

PART 3

STANDARD SPECIFICATIONS FOR WATER AND SEWER CONSTRUCTION

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**STANDARD SPECIFICATIONS
FOR
WATER & SEWER CONSTRUCTION**

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B. BIDDING DOCUMENTS

The following Bidding Documents will be prepared for each construction project in accordance with the project's specific requirements (these documents are **not** included herein):

Notice of Hearing and Letting
Instructions to Bidders
Bid Form
Bid Security Bonds

C. CONSTRUCTION CONTRACT DOCUMENTS

The following Construction Contract Documents will be prepared for each construction project in accordance with the project's specific requirements (these documents are **not** included herein):

- General Conditions (EJCDC C-700)
- Supplementary Conditions
- Construction Contract Agreement
- Contract Security Bonds
- Application for Payment
- Other Construction Related Forms

D. GENERAL REQUIREMENTS

The following General Requirements will be prepared for each construction project in accordance with the project's specific requirements (these documents are **not** included herein):

- Administrative Provisions
- Measurement and Payment
- Project Meetings
- Submittals
- Shop Drawings, Product Data, and Samples
- Quality Control
- Construction Facilities and Temporary Controls
- Contract Closeout

SECTION 02100

SITE PREPARATION

1.0 GENERAL

1.01 DESCRIPTION

1.01.1 RELATED WORK SPECIFIED ELSEWHERE

Trench Excavation and Backfill	Section 02250
Subgrade Reconstruction, Compaction, and Trimming	Section 02280
Concrete Pavement Reconstruction	Section 02410
Asphaltic Concrete Pavement	Section 02500
Water Mains and Appurtenances	Section 02600
Boring and Jacking	Section 02650
Horizontal Directional Drilling	Section 02655
Sanitary Sewers	Section 02700
Surface Restoration	Section 02900

1.02 PERMITS REQUIRED

1.02.1 PERMITS FOR CONSTRUCTION may be needed prior to the start of the work. The Contractor shall be responsible for contacting, and obtaining permits from, all applicable entities, including Mills County, the State of Iowa, City of Glenwood, City of Pacific Junction, drainage districts, and BNSF railroad.

2.0 PRODUCTS

3.0 EXECUTION

3.01 GENERAL SITE PREPARATION

3.01.1 KEEP PROJECT SITE free from drainage ponding due to construction operations during progress of Work. Make arrangements for disposal of all water and sewage received on the site from temporary connections or stoppages. Do not discharge any water or sewage onto private property outside the construction right-of-way.

3.01.2 STRIP TOP SOIL and separately store to provide depth of top soil replacement as specified.

3.01.3 REMOVE AND STORE obstructions such as culvert pipe, signs, and fences for replacement upon completion of construction. Provide temporary fencing if necessary to contain livestock or to prevent accidents until permanent fencing is restored.

3.02 EXISTING UTILITIES

3.02.1 CONTRACTOR IS RESPONSIBLE for liaison with utility companies and for repairing utilities and services which are not in direct conflict with the Work, and is responsible for damage during construction at no expense to the Owner, unless indicated otherwise on the Drawings.

3.02.2 UTILITIES SHOWN ON DRAWINGS, in direct line and grade, which conflict with the work, shall be relocated by others at no expense to the Contractor, unless indicated otherwise on the Drawings.

3.02.3 FOR UTILITIES NOT SHOWN on the Drawings and which are in direct conflict with the work, the Contractor shall notify the Engineer of the conflict. When directed, the Contractor shall perform the Work. The Contractor shall be entitled to payment for any extra work in accordance with the General Conditions.

3.02.4 UTILITY REMOVAL. Before the Contractor begins Work, he shall confer with the owners of any underground or overhead utilities which may be on or in close proximity to the Work areas and shall arrange for the necessary disconnection of the utilities in accordance with the utility company regulations. The utility company or owner of the utility shall perform the work of removing, repairing, reconditioning, or revising the utility unless otherwise specified or indicated on the Drawings. The Contractor shall cooperate with the utility companies so that the Work can be expedited to the best interests of all concerned.

3.02.5 PROTECTION OF EXISTING SERVICE LINES AND UTILITY STRUCTURES shall be the responsibility of the Contractor. The Contractor shall protect and safeguard existing service lines and utility structures shown or indicated on the Drawings and, if damaged, shall be repaired by the Contractor at his expense. Any existing line or utility structure which is not shown on the Drawings, or the location of which is not known to the Contractor in sufficient time to avoid damage, if inadvertently damaged, shall be repaired by the Contractor and he shall be entitled to payment in accordance with the General Conditions.

3.03 TREE REMOVAL

3.03.1 TREE REMOVAL shall consist of only those shown on the Drawings or as authorized by the Owner and the Engineer. Do not remove any tree not designated for removal.

3.03.2 FELL, CUT, AND REMOVE TREES together with down timber, stumps, roots, and brush. Backfill and dispose of debris.

3.04 PAVEMENT REMOVAL

3.04.1 REMOVE PAVEMENT to a minimum of one foot, zero inches from edge of trench. No undercutting will be permitted. Remove pavement on straight lines approximately parallel to the center line of the trench. Cut pavement and drives with a concrete saw and provide a minimum vertical cut of one inch.

3.04.2 REMOVE BRICK PAVEMENT in a uniform pattern. If removed bricks are not used in pavement restoration, they shall become the property of the Owner. Store and place as designated by the Owner.

3.04.3 REMOVE ASPHALT PAVEMENT in the same manner as concrete pavement. Cut all edges neatly.

3.04.4 REMOVE SIDEWALK PAVEMENT to the nearest joint beyond a minimum distance of one foot, zero inches from edge of trench.

3.04.5 REMOVE SEAL COAT AND GRAVEL SURFACES neatly with an excavating machine.

3.04.6 ALL OF THE ABOVE paragraphs are minimum standards. The City of Glenwood Public Works Department has developed Specifications For Street Repair and Rehabilitation which apply to construction of streets within the Glenwood City Limits. These City specifications shall override any conflicting specification listed above.

3.05 CONSTRUCTION ALONG OR ACROSS HIGHWAYS AND RAILROADS

3.05.1 MAINTAIN TRAFFIC FLOW on highways and railroads at all times. Obtain a work permit from the appropriate State Highway Official or Railroad Company Official before commencing Work. Follow all detailed Work requirements and procedures of the Highway Department or Railroad Company as may be required by the permit.

3.05.2 PROVIDE WARNING lights, signals, flagmen, or other precautionary measures as required to protect Work and traffic.

3.05.3 BEFORE EXCAVATION OR START OF WORK, check with the Highway Official or Railroad Company Official for location of all buried utilities or cables.

3.05.4 WORK PERFORMED ALONG OR ACROSS RAILROADS may be regulated and inspected by Railroad Company Officials. The railroad shall have the right to regulate and stop Work and correct any error with railroad forces at the Contractor's expense in an emergency or if Contractor refuses to make timely repairs.

3.06 ACCESS TO STREETS AND HIGHWAYS

3.06.1 CONTRACTOR shall maintain a suitable means of access for property owners abutting streets and highways involved in construction, except as specifically permitted otherwise by the Owner. Notify property owners 24 hours in advance of any street closure.

3.06.2 WHENEVER CONSTRUCTION IS STOPPED due to inclement weather, on week-ends and holidays, or for other reasons, suitable access shall be provided for all property owners.

3.07 DISRUPTION OF UTILITY SERVICE

3.07.1 CONTRACTOR shall maintain utility service to all property owners or customers of utilities throughout the construction period unless repairs or improvements are authorized. In the event of repairs, replacements or improvements to utility service lines, the Contractor shall give the property owner or customer 24-hour notice of the upcoming disruption. Disruption of service shall be for as brief a period as possible so as not to cause undue inconvenience to the affected property owner or customer.

3.08 REMOVAL OF EXISTING STRUCTURES

3.08.1 REMOVE STRUCTURES regardless of materials of which they are constructed. Removal shall include masonry walls, footings and foundations, sidewalks, steel, cast iron, concrete, rubbish, junk, wood, and miscellaneous items.

3.09 DISPOSAL OF DEBRIS AND REFUSE

3.09.1 CONTRACTOR shall dispose of surface materials, construction debris and trees in accordance with local ordinances and at a site approved by the Owner. Burning of refuse will not be permitted.

SECTION 02210

SITE GRADING

1.0 GENERAL

1.01 DESCRIPTION

1.01.1 WORK COVERED UNDER THIS SECTION shall consist of the grading of the site to conform to the grades, cross sections, and contours shown on the Drawings, or as directed by the Engineer. The work shall include all excavation, shaping and sloping of all cut areas, and all placing, compacting, shaping and finishing of all embankments in fill areas necessary for the completion of all site, berm, and roadway grading, including subgrades, shoulders, slopes, intersections, approaches, and entrances.

1.01.2 RELATED WORK SPECIFIED ELSEWHERE

Site Preparation	Section 02100
Trench Excavation and Backfill	Section 02250
Subgrade Construction, Compaction, and Trimming	Section 02270
Surface Restoration	Section 02900

1.02 JOB CONDITIONS

1.02.1 CONTRACTOR SHALL CAREFULLY MAINTAIN all bench marks, monuments, stakes, and other reference points and replace same if disturbed or destroyed.

1.02.2 CONTRACTOR SHALL EXERCISE EXTREME CARE to protect all existing underground and overhead utilities. Contractor shall be responsible for repairing all utilities damaged or destroyed during construction.

1.02.3 CONTRACTOR SHALL PROTECT trees, shrubs, lawns, and other features which are to remain after construction is completed.

1.03 DEFINITIONS

1.03.1 SUITABLE MATERIALS include material that is free of debris, roots, organic matter, frozen matter, and which is free of stones with any dimension greater than 1/2 of the specified loose layer thickness.

1.03.2 UNSUITABLE MATERIALS include all material that contains debris, roots, organic matter, frozen matter, stone (with any dimension greater than 1/2 the loose layer thickness), or other materials that are determined by the Engineer or testing laboratory as too wet or otherwise unsuitable for providing a stable subgrade.

