in any way, serve to modify the provisions of the contract. The CONTRACTOR shall provide and maintain on a 24-hour basis all necessary safeguards such as watchmen, traffic control devices, and night lights at CONTRACTOR's own expense in accordance with Subsection 124.

Excavation for pipe laying operations shall be conducted in a manner to cause the least interruption to traffic. Where traffic must cross open trenches, the CONTRACTOR shall provide suitable bridges at street intersections and driveways. Hydrants under pressure, valve boxes, curb stop boxes, and other utility controls shall be left unobstructed and accessible during the construction period.

Adequate provisions shall be made for the flow of sewers, drains, and water courses encountered during construction, and the structures which may have been disturbed shall be satisfactorily restored upon completion of the work.

Prior to trenching along or making any connections to the existing storm drainage system, the CONTRACTOR shall prevent infiltration and foreign material from entering the existing storm drainage system. Pipe plugs, diversion ditches, sediment traps, cofferdams, or other temporary facilities shall be installed so as to not disrupt existing drainage flow and shall remain in place until the construction has been accepted by the ENGINEER.

Trees, fences, poles, and all other property shall be protected unless their removal is authorized by the ENGINEER, and any property damages shall be satisfactorily restored by the CONTRACTOR. The cost of removal shall be included in the price bid per linear foot of sewer pipe in place unless listed separately in the proposal. Tree removal and root cutting shall be in conformance with Section 201.

802-3.3 ROCK EXCAVATION. The rock excavation shall be as defined in Section 801-3.3.

802-3.4 PIPE LAYING. Proper implements, tools, and equipment satisfactory to the ENGINEER shall be provided and used by the CONTRACTOR for the safe and convenient prosecution of the work. All pipe and fittings shall be carefully lowered into the trench piece by piece by means of a derrick, ropes, or other suitable tools or equipment in such a manner as to prevent damage to the pipe. Under no circumstance shall pipe be dropped or dumped into the trench.

After the trench has been excavated to the proper grade, the first pipe at the outlet end of the sewer shall be bedded to the proper line and grade with the bell end upstream. All pipe shall be laid to line and grade. The pipe shall be held in place by backfilling along the bottom and sides of the pipe section with bedding material, or in the case of perforated pipe, concrete sand, thoroughly tamped up to the centerline of the pipe and protected from movement.

During the pipe laying operation, the CONTRACTOR shall have available measures at the end of each work day or to install during the work day, to prevent foreign material from entering the newly installed pipe.

The CONTRACTOR shall exercise due care, so as to prevent water and other foreign matter from entering the newly constructed sewer mains at new manhole and inlet locations.

All joints shall be installed in accordance with the pipe manufacturer's instructions.

Where polyvinyl chloride sewer pipe is installed in a vitrified clay sewer line, V.C. to P.V.C. adaptors shall be used at each junction. Adapters shall be equal to those manufactured by Fernco Joint Sealer Company, or approved equal.

The cost of adapters shall be considered incidental to the unit price bid for cast iron sewer pipe or polyvinyl chloride sewer pipe.

The interior of the flexible pipes shall be cleaned as the work progresses. The manholes and sewer pipe shall be flushed with clean water after completion and prior to acceptance by the ENGINEER.

802-3.5 BACKFILLING OF PIPE TRENCH. After the pipe has been laid to line and grade, the trench shall be backfilled under and along the sides of the pipe up to the centerline of the pipe by thoroughly compacting bedding material into place so as to form a uniform bed for the pipe. The compaction may be obtained by any approved method or equipment which will produce a uniform density meeting the requirement to obtain not less than 85 percent maximum dry density at optimum moisture made in accordance with ASTM D1557. Care shall be exercised not to displace the pipe or injure the pipe during the compaction operations. If the material in the trench is sand or gravel and acceptable to the ENGINEER, it will not be necessary to furnish any other material than that found within the trench to backfill up to the centerline of the pipe. If sand or gravel is not found within the trench, the CONTRACTOR will be required to furnish bedding material. It will be required to keep the gravel backfill completed within 3 lengths of the last pipe being laid and shall all be completed at the end of each day's work. After bedding operations, the trench shall be backfilled to a point 2 feet above the top of the pipe by any approved method or equipment which will produce a uniform density meeting the requirements to obtain not less than 80 percent of the maximum dry density at optimum moisture as determined by ASTM Compaction Control Test Designation D1557. The use of drop pile hammers, loaded or unloaded clam shells or

backhoe buckets, or other similar equipment will not be permitted to obtain the required density below a point 2 feet above the top of the pipe.

When backfilling perforated storm drain, the CONTRACTOR shall backfill with fine aggregate conforming to Section 501-2.5 to a point 2 feet below the finished surface. The remaining 2 feet shall be backfilled with existing spoil. The excess spoil shall be disposed of by the CONTRACTOR, incidental to other bid items. Care shall be taken when backfilling around the wrapped pipe to prevent damage to the geotextile fabric.

When backfilling corrugated polyethylene pipe, the CONTRACTOR shall place and compact bedding material to a point 1 foot above the top of the pipe. Care shall be used not to over-deflect the roundness of the pipe.