1.03.3 DEGREE OF COMPACTION required is expressed as a percentage of the maximum dry density determined by ASTM D 698. Moisture content shall be adjusted to not more than 4% below or 4% above optimum moisture content.

2.0 PRODUCTS

2.01 MATERIALS

2.01.1 ALL FILL AND BACKFILL MATERIALS shall be select subsoil and shall be clean, inorganic, low-plasticity lean clay or silt. Material shall be selected from off-site borrow areas as approved by the Engineer and testing laboratory. The Contractor shall furnish and haul all offsite borrow material to the job site.

2.01.2 TOP SOIL shall be rich, fine, and well drained material which has previously been stripped and stored on the site. Reuse existing topsoil which is natural, fertile, agricultural soil capable of sustaining vigorous plant growth, free of unsuitable materials as herein defined. Import topsoil if existing topsoil does not cover ground to the extent specified.

2.01.3 SUBGRADE STABILIZATION MATERIAL shall be coarse stone, consisting of crushed, screened, natural stone, free of shale, clay, and debris. Size of material shall be 1 inch to 3 inches in diameter.

3.0 EXECUTION

3.01 EQUIPMENT

3.01.1 ALL EQUIPMENT shall be adequate for the purpose for which it is to be used and shall be kept in satisfactory working order. Equipment shall be adequate to perform all stripping, excavation, hauling, placement of embankment, compaction, trimming, and shaping.

3.02 STRIPPING

3.02.1 STRIP THE ENTIRE AREA OF THE SITE of topsoil to a depth of four inches or to just below the topsoil strata, whichever is greater. Do not strip topsoil when wet and do not allow topsoil to become mixed with subsoil. Deposit topsoil in storage piles in locations separate from other excavated material, free from roots, stones, and other deleterious material. Do not drive heavy equipment over stockpiled topsoil.

3.02.2 PLACE TOPSOIL STRIPPINGS as shown on the Drawings to be used for erosion control terraces. The topsoil strippings shall be used by others at completion of the future, final site grading.

3.03 EXCAVATION

3.03.1 EXCAVATE THE SITE to the grades, lines, and contours shown on the Drawings. Do not excavate wet topsoil. If necessary, stockpile excavation for future use as embankment. Keep excavation areas free draining to prevent the accumulation of water. Shape and slope all excavation areas at completion of excavation work.

3.03.2 ALL MATERIALS REMOVED FROM EXCAVATION AREAS shall be used as far as practical in the formation of embankments, subgrades and shoulders and at such locations as directed by the Engineer. When materials are considered unsatisfactory for use in embankments, subgrades or shoulders, the Engineer will require that the material be excavated and replaced with suitable materials.

3.03.3 THE UPPER 12 INCHES OF ROADBED, which is within excavation areas, shall be compacted to conform with the compaction requirements for embankments. Unless the Engineer considers the material in the excavation area unsatisfactory for use in the subgrade, the Contractor shall perform all work required, including the application of water if necessary, to facilitate compaction.

3.03.4 DURING CONSTRUCTION OF ROADWAYS, the roadbed shall be maintained in such condition that it will be adequately drained at all times. Side ditches emptying from cuts to embankments shall be constructed so as to avoid damage to embankments by erosion. The finished roadway shall be free from waves and true to the lines, grades, and cross sections shown on the Drawings.

3.03.5 PAYMENT WILL NOT BE MADE FOR REEXCAVATION of any materials which is necessary for the Contractor to stockpile in the performance of other work required on the Drawings or for any material which may be stockpiled to drain and dry before placement in the embankment.

3.03.6 ALL EXCAVATIONS shall be performed to within a tolerance of 0.1 foot from the lines, grades, and contours shown on the Drawings.

3.04 EMBANKMENT

3.04.1 EMBANKMENTS SHALL BE CONSTRUCTED OF SUITABLE MATERIAL removed from excavation areas on the site. Unsuitable materials as defined above shall not be used. Imported material may be required depending on job conditions.

3.04.2 WHEN EMBANKMENTS ARE CONSTRUCTED ON SIDE-HILL SLOPES steeper than four to one, the area of the original slope on which embankment is to be placed shall be stepped to a vertical depth of at least 12 inches in order to integrate the embankment and the slope.

3.04.3 PLACE ALL EMBANKMENTS to the grades, lines, and contours shown on the Drawings. Place embankment systematically, as early as possible, to allow maximum time for natural settlement. The hauling of embankment material shall be distributed over the entire embankment areas to assist in compacting the material.

3.04.4 DO NOT PLACE EMBANKMENTS over porous, wet, or spongy subgrade surfaces. If necessary, remove such unsuitable material and replace with satisfactory stabilizing materials, as directed by the Engineer.

3.04.5 PLACE MATERIAL FOR EMBANKMENTS in successive horizontal layers not to exceed eight inches of loose thickness for heavy equipment and four inches of loose thickness for light equipment. Level and compact each layer to a uniform density of 92% of maximum density, as determined by ASTM D 698.

3.04.6 ALL EMBANKMENTS shall be compacted in place to a tolerance of 0.1 foot from the lines, grades, and contours shown on the Drawings.

3.05 COMPACTION

3.05.1 COMPACTION OF ALL EXCAVATION AND EMBANKMENT AREAS shall be to a uniform density of 92% of maximum density, as determined by ASTM D 698.

3.05.2 COMPACTION OF THE TOP EIGHT INCHES OF ROADWAY SECTIONS shall be to a uniform density of 92% of maximum density, as determined by ASTM D 698.

3.05.3 THE CONTRACTOR shall be responsible for all compaction density testing. Density tests shall be performed by an approved testing laboratory. Tests shall be performed randomly, but in sufficient numbers to ensure that the specified density is being obtained for the work. The specific locations of compaction density tests shall be determined by the Engineer. Copies of all testing reports shall be furnished to the Engineer in accordance with the General Requirements.

3.05.4 COMPACTION TESTS SHALL BE PERFORMED in sufficient numbers to ensure that the specified density is being obtained throughout the site. The cost of density testing shall be made from the testing allowance included in the Contract Documents.

3.05.5 COMPACTION TESTS shall be performed according to the following frequency:

One test per each 1,500 CY of embankment. Tests shall be taken in every other 8-inch lift of placed embankment.

3.05.6 THE CONTRACTOR SHALL BE RESPONSIBLE for the stability of all embankment and excavation areas and shall replace, at Contractor's own expense, any portions which become displaced or unstable prior to the expiration of the warranty period.

3.06 DRAINAGE

3.06.1 GRADE ALL EXCAVATION AND EMBANKMENT AREAS so that positive drainage exists during and after construction. Prevent the ponding of surface water unless specifically called for on the Drawings or directed by the Engineer.

3.07 PLACING TOPSOIL

3.07.1 PLACE TOPSOIL in areas where seeding, sodding and planting is scheduled, and as directed by the Engineer.

3.07.2 USE TOPSOIL in relatively dry state and place during dry weather. Fine grade topsoil to eliminate rough or low areas and maintain levels, profiles, and contours of the subgrade. All areas shall be finish graded so final grades will be in accordance with the Drawings. Remove all stone, roots, grass, weeds, debris, and foreign material from the topsoil while spreading.

3.07.3 MANUALLY PLACE TOPSOIL around trees, plants, and buildings to prevent damage. Assure positive drainage away from buildings and structures.

3.07.4 LIGHTLY COMPACT PLACED TOPSOIL. Settle topsoil with a fine spray of water to avoid separation of ingredients. Do not jet or flood topsoil.

3.07.5 FINE GRADE PLACED TOPSOIL to obtain final grade. Hand rake as necessary around trees, plants, buildings, and structures. Maintain sufficient topsoil reserve to regrade as necessary after initial settlement. Upon regrading, remove surplus topsoil and subsoil from the site.

3.07.6 FINAL TOPSOIL THICKNESS shall be as follows:

<u>Location</u>	<u>Thickness</u>
Seeded Grass Areas	6"
Sod Areas	4"
Tree and Shrub Beds	12"
Groundcover Areas	12"

SECTION 02250

TRENCH EXCAVATION AND BACKFILL

1.0 GENERAL

1.01 DESCRIPTION

RELATED WORK SPECIFIED ELSEWHERE

Site Preparation	Section 02100
Water Mains and Appurtenances	Section 02600
Boring and Jacking	Section 02650
Horizontal Directional Drilling	Section 02655
Sanitary Sewers	Section 02700
Surface Restoration	Section 02900

1.02 PROTECTION OF EXISTING UTILITIES

1.02.1 VERIFY THE EXISTENCE AND LOCATION of underground utilities along the entire route of the Work. Omission from, or inclusion of, utility locations on the Drawings is not to be considered as the nonexistence of, or a definite location of, existing underground utilities. Prior to construction operations, locate and mark, or have others locate and mark, all underground and overhead utilities, including, but not limited to, water, sanitary sewer, storm sewer, gas, power, telephone, cable television, etc.

1.02.2 PROTECT EXISTING UTILITIES from damage due to Work operations. The Contractor shall repair any damage to existing utilities caused by his operations.

2.0 PRODUCTS

2.01 TRENCH BOTTOM STABILIZATION MATERIAL (IF REQUIRED)

2.01.1 TRENCH BOTTOM STABILIZATION MATERIAL shall consist of clean, coarse, crushed rock of three-fourths inch to one and one-half inch (3/4" to 1 1/2") size, as approved by the Engineer.

2.02 PIPE BEDDING MATERIAL

2.02.1 PIPE BEDDING MATERIAL shall consist of well graded crushed stone meeting the requirements of ASTM C 33, Gradation 67 (3/4 inch to No. 4) or well graded gravel meeting the same requirements.

2.03 BACKFILL MATERIAL

2.03.1 BACKFILL MATERIAL shall consist of earth material from onsite trenching operations including clay, silt, sand, gravel, hardpan, and disintegrated shale. Large rocks and boulders will not be permitted to be used as backfill material.

3.0 EXECUTION

3.01 EXCAVATION AND TRENCHING

3.01.1 PERFORM EXCAVATION AND TRENCHING operations to the depth indicated on the Drawings or as specified.

3.01.2 PILE excavated material suitable for backfill in an orderly manner sufficient distance back from edge of excavation to avoid rollbacks, slides, or cave-ins.

3.01.3 REMOVE soil not suitable for backfill and waste at a disposal area designated by the Engineer.

3.01.4 WHERE NEW CONSTRUCTION crosses or closely parallels existing utilities or utility services, excavate in advance of pipe laying to determine location and crossing arrangement, including exact construction line and grade.

3.01.5 BORE AND JACK beneath existing streets, utilities, and structures, except as noted on the Drawings or as directed by the Engineer.

3.01.6 REFERENCE to percent maximum density shall mean a soil density not less than the stated percent of maximum density for soil, as determined by ASTM D Choose an item.

3.01.7 KEEP WIDTH OF TRENCH as narrow as possible, but provide adequate room for backfilling and jointing. Keep sides of the trench as nearly vertical as practical within the limits of excavation codes and maintain vertical walls of excavation below top of pipe. Trench widths shall be as follows:

<u>Pipe Size</u>	<u>Trench Width</u>
3/4" to 3"	12"
4" to 8"	24"
10" to 16"	36"
18" to 24"	48"
30" and Greater	Pipe Size Plus 18" Each Side

3.01.8 EXCAVATE to full depth by machine and level trench bottom to provide uniform bearing and support for full length of pipe. Trench bottom shall be continuous, relatively smooth, and free of rocks.

3.01.9 BED TRENCH BOTTOM as shown on the Drawings or as directed by the Engineer.

3.01.10 PROVIDE BELL HOLES at each pipe joint and allow access completely around circumference of pipe for proper jointing operations.

3.01.11 INSTALL PIPE and provide a minimum pipe envelope consisting of compacted backfill completely around the pipe and a distance 12 inches above the top of the pipe.

3.01.12 WHEN UNSTABLE MATERIAL is encountered which may not provide a suitable foundation for pipe, notify the Engineer immediately. If determined by the Engineer upon his investigation that the material is unsuitable for foundations, the Engineer may specify and authorize remedial measures. If removal of unsuitable material is authorized, replace it with a stabilizing material consisting of $\frac{3}{4}$ " to 1 $\frac{1}{2}$ " size, coarse, sharp and cleat crushed stone or other approved material. Provide a minimum of four inches (4") of bedding material on top the stabilizing material to prevent point load.

3.01.13 EXCAVATE BY HAND under and around utilities, where overhead clearance prevents use of machine, and under trees and shrubs where shown on the Drawings.

3.02 SHEETING, SHORING, AND BRACING

3.02.1 CONSTRUCT SHEETING, SHORING, AND BRACING required to hold walls of excavation, to provide safety for workmen, to protect existing utilities or structures, and to permit construction in the dry. If wood sheeting is driven below the level of pipe, it shall be left in place to a level 5 feet below finished grade. Steel sheeting shall be pulled upon completion unless indicated otherwise on the Drawings. When a movable trench shield is used below the spring line of the pipe, it shall be lifted prior to any forward movement to avoid pipe displacement.

3.03 DEWATERING (IF REQUIRED)

3.03.1 IF DEWATERING IS NECESSARY, obtain the Engineer's approval of proposed methods of dewatering. When dewatering is necessary, provide for handling of water encountered during construction. Lay no pipe in and pour no concrete on excessively wet soil. Prevent surface water from flowing into the excavations and remove water as it accumulates. Divert stream flow away from areas of construction. Do not pump water onto adjacent property without approval of Engineer and adjacent property owner. Do not use sanitary sewers for disposal of trench water. The cost of dewatering shall be included in the original Bid Price for construction. No additional remuneration for dewatering shall be permitted.

3.04 EXCAVATION FOR STRUCTURES AND APPURTENANCES

3.04.1 EXCAVATE as required for manholes and other appurtenances until firm, undisturbed soil is reached. If excavation is carried below bottom of foundations as shown on the Drawings, fill with 3,000 psi concrete or stabilizing material, as directed by the Engineer, at no expense to Owner.

3.04.2 WHEN UNSTABLE MATERIAL is encountered which will not provide suitable foundation, fill with 3,000 psi concrete or stabilizing material specified herein, or as directed by Engineer. Contractor shall be entitled to payment for this extra work in accordance with the General Conditions.

3.05 BACKFILL FOR TRENCHES

3.05.1 BACKFILL TRENCHES immediately after the location of all lines, connections, and appurtenances are recorded, or at the Engineer's direction.

3.05.2 CONSTRUCT MANHOLES and appurtenances and perform backfilling as Work progresses. Closing of street intersections as the Work progresses shall be subject to the Owner's approval, and in the case of a highway intersection, at the approval of the State Highway Department.

3.05.3 BACKFILL with material removed from excavation except where sand backfill may be specified. Backfill material shall be as specified herein and shall not contain any debris, frozen earth, large clods, stones, or other unsuitable material.

3.05.4 PLACE BACKFILL simultaneously on both sides of the pipe to prevent displacement. Place backfill into the trench at an angle so that the impact on the installed pipe is minimized. Install a cushion of four feet (4') of backfill above the pipe envelope before using heavy compaction equipment.

3.05.5 HAND PLACE BACKFILL in the pipe envelope and compact finely divided material to twelve inches (12") over the top of the pipe. Compact the material to ninety-five percent (95%) of maximum density, as determined by ASTM D 698.

3.05.6 BACKFILL REMAINDER OF TRENCH with excavated material up to the bottom of the specified surface restoration. Compact to ninety-eight percent (98%) of maximum density under and within two feet (2') of pavement and ninety-five percent (95%) of maximum density in other areas, as determined by ASTM D.

3.05.7 BACKFILL TOP TWELVE INCHES (12") of the trench with soil equivalent to adjacent topsoil.

3.06 BACKFILL FOR STRUCTURES AND APPURTENANCES

3.06.1 BACKFILL after concrete or masonry has cured for seven (7) days and has been inspected and approved by Engineer. Backfill with material removed from excavation except where sand backfill is specified. Backfill material shall be as

specified herein and shall not contain any debris, frozen earth, large clods, stones, or other unsuitable material. Backfill simultaneously on all sides of the structure to prevent damage at all times. Brace walls of structures as required.

3.06.2 COMPACT BACKFILL at structures to a density not less than specified for the adjacent trench.

3.06.3 TERMINATE BACKFILL at finish grade as shown on the Drawings and dispose of excess excavation material as directed by the Engineer. Prepare backfill for surface restoration as specified for adjacent trench.

3.07 BACKFILL SETTLEMENT

3.07.1 THE CONTRACTOR shall be responsible, financially or otherwise, for any and all settlement of trench and structures backfill which may occur for a period of two (2) years after Substantial Completion. Contractor shall make all necessary backfill replacements and repairs or replacements appurtenant thereto within thirty (30) days from and after due notification by the Owner or Engineer of backfill settlement and resulting damage at any designated location or locations.

3.08 TESTING

3.08.1 THE CONTRACTOR shall be responsible for all backfill compaction density testing. Density tests shall be performed by an approved Testing Laboratory. Tests shall be performed in sufficient numbers to insure that the specified density is being obtained, in accordance with the following schedule:

Depth Over Top of Pipe	Location of Test	Frequency of Test
0 - 5'	Surface	300 L.F.
5 - 12'	Surface and 1/2 Depth	300 L.F.
Over 12'	Surface, 1/3 Depth and 2/3 Depth	300 L.F.

The specific locations of each compaction density test shall be determined by the Owner. The owner reserves the right to adjust the frequency of testing depending on local conditions and on the quality of initial testing and contractor's compaction efforts. Copies of all testing reports shall be furnished to the Engineer in accordance with the General Requirements.

SECTION 02280

SUBGRADE RECONSTRUCTION, COMPACTION, AND TRIMMING

1.0 GENERAL

1.01 DESCRIPTION

1.01.1 RELATED WORK SPECIFIED ELSEWHERE

Site Preparation	Section 02100
Concrete Pavement Reconstruction	Section 02410
Asphaltic Concrete Pavement	Section 02500
Surface Restoration	Section 02900

1.01.2 WORK COVERED UNDER THIS SECTION shall consist of subgrade reconstruction, compaction, and trimming after pavements have been removed in preparation for pavement reconstruction. The work shall include adjusting grade lines to meet intersections, pavements, or any other physical features designated by the Engineer; undercutting if necessary to provide adequate width; disposing of surplus excavated material; and such scarifying, drying, reshaping, and recompacting as is necessary to conform to the typical cross sections shown on the Drawings and to comply with the compaction requirements specified.

1.01.3 ALL WORK shall comply with the Specifications for Street Repair and Rehabilitation of the City of Glenwood Public Works Department, latest edition.

2.0 PRODUCTS

2.01 SUBGRADE MATERIAL

2.01.1 SUBGRADE MATERIAL shall consist of suitable soil removed from excavations or borrow areas which can be used in the formation of subgrades, embankments, and shoulders. Suitable material shall be select subsoil and shall be clean, inorganic, low-plasticity lean clay or silt. Material shall be free of debris, roots, organic matter, frozen matter, large stone, or other materials that are determined by the Engineer or testing laboratory to be unsuitable.

2.01.2 THE USE OF GRANULAR MATERIAL for subgrades, embankments, and shoulders beneath pavement reconstruction areas shall be prohibited, unless such material matches that of existing subgrades or is approved by the Engineer.

3.0 EXECUTION

3.01 EQUIPMENT

3.01.1 COMPACTION EQUIPMENT shall be adequate for the purpose for which it is to be used and shall be kept in satisfactory working order. Equipment shall be adequate to perform the compaction required for the type of material being compacted. Equipment shall consist of multiple-wheel, pneumatic-tired rollers or sheeps-foot rollers of proper design to insure compliance with the specified compaction density.

3.02 CONSTRUCTION METHODS

3.02.1 THE WORK OF SUBGRADE RECONSTRUCTION shall be performed to provide that, immediately prior to the first placement of surfacing material, the upper eight inches of subgrade shall conform to a uniform density of not less than 98% of maximum density as determined by ASTM D 698. If necessary, the moisture content of the subgrade material shall be adjusted to not more than 4% above or below optimum moisture content.