The remaining trench shall be backfilled in accordance with the specifications for the class of backfill as set forth in Subsection 801-3.6. The areas for each class of backfill specified shall be designated on the plans.

The CONTRACTOR shall engage an independent soils testing laboratory, approved by the ENGINEER, to determine the soil proctors and perform the required compaction testing to be determined by the ENGINEER.

The compaction control tests for this section are based on one individual compaction test per 300 feet of trench per 30 inches of backfill. The CONTRACTOR shall be responsible for all retesting of failing tests and a proctor determination to represent each soil condition to be encountered on the project. The time, locations, depths, and frequency of compaction testing shall be at the discretion of the ENGINEER during construction. Should it become necessary to require an additional number of initial compaction tests, over and above the number specified for bidding purposes, the CITY OF MANDAN will assume the responsibility to perform said additional testing. The CONTRACTOR, however, will be required to assume the cost of all retesting of failing tests regardless of the total number required during construction.

Compaction testing to determine densities may be accomplished with a nuclear density testing apparatus and/or the sand cone method. Should disputes arise concerning test results, they will be resolved by using only the sand cone.

Written reports of all test results shall be supplied to the ENGINEER and the CONTRACTOR by the testing laboratory as soon as possible. To expedite construction progress, it is necessary that the CONTRACTOR and ENGINEER be furnished with the results of all tests as soon as testing is completed.

The availability of the independent testing laboratory when needed and speed of testing and reporting are to be considered the responsibility of the CONTRACTOR.

Compaction control tests as stated above shall be incidental to the price bid for 802-2 Storm Sewer Pipe.

All excess dirt and rock must be removed from the streets and disposed of at such places as the ENGINEER may direct.

The CONTRACTOR shall restore all shrubbery, fences, sod, or other surfaces disturbed to a condition equal to that before the work began, furnishing all labor and material incidental thereto. If the area cannot be restored to the original line and cross section without the aid of grade stakes, they will be furnished by the ENGINEER at the CONTRACTOR's expense.

Following the certification of completion by the ENGINEER, the CONTRACTOR shall maintain the surface of unpaved trenches, adjacent curbs and gutters, sidewalks, driveways, shrubbery, fences, sod, or other surfaces disturbed for a period of three months thereafter. All material and labor required for maintenance of the trenches and adjacent structures shall be supplied by the CONTRACTOR and the work done in a manner satisfactory to the ENGINEER. The cost of backfilling and cleanup shall be included in the price per linear foot of sewer pipe in place.

802-3.6 BACKFILL CLASSIFICATIONS. The backfill classifications shall be as defined in Section 801-3.6.

802-3.7 Protecting Underground and Surface Structures. Temporary support, adequate protection and maintenance of all underground and surface structures, drains, sewers, water mains, service connections for both sewer and water, and other obstructions encountered in the progress of the work shall be furnished by the CONTRACTOR all at their own expense as approved by the ENGINEER.

(a) Deviations Occasioned by Other Utility Structures. Wherever existing utility structures or branch connections leading to main sewer or water mains or other conduits, ducts, pipes, or structures form obstructions to the grade and alignment of the sewer to be laid, they shall be permanently supported, removed, relocated, or reconstructed by the CONTRACTOR through cooperation with the Owner of the utility, structure, or obstruction involved. In those instances where their relocation or reconstruction is impracticable, a deviation from the line and grade will be ordered by the ENGINEER, and the change shall be made in the manner directed by the ENGINEER.

Wherever possible, all existing utility structures or branch connections leading therefrom will be located in advance of the excavation of the trench and properly marked. The CONTRACTOR shall not cut any existing utility lines unless it is determined by the ENGINEER that it is necessary in order to install the new sewer pipes. All utility lines that are cut by the CONTRACTOR with the approval of the ENGINEER shall be repaired or replaced by the CONTRACTOR as Extra Work.

All utility lines that are damaged by the CONTRACTOR shall be repaired or replaced by the CONTRACTOR at the CONTRACTOR's expense.

Wherever the ENGINEER shall determine it is necessary to remove or relocate any existing utility in order to properly install the new sewer pipe, the change shall be made

in a manner directed by the ENGINEER and for which extra compensation will be allowed the CONTRACTOR.

(b) Deviation Without Engineer's Consent. No deviation shall be made from the required line and grade established by the ENGINEER without the consent of the ENGINEER.

(c) Subsurface Explorations. Whenever necessary to determine the location of existing pipes, valves, or other underground structures, the CONTRACTOR, after examination of available records and upon written order from the ENGINEER, shall make all exploration and excavations for such purpose for which the ENGINEER may allow extra compensation.

802-3.8 CIRCULAR DEFLECTION TEST. All fittings and plastic or HDPE pipe of 18 inches in diameter or larger shall be tested by the CONTRACTOR to ensure that circular deflections do not exceed the maximum allowable deflection. The CONTRACTOR shall test in accordance with Section 801-3.8 "Circular Deflection Test."