3.02.2 THE SUBGRADE shall be reshaped to the typical cross section shown on the Drawings. In the event the subgrade width is less than the width shown on the typical cross sections, the widening shall be accomplished either by undercutting the grade, by placing additional embankment on the shoulder slopes, or by a combination of the two as approved by the Engineer. Widening by placement of additional embankment material on the shoulder slopes to provide the minimum width will be permitted only if the existing slope is flatter than 4:1. After placement, shaping, and the compaction of the material, the slope shall be no steeper than 4:1. The embankment material shall be compacted to comply with the compaction requirements shown in these Specifications.

3.02.3 THE WORK of correcting faulty subgrade conditions below the 8-inch depth will be performed by removing and disposing of the faulty subgrade by the Contractor. The excavation will then be backfilled with suitable material up to the proper grade and cross sections shown on the Drawings. Should faulty subgrade conditions be caused by the Contractor's operations, they shall be corrected at the Contractor's expense.

3.02.4 THE WORK of maintaining the compacted subgrade shall be the responsibility of the Contractor until the material for subsequent construction has been placed.

3.03 BASIS OF PAYMENT

3.03.1 UNLESS DIRECT PAYMENT is otherwise provided, the work of subgrade reconstruction and compaction will not be paid for directly, but shall be considered to be subsidiary to the pavement, base course, or aggregate surfacing item.

3.04 TESTING

3.04.1 THE CONTRACTOR shall be responsible for all compaction density tests. Density tests shall be performed by an approved testing laboratory. Tests shall be

performed randomly, but in sufficient numbers to ensure that the specified density is being obtained for the work. The specific locations of compaction density tests shall be determined by the Owner. The total number of tests shall be determined by the Owner and shall be paid for from the testing allowance. Copies of all testing reports shall be furnished to the Engineer in accordance with the General Requirements.

SECTION 02410

CONCRETE PAVEMENT RECONSTRUCTION

1.0 GENERAL

1.01 DESCRIPTION

1.01.1 RELATED WORK SPECIFIED ELSEWHERE

Site Preparation	Section 02100
Trench Excavation and Backfill	Section 02250
Subgrade Reconstruction, Compaction, and Trimming	Section 02280
Surface Restoration	Section 02900

1.01.2 WORK COVERED UNDER THIS SECTION shall consist of the removal and disposal of existing concrete pavement and the replacement of Portland cement concrete at locations shown on the Drawings and designated by the Engineer. In general, the pavement reconstruction shall be constructed where existing pavement must be removed and replaced to match new grades, alignments, and cross sections due to water and sewer utility work. All pavement reconstruction shall be constructed on prepared or reconstructed subgrades in accordance with the requirements of these Specifications.

1.01.3 ALL WORK OF PAVEMENT RECONSTRUCTION within the City limits of Glenwood shall be in accordance with the Specifications For Street Repair and Rehabilitation, City of Glenwood Public Works Department, latest edition. Copies of these specifications shall be obtained from the City of Glenwood. For work outside the City Limits, contact GMU for the appropriate Mills County or GMU pavement specifications to follow.

1.02 GENERAL PROVISIONS

1.02.1 THE FOLLOWING ARE A SUMMARY of some of the key standards required for concrete paving reconstruction within the City of Glenwood (consult the entire set of Specifications for further details):

- .1 PAVEMENT THICKNESS: Arterial Streets: Existing thickness plus 1-inch,
or 8-inches minimum.

All Other Streets: Existing thickness plus 1-inch,
or 6-inches minimum.

.2 MIX DESIGN: Arterial Streets: IDOT Class M (M4) high early strength.
All Other Streets: IDOT Class C (V47B).

SECTION 02500

ASPHALTIC CONCRETE PAVEMENT

1.0 GENERAL

1.01 DESCRIPTION

1.01.1 WORK COVERED UNDER THIS SECTION shall consist of the application of one or more courses of hot-mixed, hot-laid, asphaltic concrete, surface overlays, and/or base course, on prepared subgrades, subbases, or existing surfacing. All Work shall be in accordance with the requirements of these Specifications and in conformity with the lines, grades, and typical cross sections shown on the Drawings or as designated by the Engineer.

1.01.2 RELATED WORK SPECIFIED ELSEWHERE

Site Preparation	Section 02100
Subgrade Reconstruction, Compaction, and Trimming	Section 02280
Surface Restoration	Section 02900

1.01.3 ALL WORK OF PAVEMENT CONSTRUCTION within the City limits of Glenwood shall be in accordance with the Specifications For Street Repair and Rehabilitation, City of Glenwood Public Works Department, latest edition. Copies of these specifications shall be obtained from the City of Glenwood. For work outside the City limits, contact GMU for the appropriate Mills County or GMU pavement specifications to follow.

SECTION 02600

WATER MAINS AND APPURTENANCES

1.0 GENERAL

1.01 DESCRIPTION

1.01.1 RELATED WORK SPECIFIED ELSEWHERE

Site Preparation	Section 02100
Trench Excavation and Backfill	Section 02250
Pipe Boring and Jacking	Section 02650
Horizontal Directional Drilling	Section 02655
Surface Restoration	Section 02900

1.02 SUBMITTALS

1.02.1 SHOP DRAWINGS shall be submitted to Engineer. Submittals shall include, but are not limited to, the following:

- Piping and Fittings
- Valves, Valve Boxes, and Covers
- Fire Hydrants
- Backflow Devices
- Air Release Valve
- Tracing Wire
- Locator Access Boxes
- Tapping Sleeve and Valve
- Corporation Stops
- Water Meters
- Backflow Preventers

2.0 PRODUCTS

2.01 PIPE

2.01.1 DUCTILE IRON PIPE (DIP) shall be pressure class 350 and of the size called for on the Drawings, and shall conform to the American National Standards Institute (ANSI) and American Water Works Association (AWWA) standards C151/A21.51 and C150/A21.50. Joints for ductile iron pipe shall conform to ANSI/AWWA C111/A21.11. Ductile iron pipe and fittings shall be cement mortar lined in conformance with ANSI/AWWA C104/A21.4.

2.01.2 POLY VINYL CHLORIDE (PVC) PIPE (WHEN ALLOWED) shall conform to the following:

- .1 Size 4" to 12": AWWA C900, Class 305 (DR 14), or Class 235 (DR 18) as determined by GMU.

All joints shall be push-on type with gaskets. Solvent cemented joints are not acceptable.

2.01.3 POLYVINYL CHLORIDE (PVC) PIPE for directional boring purposes shall conform to the following:

- .1 Size 4" to 12": Certa-Lok C900/RJ Restrained Joint PVC Pipe (Class 200-DR14).

2.01.4 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS for directional boring purposes shall conform to the following:

- .1 Size 4" to 12": AWWA C 906-07, Ductile Iron Pipe Size (DIPS) and SDR 9 (Pressure Class 200psi). HDPE pipe and fittings shall be constructed of PE 3608 materials.

2.01.5 COPPER PIPE for service lines shall be soft temper, Type K, with compression or flared-type joints or rigid with compression or silver solder sweat joints. Silver solder joints shall be made by an experienced and licensed plumber.

2.02 FITTINGS

2.02.1 FITTINGS for D.I.P. and P.V.C. shall be ductile iron conforming to ANSI/AWWA C153/A21.53, compact size. Fittings shall be equipped with mechanical joint ends. Payment for fittings shall be determined by weight and shall be based upon AWWA C153 standards, body weight only.

2.02.2 FITTING FOR HDPE PIPE shall be of the same cell classification and pressure class as the HDPE pipe and shall be coupled to the pipe with electrofusion. All electrofusion couplings, either pipe joints or fitting joints, shall be installed by certified fusion technicians.

2.02.3 SPECIAL FITTINGS AND PIPE PRODUCTS used in conjunction with HDPE pipe (i.e. repair clamps, service saddles, tapping sleeves, etc.) shall be stainless steel, manufactured by Romac Industries, or approved equal.

2.02.4 TRANSITION COUPLERS, M.J. ADAPTER CONNECTIONS AND SPECIAL FITTINGS, used to join different pipe materials and different pipe diameters shall be AWWA approved and suitable for the material being joined or coupled together.

Acceptable manufactures include Dresser, Performance Pipe, Romac Industries and other approved equals.

2.03 DEFECTIVE PIPE AND FITTINGS

2.03.1 ANY PIPE OR ANY FITTING, valve, or special found to be defective in materials or workmanship shall be rejected.

2.04 THRUST BLOCKING

2.04.1 THRUST BLOCKING for unbalanced thrust forces in the piping shall consist of cast-in-place concrete with a compressive strength of 4,000 psi at twenty-eight (28) days. Tie rods shall be required and shall be steel and coated to prevent corrosion. When specified, concrete shall be fast-curing, Type M4, to accelerate use of the water main. Refer to Standard Detail GMU-1 for thrust block placement.

2.04.2 ALTERNATIVE BLOCKING METHOD (when approved by GMU) shall consist of joint restraint devices for mechanical joint fittings conforming to ANSI/AWWA C153/A21.53, and shall consist of multiple gripping wedges incorporated into a follower gland at the pipe/fitting joint. Joint restraint system shall be EBAA Megalug Series 1100, or approved equal. All pipe restraints, adaptors, and couplings shall be appropriate to the pipe material used. Dry blocks may also be required to help support thrust forces.

2.05 DISINFECTION

2.05.1 DISINFECTION of piping, fittings, valves, etc., shall be accomplished through the use of Hypochlorites conforming to AWWA B300 or through the use of Chlorine conforming to FS BBC-120.

2.06 LINE TRACING WIRE

2.06.1 THE CONTRACTOR SHALL install a line tracing wire with all water main. The type of wire or tape shall be 10-gauge type TW or THHN, orange insulated solid strand with approved watertight twister grease-filled wirenut splice connectors for wet, direct bury locations. Locator access shall be placed adjacent to a valve box, fire hydrant, air release manhole, blow-off valve, etc., and shall consist of a stand-alone access box (see paragraph 2.07 and 3.11). Access shall not exceed one block. Tracing wire shall be taped to the top of the main during installation to prevent separation in the trench. For directional bored pipe, the Contractor shall tape two (2) separate tracing wires to the pipe (at separate locations).