802-4 MEASUREMENT AND PAYMENT

802-4.1 thru 4.24 (SIZE) INCH STORM SEWER PIPE. Storm Sewer Pipe shall be measured by the linear foot (LF) from centerline of manhole or inlet to centerline of manhole or inlet and paid for at the unit price for "(Size) Inch Storm Sewer Pipe" complete in place and accepted by the ENGINEER.

802-4.25 thru 4.35 (SIZE) INCH ARCH STORM SEWER PIPE. (Size) Inch Arch Storm Sewer Pipe shall be measured by the linear foot (LF) from centerline of manhole or inlet to centerline of manhole or inlet and paid for at the unit price bid for "(Size) Inch Arch Storm Sewer Pipe" complete in place and accepted by the ENGINEER.

802-4.36 thru 4.50 (SIZE) INCH CORRUGATED STEEL STORM SEWER PIPE. Corrugated Steel Storm Sewer Pipe shall be measured by the linear foot (LF) from centerline of manhole or inlet to centerline of manhole or inlet and paid for at the unit price bid for "(Size) Inch Corrugated Steel Storm Sewer Pipe" complete in place and accepted by the ENGINEER.

802-4.51 thru 4.79 (SIZE) INCH (TYPE OF PIPE) FLARED END SECTION. Flared End Sections shall be measured on an individual unit basis (Ea.) and paid for at the unit price bid for "(Size) Inch Flared End Section" complete in place and accepted by the ENGINEER.

802-4.80 thru 4.89 (SIZE) INCH PERFORATED PIPE. (Size) Inch Perforated Pipe shall be measured by the linear foot (LF) in place and accepted by the ENGINEER. Bends, tees, caps, coupling bands, filter fabric, and backfill sand in accordance with Section 501-2.5 shall be considered incidental to the unit price bid.

802-4.90 BEDDING MATERIAL. Bedding Material shall be measured and paid for under Subsection 801-4.60.

802-4.91 SUBCUT GRAVEL. Subcut Gravel shall be measured and paid for under Subsection 801-4.61.

802-4.92 ROCK EXCAVATION. Rock Excavation shall be measured and paid for under Subsection 801-4.62.

802-4.93 CONCRETE MANHOLES AND INLETS. Concrete Manholes and Inlets shall be measured and paid for under Section 1205.

802-4.94 thru 802-4.98 RIP RAP - TYPE (). Rip Rap shall be measured by the ton and paid for at the unit price bid for “Rip Rap – Type ()” complete in place and accepted by the ENGINEER.

802-4.99 RIP RAP GROUT. Rip rap grout shall be paid for by the cubic yard (CY) of rip rap grout installed and accepted by the ENGINEER. Granular bedding material and installation shall be considered incidental to the price bid for “grouted rip rap.”

802-2.19 RIP RAP. Rock shall be hard, durable, angular in shape, and free from cracks, overburden, shale, and organic material. The width and the thickness of a single stone shall each be less than 1/3 the length of the stone. Rock shall not sustain a loss of more than 40 percent after 500 revolutions in an abrasion test conducted in accordance with ASTM C535-69. Rock shall not sustain a loss of more than 10 percent after 12 cycles of freezing and thawing (AASHTO test 103 for ledge rock procedure A). Rock shall have a minimum specific gravity of 2.50.

Contractor shall be responsible for all costs of testing rock for compliance with these specifications. In lieu of testing proposed rock for compliance with these specifications, rock obtained from county or North Dakota Department of Transportation approved quarries may be used. All rock materials considered for use as rip rap shall have prior approval by the ENGINEER, before being placed.

Gradation for Type VL, L, M, H, and VH rip rap are as follows:

<u>Rip Rap Designation</u>	<u>% Smaller Than Given Size By Weight</u>	<u>Intermediate Rock Dimension (Inches)</u>	<u>(Inches)</u>
Type VL	70-100	12	6**
	50-70	9	
	35-50	6	
	2-10	2	
Type L	70-100	15	9**
	50-70	12	
	35-50	9	
	2-10	3	
Type M	70-100	21	12
	50-70	18	
	35-50	12	
	2-10	4	
Type H	100	30	18
	50-70	24	
	35-50	18	
	2-10	6	
Type VH	100	42	24
	50-70	33	
	35-50	24	
	2-10	9	

*d₅₀ = Mean particle size

**Bury types VL and L with native top soil and revegetate to protect from vandalism.

Filter fabric shall be used under the rip rap as bedding. The fabric shall have the same properties as, and be equal to, the nonwoven geotextile fabric Amoco 4551. Filter fabric shall be installed in accordance with manufacturer's recommendations. All costs for providing and installing the filter fabric shall be incidental to the rip rap.

Hand placement of rip rap may be required to insure an acceptable gradation, uniform surface, and to fill gaps between larger rocks to cover any exposed filter fabric.

Because of this relatively small size and weight, Type VL rip rap and Type L rip rap shall be buried with topsoil and revegetated to protect the rock from vandalism. All items shall be considered incidental to the bid price for rip rap.

Rip rap shall be measured by the ton and paid for at the unit price bid for "Rip Rap - Type ()" complete and in place and accepted by the ENGINEER.