2.07 TRACER WIRE ACCESS BOX

2.07.1 TRACER WIRE ACCESS BOX shall be by VALVCO, INC. Access box shall allow for easy access to the tracer wire, and shall contain a protective box complete with a

tamper-proof lid. The box shall be opened with a standard pentagonal head key. Tracer wire shall be attached to the lid with stainless steel terminal bolts. The collar and cover shall be cast iron. The word "WATER" shall be cast in the lid. Access box shall be obtained from C.P. TEST SERVICES - VALVCO, INC., New Berlinville, PA (888-482-5826)

2.08 VALVES

2.08.1 GATE VALVES shall conform to the requirements of AWWA Standard C509 and ANSI Standard A21.11 and shall be Resilient Seat, iron body with modified wedge disc, NRS type. Valves shall be able to withstand working pressures and test pressures of 200 psi and 400 psi respectively.

2.08.2 BUTTERFLY VALVES shall be Mueller Lineseal III 150B butterfly valve or approved equal. Maximum working pressure shall be 150 pounds per square inch, and hydrostatic test pressure shall be 200 pounds per square inch. Butterfly valves shall meet or exceed AWWA C504.

2.08.3 CHECK VALVES shall conform to the requirements of AWWA Standard C508 and shall be iron body with flanged ends. Valve shall be of the swing check type with lever and weight, and shall have an air cushion cylinder.

2.08.4 BALL VALVES shall conform to the requirements of AWWA Standard C507 and shall be bronze with blowout proof stem. Valves shall be chromium plated with reinforced PTFE seats and multifill high cycle stem packing. Maximum working pressure shall be 600 psi.

2.08.5 AIR RELEASE VALVES shall be VALMATIC Series 15. Size and model number shall be as shown on the Drawings.

2.08.6 AIR AND VACUUM VALVES shall be VALMATIC Series 100. Size and model number shall be as shown on the Drawings.

2.08.7 COMBINATION AIR VALVES shall be VALMATIC Series 200. Size and model number shall be as shown on the Drawings.

2.08.8 TAPPING SLEEVES AND VALVES shall be stainless steel, mechanical joint, and manufactured by Mueller, Clow, or approved equal, and shall be used for making branch connections to live, pressurized mains. The size of the tapping sleeve and valve shall be compatible with the size of main to be tapped and the new branch line. All connections of new branch lines to existing mains shall be made by using tapping sleeves and valves, unless approved otherwise by the GMU.

2.09 VALVE BOXES AND COVERS

2.09.1 VALVE BOXES AND COVERS shall be cast iron. Boxes shall be the extension type with screw-type adjustment and with flared base. Covers shall have the word "WATER" cast in them.

2.10 CURB VALVES AND BOXES

2.10.1 CURB VALVES shall be the size shown on the Drawings or as determined by GMU, shall meet AWWA standards, and shall be for copper service. Curb boxes shall be cast iron extension type with Minneapolis pattern base, with 1-1/4 or 1-1/2-inch inside diameter upper section. Curb box shall be flush with the ground and cast in 12-inch square concrete pad 8 feet from back of curb or cast in the sidewalk. Curb valves must be obtained from GMU and shall be a ball valve type with either compression or flare connections. The brass material in the valves shall be lead free.

2.11 CORPORATION STOPS

2.11.1 CORPORATION STOPS shall be of the size shown on the Drawings or as determined by GMU, shall meet AWWA standards, and shall be for copper service. Corporation stops must be obtained from GMU and shall include the corporation stop and 90 degree fitting with either compression or flare connection. The brass material in the valves shall be lead free.

2.12 FIRE HYDRANTS

2.12.1 FIRE HYDRANTS shall conform to the requirements of AWWA Standard C502. Fire hydrants shall be Mueller Company, Centurion Fire Hydrant, Catalog No. A-423. The hydrant lead shall be 6 inches in diameter. Every fire hydrant shall have an isolation valve in the lead section of pipe off of the main.

2.13 VALVE MANHOLES

2.13.1 VALVE MANHOLES shall be used for all valves larger than 12 inches in diameter and where designated on the Drawings.

2.13.2 MANHOLES shall be 48 inches diameter, precast, concentric manhole sections meeting the requirements of ASTM C 478.

2.13.3 MANHOLE FRAME AND COVER shall be as specified on the Drawings. The frame and cover shall be located directly above the valve stem to allow valve operation with a valve wrench from above ground.

2.14 WATER METERS

2.14.1 WATER SERVICE METERS (5/8" to 1" sizes) shall be Sensus iPerl meeting the requirements of ANSI/AWWA Standard C-700 and C-710 for accuracy and pressure loss requirements. The meters shall utilize the electromagnetic flow measurement technology. The meter shall have a high resolution 9-digit hermetically sealed electronic register with LCD display. Meters shall be equipped with RadioRead automatic meter reading transmitter systems. The flow ranges of the meter size shall be as follows:

<u>Size</u>	<u>Starting Flow</u>	<u>Normal Operating Range</u>
5/8"	0.03 gpm	0.18 to 25 gpm
5/8" x 3/4"	0.03 gpm	.018 to 35 gpm
1"	0.11 gpm	0.40 to 55 gpm

2.14.2 WATER SERVICE METERS (1 1/2" and 2" sizes) shall be SENSUS OMNI R2 meeting the requirements of ANSI/AWWA Standard C701 Class II Standards. The meters shall utilize the floating ball measurement technology. The meter shall have an all-electronic register with easy to read LCD display. Meters shall be equipped with RadioRead automatic meter reading transmitter systems. The flow ranges of meter sizes shall be as follows:

<u>Size</u>	<u>Low Flow</u>	<u>Normal Operating Range</u>
1 1/2 "	0.75 gpm	2 to 150 gpm
2"	1.0 gpm	.2.5 to 200 gpm

2.14.3 COMPOUND WATER METERS (1 ½" TO 4") shall be SENSUS OMNI C2 meeting the requirements of ANSI/AWWA Standard C701 and C702 Class II for accuracy and pressure loss requirements. The meters shall utilize the floating ball measurement technology. The meter shall have an all-electronic register with easy to read LCD display. Meters shall be equipped with RadioRead automatic meter reading transmitter systems. The flow ranges of meter sizes shall be as follows:

<u>Size</u>	<u>Operating Range</u>	<u>Low Flow</u>	<u>Max Flow</u>	<u>Intermittent Flow</u>
1 ½"	0.5 to 200 gpm	0.25	160	200
2"	0.5 to 200 gpm	0.25	160	200
3"	1.0 to 500 gpm	0.50	400	500
4"	1.5 to 1000 gpm	.075	800	1000

2.14.4 INSIDE METER SETTINGS if used, shall be as manufactured by Ford, or approved equal. Settings shall be 5/8 inch by 3/4 inch size or 1" size and shall be for installation on existing piping. The type of setting body shall be selected to fit the existing inside piping arrangement for which the setting and meter are to be applied. Settings shall be equipped with all couplings, adaptors, and transitions to allow connection to the water piping. In lieu of meter setters, the Contractor or plumber shall install an angle ball meter valve, the meter, and the meter check valve or angle or straight configuration, as purchased from the GMU.

2.14.5 OUTSIDE METER SETTINGS shall be for 5/8 inch by 3/4 inch meters or 1" meters, installed in pit applications. Each setting shall be equipped with a ball valve with locking wing on the inlet side and a check valve on the outlet side. Settings shall be equipped with all couplings, adaptors, and transitions to allow connection to the water piping. Settings shall be purchased from the GMU. All brass shall be lead free.

2.15 OUTSIDE METER PITS AND LIDS

2.15.1 OUTSIDE METER BOXES shall be rigid polyvinyl chloride (PVC) or polyethelene blend conforming to ASTM D 1784, Type 1, Grade 2, as manufactured by Ford Meter Box Company. Boxes shall be 20 inches or 30 inches in diameter and 60 inches deep. Boxes shall be equipped with cut-outs to permit the bottom end to fit over the water service piping. Meter box lids shall be as manufactured by Ford, or approved equal. Lids shall be of the Wabash, double lid type for greater frost protection of meters. Lids shall be equipped with lifter worm locking devices. Consult standard details.

2.15.2 FOR LARGE METERS (i.e. above 2" size) use minimum 48-inch pre-cast concrete manhole for meter pit, size to be approved by GMU.

2.16 BLOWOFF DEVICE

2.16.1 BLOWOFF DEVICE shall consist of a tee, valve, riser pipe elbow, and hose connection bib with cap, to allow for flushing water mains at locations were indicated on the Drawings. All blowoff piping, valves, fittings, etc., shall be six inch size to accommodate future fire hydrant connections. If the water main is smaller than six inch size, appropriate reductions in blowoff piping and valving size shall be made. Consult standard details.

2.17 BACKFLOW DEVICES

2.17.1 BACKFLOW DEVICES shall be by Watts (or equal) and shall be as follows:

- .1 Double Check Valve Backflow Preventer (DuC) (Low Hazard) - Watts Series 007, sizes one-half inch to one and one quarter inch.
- .2 Double Check Valve Assembly (DCVA) (Low Hazard) - Watts Series 709, sizes three quarter inch to two inches. Assembly has bronze valves with test cocks.
- .3 Hose Bibb Vacuum Breakers (HVB) (Low or High Hazard) - Watts Series 8, sizes three-fourths inch
- .4 Reduced Pressure Zone Backflow Preventer (RPZ) (High Hazard) - Watts Series 909, sizes three quarter inch to two inches, or two and one half inches to ten inches.
- .5 Pressure Type Vacuum Breakers (PVB) (High Hazard) - Watts Series 800, sizes one-half inch to two inches.

2.17.2 DETERMINATION OF HAZARD LEVEL, AND SELECTION OF TYPE of backflow device shall be determined by the Glenwood Municipal Utilities. Backflow devices shall be tested annually by certified backflow testing personnel at the property owner's expense. Copies of test results shall be furnished to GMU.

2.18 EXPANSION TANK

2.18.1 EXPANSION TANKS are recommended in all new or existing homes that have check valves following the meter. Expansion tanks shall be Rheem RRT Therm-X-Guard Model RRT-5 (2.5 gal), or RRT-25 (10.0 gal) or equal. Expansion tanks

shall be sized, provided, and installed by the contractor, builder, or plumber to match the plumbing and use requirement of each specific home or business.

2.19 PRESSURE REGULATING VALVES

2.19.1 PRESSURE REGULATING VALVES shall be Watts 25 AUB, or equal, with built in strainer. Valves shall be sized to match the incoming water service line (either $\frac{3}{4}$ inch or 1 inch) and shall have adjustable operating ranges of either 10 to 35 psi, or 25 to 75 psi, to meet desired reduction requirements. Valves shall be sized and installed by the contractor, builder, or plumber to meet the requirements of each specific home or business.

2.20 POLYETHYLENE ENCASEMENT

2.20.1 FILM FOR POLYETHYLENE ENCASEMENTS shall be 8 mil polyethylene Type I, Class A or C, Grade E-1 with a 0.4 maximum flow rate, of virgin polyethylene encasement and shall be installed in accordance with AWWA C-105. The tube size shall be as recommended for the size of pipe installed.

2.21 PIPELINE UTILITY MARKERS

2.21.01 PIPELINE UTILITY MARKERS shall be made from flexible high impact fiberglass reinforced resins manufactured by Pro-Mark, or its equal. Markers shall be Model PM-301 and used to mark water lines, manholes, tracer boxes, valve boxes and other locations required by GMU. Markers shall have a 3 rib profile design, be 72 inches high by 3.85 inches wide, with blue background color and white lettering stating "CAUTION WATER PIPELINE".

2.22 AIR RELEASE SUPPORT

2.22.1 AIR RELEASE SUPPORT for air release valve blow off piping shall be 6" diameter concrete filled steel pipe. Pipe shall be painted safety blue.

3.0 EXECUTION

3.01 PIPE AND FITTINGS

3.01.1 INSTALL PIPE, FITTINGS, AND APPURTENANCES in conformance with AWWA Standard C600 for ductile iron pipe and AWWA Standard C605 for PVC pipe. Install pipe and fittings in trenches with a minimum cover of five feet (5') over the top of pipe or as otherwise shown on the Drawings or as directed by the Engineer. Pipe shall not be installed in or under water and no pipe or fittings shall be installed when the trench or weather conditions are unfavorable for satisfactory Work. Lay pipe in trenches and support each section of pipe by undisturbed earth along the full length of the pipe barrel,

with recesses dug to receive bells and other joints. Joint deflections shall not exceed the pipe manufacturer's maximum pipe deflections and, if necessary, the Contractor shall install special bends. Inspect and clean each pipe section to remove all dirt and foreign material prior to assembly of all joints. Cutting of pipe must be performed according to the recommendations of the pipe manufacturer to insure that all cuts are square and beveled.

3.01.2 PIPE INSTALLATION shall be in accordance with the following standards:

- .1 For ductile iron pipe, AWWA Standard C600-10, Installation of Ductile Iron Water Mains and Their Appurtenances
- .2 For PVC pipe, ASTM D2774, Recommended Practice for Underground Installation of Thermoplastic Pressure Piping and PVC Pipe and AWWA Standard C605;
- .3 For HDPE pipe, ASTM D2774, Recommended Practice for Underground Installation of Thermoplastic Pressure Piping and AWWA Manual of Practice M55, 2006;
- .4 For Steel pipe, AWWA Standard C604-11, Installation of Buried Steel Water Pipe- 4 inch and Larger.

3.02 TRACER WIRE

3.02.1 TRACER WIRE shall be installed on all water mains and appurtenances. The wire shall be installed on in such a manner to be able to properly trace all mains without loss or deterioration of signal.

3.02.2 TRACER WIRE shall be laid flat and securely affixed to the pipe at 10 foot intervals. Contractor shall protect wire from damage during execution of work.

3.02.3 DIRECTIONAL BORE TRACER WIRE shall be laid flat and securely affixed to the pipe at 5 foot (min.) intervals.

3.02.4 TRACER WIRE shall be extended a minimum of 6 feet to all appurtenances and water main end caps, coiled and secured to appurtenances for future connections.

3.02.5 TRACER WIRE LOCATOR ACCESS locations shall be installed at the nearest valve box and/or fire hydrant. Access shall not exceed one block or 800 feet. Tracing wire shall be taped to the main during installation to prevent separation in the trench.

3.02.6 TESTING shall be performed by the local utility in the presence of the Engineer. If defects are found, Contractor shall repair or replace failed segment of the wire.

3.03 POLYETHYLENE ENCASEMENT

3.03.1 Encase all ductile iron pipe in polyethylene. The polyethylene shall be furnished in either tube or sheet form. Installation shall be per the requirements of the American National Standard for Polyethylene Encasement for Ductile Iron Pipe Systems (ANSI/AWWA C105).

3.03.2 All joints and fittings (valves, tees, bends, reducers, offsets, etc.) shall have polyethylene encasement installed per manufacturer's requirements and procedures. The polyethylene encasement shall be installed with a minimum lap of one (1) foot at joints. Tape the polyethylene encasement every three (3) feet and at joints sufficiently to prevent soil from coming into contact with the pipe. Carefully place the polyethylene encasement around the pipe and fittings and carefully backfill to prevent tears and punctures. Promptly repair all tears and punctures in the polyethylene per manufacturer's recommendations.

3.03.3 When connecting to or tapping into an existing or new polyethylene encased pipe, prepare the site per ANSI/AWWA C105 requirements. All cuts and repairs to the polyethylene wrap shall be per ANSI/AWWA C105. Polyethylene wrap cut away to allow the connection or tap shall be replaced and the repair material shall have the required lap and shall be taped securely to the pipe.

3.04 PRESSURE TESTS

3.04.1 PIPE, FITTINGS, VALVES, and appurtenances shall be hydrostatically pressure tested by the Contractor. The Engineer shall specify the test pressure, but it shall not be less than 150 pounds per square inch or 1.5 times the normal operating pressure in the lowest elevation in the test section, whichever is greater. The test pressure shall be maintained by the Contractor for no less than two (2) hours to permit a complete inspection of the pipe sections and joints for leaks. Should any leaks be detected, the Contractor shall repair the leaks or replace defective pipe, fittings, valves, and appurtenances or defective work. The pressure test shall then be repeated until the pipe section is acceptable to Engineer. Pressure testing shall be in conformance with AWWA C600 for ductile iron pipe and AWWA C605 for PVC pipe. The Contractor shall provide a tap and corporation stop on the main to be tested to perform all pressure testing operations.

3.05 PRESSURE AND LEAKAGE TESTS

3.05.1 PRESSURE AND LEAKAGE TESTS shall be performed in accordance with AWWA C600 for ductile iron pipe and AWWA C605 for PVC pipe. No pipe shall be accepted until all tests have been run and the results are within tolerances specified in the standard. The hydrostatic test shall be of at least a two-hour duration.

3.04.1. Each valved section of pipe shall be slowly filled with water, and the specified test pressure, based on the elevation of the lowest point of the line under test and corrected to the elevation of the test gauge, shall be applied by means of a pump. Stabilize the system at the test pressure before conducting the leakage test.

3.05.3 REMOVE ALL AIR from the section of the line being tested before running the test. If necessary, the Contractor shall install corporation cocks at all necessary points to expel the air as the line is filled with water.

3.05.4 LEAKAGE shall be defined as the quantity of water that must be supplied into the pipe section to maintain pressure within five (5) psi of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in the test section over a period of time.

3.05.5 ALLOWABLE LEAKAGE shall be determined by the following formula:

$$L = \frac{SD\sqrt{P}}{148,000}$$

Where:	L	=	Allowable leakage (makeup water), in gallons per hour.
	S	=	Length of pipe tested, in feet.
	D	=	Nominal diameter of the pipe, in inches.
	P	=	Average test pressure during the leakage test, in pounds per square inch (gauge).

The formula is based upon an allowable leakage of 10.49 gallons per minute, per mile of pipe, per inch of nominal diameter at a pressure of 150 pounds per square inch.

No pipe installation shall be accepted if the quantity of make-up water is greater than that determined by the above formula, and/or by valves of testing shown in the following table:

3.05.6 HYDROSTATIC TESTING ALLOWANCE at various test pressures and pipe sizes is shown below:

ALLOWABLE MAKE-UP WATER PER 1,000 FEET OF PIPELINE								
GALLONS PER HOUR								
Ave. Test Pressure (psi)	Nominal Pipe Diameter (Inches)							
	4	6	8	10	12	14	16	18
200	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72
175	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61
150	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49
125	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36
100	0.27	0.41	0.54	0.65	0.81	0.95	1.08	1.22

3.05.7 ACCEPTANCE shall be determined on the basis of allowable leakage. If any test of laid pipe discloses leakage greater than that specified above, the Contractor shall, at his own expense, locate and make approved repairs as necessary until the leakage is within the specified allowance. All visible leaks are to be repaired, regardless of the amount of leakage.

3.06 DISINFECTION

3.06.1 DISINFECTION of water mains, including piping, fittings, valves, and appurtenances shall be in accordance with AWWA C651. All water mains shall be disinfected before being put into service. A minimum of two (2) water samples taken twenty-four (24) hours apart for bacteriological quality tests, shall show absence of coliform bacteria. Sample locations shall be at the end of each pipe section, at every branch off of the main, and at every 1,200 feet along the pipe section. Install sample taps as necessary. After disinfection, have water samples tested by a State approved laboratory for bacterial acceptance and submit results to the Engineer. Upon completion of disinfection, flush the new main and discharge all test water from the system.

3.07 THRUST BLOCKS

3.07.1 INSTALL THRUST BLOCKS where unbalanced thrust forces occur in the piping system. Locations include, but are not limited to, bends, reducers, tees, valves, wyes, offsets, dead-ends, and hydrants. Concrete bearing blocks shall be cast-in-place with overall dimensions to be based upon trench size, soil bearing strength, and pressure in the pipe. Placement of the bearing surface shall be against undisturbed soil and concrete shall not be poured on joints. The minimum size of the thrust block shall be as detailed in the Drawings and standard details. Larger sizes may be required to reach undisturbed soil.

3.08 SEPARATION FROM EXISTING UTILITIES AND FACILITIES

3.08.1 INSTALL WATER MAINS to provide maximum horizontal and vertical separation from sanitary sewers, force mains, storm sewers, and sewer manholes.

3.08.2 WHEN sewer mains must be constructed of water main pipe material, the constructed or reconstructed sewer pipe shall meet the requirements of a minimum pressure rating of 150 psi, and the specification requirements of this Section 2600.

3.08.3 PUBLIC WATER MAINS shall be separated from manholes, gravity sanitary sewer mains, service lines, and force mains by a minimum horizontal distance of ten (10) feet. When horizontal separation cannot be met, the sanitary sewer main, service line, or force main shall be replaced with water main materials as specified in Paragraph 3.08.2.

3.08.4 IN NO CASE shall there be less than two (2) feet of clear horizontal separation between a water main and a sewer main, water service line, sewer service line, storms sewer, or gas line. In no case shall there be less than four (4) feet of clear horizontal separation between a water main and a sewer force main.

3.08.5 PUBLIC WATER MAINS, which cross gravity sanitary sewer mains, service lines, and force mains, shall have a minimum vertical separation of 18-inches, with the water main being constructed over top of the sewer main, service line, or force main. If the vertical separation is less than 18 inches, the sewer main shall be constructed or reconstructed of water main pipe material as specified in Paragraph 3.08.2, and no sewer pipe joint shall be less than 10 feet from the water main centerline. In no case shall there be less than six (6) inches of clear vertical separation between the two utilities.

3.08.5 WHERE a sewer main is to be constructed over a water main, or a water main is to be constructed under a sewer main, there shall be at least two (2) feet of clear vertical separation between a water main and a sewer main, with the sewer pipe joints or the water pipe joints spaced 10 feet horizontally from the centerline of the other pipe. Additionally, the sewer materially must be constructed of water main material as described in Paragraph 3.08.2

3.08.6 WHEN any unusual condition occurs with utility conflicts, consult with the Engineer for clarification and direction.

3.08.7 IN NO CASE shall any two utility lines occupy the same trench, whether they be public mains or private service lines.

3.08.8 SERVICE LINES TO HOMES AND BUSINESS (i.e. water and sewer) shall be in separate trenches. Within street R.O.W. services shall be 10-feet apart. On private property, services shall be a minimum of two (2) feet apart.

3.09 CUTS IN PAVEMENTS AND SIDEWALKS

3.09.1 REPLACE, REPAIR, OR PATCH existing slabs, pavements, sidewalks, and all weather surfacing disturbed by the construction activity. The Contractor shall be required to match the existing surfacing unless otherwise directed by the Engineer or indicated on the Drawings. See other related sections of these Specifications for specific requirements on subgrade recompaction and pavement reconstruction. All pavement repairs and replacements within the City of Glenwood shall be performed in accordance with the City of Glenwood standards.

3.10 SERVICE LINE TAPS

3.10.1 ALL SERVICE LINE TAPS shall be performed by the Contractor under the supervision of the Glenwood Municipal Utilities. All tapping materials shall be obtained from the Glenwood Municipal Utilities, and paid for by the Contractor or Owner.

3.11 WATER SERVICE METERS

3.11.1 WATER SERVICE METERS shall be installed by the Contractor. The Contractor shall install radio-access readouts and wiring between the meter and readout, at locations approved by the Glenwood Municipal Utilities. GMU will inspect the function and operation of each meter installation and remote readout installation.

3.12 TESTING

3.10.1 THE CONTRACTOR shall be responsible for all pressure tests, leakage tests, and disinfection tests. If the Contractor does not have the means to perform the tests, they shall be performed by an approved Testing Laboratory. Copies of all test reports shall be submitted to the Engineer in accordance with the General Requirements.

3.13 LINE TRACING WIRE AND LOCATOR ACCESS BOXES

3.13.1 LINE TRACING WIRE shall be taped to the top of the water main pipe in the trench, prior to backfill. Locator access boxes shall be located adjacent to valve boxes, fire hydrants, and blowoff assemblies, and shall be secured in concrete to prevent movement. Locator access boxes shall also be located at stand-alone locations with a 2

foot square concrete pad, where valve boxes, fire hydrants, or blowoffs are not available and the distance between access points exceeds 800 feet.

3.13.2 TRACING WIRE shall be tested for resistance and continuity after installation to confirm the workability of the wire. Verify test procedure and test equipment to be used with the GMU. The GMU shall witness all tests. The Contractor shall be responsible for replacing or repairing the tracing wire if damage has occurred.

3.14 BLOWOFF DEVICES

3.14.1 BLOWOFF DEVICES shall be located where shown on the Drawings or directed by the Engineer. The device shall be anchored to the main meter line with tie-rods and to the base elbow with the rods. Place concrete thrust blocks behind tees and elbows.

3.14.2 BLOWOFF DEVICES shall be equipped with a screwed cap with fire hose threads and shall be painted "fire-hydrant red".

SECTION 02650
BORING AND JACKING

1.0 GENERAL

1.01 DESCRIPTION

1.01.1 WORK COVERED IN THIS SECTION shall consist of furnishing and installing a pipeline by horizontal bores, by cutting, hand mining, or boring an opening in the soils material and simultaneously forcing the casing pipe through it with hydraulic jacks beneath existing railroad tracks and/or paved road surfaces. Boring and Jacking shall be accomplished dry mechanical auger boring method without jetting, sluicing or wet boring.

1.01.2 RELATED WORK SPECIFIED ELSEWHERE:

Site Preparation	Section 02100
Trench Excavation and Backfill	Section 02250
Water Mains and Appurtenances	Section 02600
Horizontal Directional Drilling	Section 02655
Sanitary Sewers	Section 02700
Surface Restoration	Section 02900

1.02 SUBMITTALS

1.02.1 SHOP DRAWINGS shall be submitted to the Engineer. Submittals shall include, but are not limited to, the following:

Casing Pipe
Carrier Pipe
Casing Spacers
Work Plan

1.03 COORDINATION OF THE WORK

1.03.1 NO WORK SHALL COMMENCE until Engineer has obtained all approved permits and required submittals.

1.03.2 CONTRACTOR shall obtain all required protective liability insurance policies as defined in Section 00800, Supplemental Conditions.

1.03.3 ADVANCE NOTICE shall be given to the respective authority prior to entering the property and performing work.

1.03.4 INSTALL all required safety, precautionary and protective devices as required by the Railroad prior to proceeding with Work.

2.0 PRODUCTS

2.01 CASING PIPE

2.01.1 GENERAL USE CASING PIPE as shown on the Drawings

- .1 CASING PIPE DIAMETER shall generally be four (4) inches larger than the largest outside diameter of the carrier pipe.

2.01.2 CASING PIPE shall be steel, with a minimum yield strength of 35,000 pounds per square inch and capable of meeting E-80 loadings. Steel casing shall meet the requirements of ASTM A 139/A 139M, Grade B; ASTM A 252, Grade 2. The casing shall be welded or seamless. The casing diameter and wall thickness shall be as indicated below:

Pipe Diameter (")	Casing Diameter (")	Wall Thickness (")	
		Under Highway	Under Railroad
4-6	12	0.375	0.375
8	16	0.375	0.375
10	20	0.375	0.375
12	24	0.375	0.375
14	26	0.375	0.375
16	28	0.375	0.375
18	30	0.375	0.375
20-24	36	0.375	0.375

2.01.3 JOINTS shall be full penetrating welds around the circumference of the pipe conforming to American Welding Society Code D1.1M/D1.1.

2.01.4 Upon approval of the Engineer, an interlocking casing pipe connection system may be used in lieu of field welding the sections of casing pipe.

2.02 WATER MAIN CARRIER PIPE

2.02.1 WATER MAIN CARRIER PIPE shall meet the minimum requirements specified in Section 02600, Water Mains and be Restrained Joint (RJ) Ductile Iron Pipe (D.I.P.) able to withstand 350 PSI hydrostatic pressure and thrust for fittings without thrust blocks and capable of being deflected 4° degrees. Restrained Joint pipe shall be "Lok-Ring" and "Flex-Ring" by American Cast Iron Pipe Company, "TR Flex" by U.S. Pipe Company, "Super-Lock" by Clow Company and "Snap-Lok" by Griffin Pipe Company.

2.03 SANITARY SEWER CARRIER PIPE

2.03.1 SANITARY SEWER CARRIER PIPE shall meet the minimum requirements specified in Section 02700, Sanitary Sewers and be Restrained Joint (RJ) PVC and shall comply with AWWA C900/C905, Pressure Class 235, DR 18. Pipe materials and joints shall be rated for 200 psi or greater.

2.03.2 CARRIER PIPE shall meet ASTM D2241 and a minimum cell classification 12454-B as defined by ASTM D1784. Pipe, couplings, and locking splines shall be completely non-metallic.

2.03.3 High-strength, flexible thermoplastic splines shall be inserted into mating, precision-machined grooves in the pipe and coupling to provide full 360° restraint with evenly distributed loading

2.03.4 COUPLINGS shall be designed for use at or above the rated pressures of the pipe with which they are utilized, and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477.

2.03.5 APPROVED MANUFACTURER includes C900/RJ PVC Certa-FLo Greeline restrained-joint pipe for gravity sewers or C905/RJ PVC restrained-joint pipe from North American Specialty Products.

2.03.6 SANITARY SEWER CARRIER PIPE shall meet the minimum requirements specified in Section 02700, Sanitary Sewer and be Restrained Joint (RJ) Ductile Iron Pipe (D.I.P.) able to withstand 150 PSI hydrostatic pressure and thrust for fittings without thrust blocks and capable of being deflected 4° degrees. Restrained Joint pipe shall be "Lok-Ring" and "Flex-Ring" by American Cast Iron Pipe Company, "TR Flex" by U.S. Pipe Company, "Super-Lock" by Clow Company and "Snap-Lok" by Griffin Pipe Company.

2.04 CASING SPACERS

2.04.1 CASING SPACERS shall be center-restrained Polyvinyl Chloride (PVC) conforming to ASTM D 149 or High Density Polyethylene Pipe (HDPE) conforming to ASTM D 638 and shall be abrasion resistant polymer with a low coefficient of friction. Fasteners shall be Type 304 stainless steel conforming to ASTM A 193.

- .1 CCI Pipeline Systems Model CSP or equal.

2.04.2 Wood skids are not allowed

2.05 CASING END SEAL

2.05.1 CASING END SEAL shall be manufactured synthetic rubber casing end seal with a minimum 1/8-inch thickness with stainless steel bands and fasteners.

- .1 CCI Pipeline Systems Model ESW or equal.
- .2 Advanced Product & Systems, Inc. (APS) Model AW wraparound or equal.

2.05.2 Concrete casing end seals are not allowed.

3.0 EXECUTION

3.01 GENERAL

3.01.1 CONTRACTOR shall take all necessary precautions to ensure against damage to existing railroad property, highway and road surfaces, or other work or facilities which are to remain in place. Repair of any damage shall be the responsibility of the Contractor.

3.01.2 CONTRACTOR shall be responsible for the protection of all utilities in and around the work to take place. Locate and mark, or have the respective utility companies locate and mark, all underground and overhead utilities. The Contractor shall be responsible for repairing all damage to utility lines caused by his operations.

3.01.3 NOTIFY ENGINEER IMMEDIATELY if obstruction stopping forward motion of operation is encountered during installation.

3.02 PREPARATION

3.02.1 CONTRACTOR shall be responsible for laying out and staking all of his work. Exercise care to establish all grades, lines, and levels in accordance with recognized surveying practices prior to digging bore pits and making horizontal bores. Locate all survey control, bench marks, monuments, and other reference points prior to beginning the work and provide protection throughout the construction period. Replace same if disturbed or destroyed.

3.03 RAILROAD UNDERCROSSING

3.03.1 RAILROAD UNDERCROSSING shall meet the requirements of the railroad track owner. The face of the boring pits shall be a minimum of 30 feet from the edge of the nearest track(s) to be bored and cased.

3.04 HIGHWAY UNDERCROSSING

3.04.1 HIGHWAY UNDERCROSSING shall meet the requirements of the railroad track owner.

3.05 CONSTRUCTION

3.05.1 EXCAVATE BORE PITS, SHAFTS in locations as shown on the Drawings or as required to complete the Work. Size pits and shaft to safely and properly perform the Work. Grade and shape spoil piles to drain and protect adjacent properties from ponding drainage.

3.05.2 JACK CASING PIPE with an auger rotating within pipe and remove spoils.

3.05.3 MAINTAIN face of cutting head to preclude free flow of soil material.

3.05.4 OVERCUT OF HEAD shall be no more than ½-inch of the outside diameter of the casing pipe to minimize ground settlement.

3.05.5 CONTROL LINE AND GRADE of casing pipe during boring operations.

3.05.6 WELD STEEL PIPE CASING as required herein.

3.06 INSTALLATION

3.06.1 INSTALLATION OF WATER MAIN CARRIER PIPE shall be as specified in Section 02600, Water Mains and Appurtenances and paragraph 2.02.

3.06.2 INSTALLATION OF SANITARY SEWER CARRIER PIPE shall be as specified in Section 02700, Sanitary Sewers and paragraph 2.03.

3.06.3 INSTALL END SEALS per manufacturers recommendations

3.06.4 SEAL CARRIER PIPE ENDS until they are connected to the remaining piping system.

3.06.5 BACKFILL BORE PITS, SHAFTS in accordance with Section 02250, Trench Excavation and Backfill compaction requirements.

3.07 FIELD QUALITY CONTROL

3.07.1 MAINTAIN LINE AND GRADE following tolerances:

.1 PRESSURIZED PIPE

- (a) Horizontal 6"
- (b) Vertical 3"

.2 GRAVITY PIPE

- (a) Horizontal 3"
- (b) Vertical ½"

(c) Backfall on pipe will not be allowed

3.07.2 DEVIATION FROM LINE AND GRADE may be cause for rejection. Provide adequate clearances from other utilities or tracks for proper installation of the pipe.

3.08 ACCEPTANCE TESTING

3.08.1 ACCEPTANCE TESTING OF WATER MAIN CARRIER PIPE shall be as specified in Section 02600, Water Mains and Appurtenances.

3.08.2 ACCEPTANCE TESTING OF SANITARY SEWER CARRIER PIPE shall be as specified in Section 02700, Sanitary Sewers.

END OF SECTION

SECTION 02655

HORIZONTAL DIRECTIONAL DRILLING

1.0 GENERAL

1.01 DESCRIPTION

1.01.1 WORK COVERED IN THIS SECTION shall consist of furnishing and installing a pipeline by horizontal directional drilling (HDD), by cutting, hand mining, or boring an opening in the soils material beneath existing paved road surfaces, driveways, and other areas.

1.01.2 RELATED WORK SPECIFIED ELSEWHERE

Site Preparation	Section 02100
Trench Excavation and Backfill	Section 02250
Storm Sewers	Section 02300
Water Mains and Appurtenances	Section 02600
Sanitary Sewers	Section 02700
Surface Restoration	Section 02900

1.02 SUBMITTALS

1.02.1 SHOP DRAWINGS shall be submitted to the Engineer. Submittals shall include, but are not limited to, the following:

Work Plan
Equipment
Materials

1.03 COORDINATION OF THE WORK

1.03.1 NO WORK SHALL COMMENCE until Engineer has obtained all approved permits and required submittals.

1.03.2 ADVANCE NOTICE shall be given to the respective authority prior to entering the property and performing work.

1.03.3 INSTALL all required safety, precautionary and protective devices as required by the Railroad prior to proceeding with Work.

2.0 PRODUCTS

2.01 GENERAL

2.01.1 DIRECTIONAL BORING EQUIPMENT shall consist of a directional boring rig of sufficient capacity to perform the bore and pull back the pipe, a boring fluid mixing &

delivery system of sufficient capacity to successfully complete the crossing, a guidance system to accurately guide boring operations and trained and competent personnel to operate the system. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project.

2.02 BORING SYSTEM

2.02.1 DIRECTIONAL BORING MACHINE shall consist of a hydraulically powered system to rotate, push and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the crossing. The hydraulic power system shall be self-contained with sufficient pressure and volume to power boring operations. Hydraulic system shall be free of leaks. Rig shall have a system to monitor and record maximum pull-back pressure during pull-back operations. The rig shall be grounded during boring and pull-back operations. Sufficient spares shall be kept on hand for any break-downs which can be reasonably anticipated.

2.02.2 BORE HEAD shall be steerable by changing its rotation and shall provide the necessary cutting surfaces and boring fluid jets.

2.02.3 MUD MOTORS (if required) shall be of adequate power to turn the required boring tools.

2.02.4 DRILL PIPE: Shall be constructed of high quality 4130 seamless tubing, grade D or better, with threaded box and pins. Tool joints should be hardened to 32-36 RC.

2.03 GUIDANCE SYSTEM

2.03.1 GUIDANCE SYSTEM shall be of a proven type and shall be setup and operated by personnel trained and experienced with this system. The Operator shall be aware of any magnetic anomalies and shall consider such influences in the operation of the guidance system if using a magnetic system.

2.04 BORING FLUID (MUD) SYSTEM

2.04.1 MIXING SYSTEM: A self-contained, closed, boring fluid mixing system shall be of sufficient size to mix and deliver boring fluid composed of bentonite clay, potable water and appropriate additives. Mixing system shall be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure thorough mixing. The drilling fluid reservoir tank shall be sized for adequate storage of the mud. Mixing system shall continually agitate the boring fluid during boring operations.

2.04.2 BORING FLUIDS shall be composed of clean water and an appropriate additive. Water shall be from a clean source with a pH of 8.5 - 10. Water of a lower pH or with excessive calcium shall be treated with the appropriate amount of sodium carbonate or

equal. The water and additives shall be mixed thoroughly and be absent of any clumps or clods. No hazardous additives may be used. Boring fluid shall be maintained at a viscosity sufficient to suspend cuttings and maintain the integrity of bore wall.

2.04.3 DELIVERY SYSTEM: The mud pumping system shall have a minimum capacity to supply mud in accordance with the drilling equipment pull-back rating at a constant minimum pressure. The delivery system shall have filters in-line to prevent solids from being pumped into the drill pipe. Connections between the pump and drill pipe shall be relatively leak-free. Used boring fluid and boring fluid spilled during boring operations shall be contained and properly disposed of. A berm, minimum of 12" high, shall be maintained around boring equipment, boring fluid mixing system, entry and exit pits and boring fluid recycling system (if used) to prevent spills into the surrounding environment. Pumps and or vacuum truck(s) of sufficient size shall be in place to convey excess boring fluid from containment areas to storage facilities.

2.05 OTHER EQUIPMENT:

2.05.1 PIPE ROLLERS, if required, shall be of sufficient size to fully support the weight of the pipe while being hydro-tested and during pull-back operations. Sufficient number of rollers shall be used to prevent excess sagging of pipe.

2.05.2 HYDRAULIC OR PNEUMATIC PIPE RAMMERS OR PULLERS may only be used if necessary and with the authorization of Engineer.

2.05.3 OTHER DEVICES OR UTILITY PLACEMENT SYSTEMS for providing horizontal thrust other than those previously defined in the preceding sections shall not be used unless approved by the Engineer prior to commencement of the work. Consideration for approval will be made on an individual basis for each specified location. The proposed device or system will be evaluated prior to approval or rejection on its potential ability to complete the utility placement satisfactorily without undue stoppage and to maintain line and grade within the tolerances prescribed by the particular conditions of the project.

2.06 WATER MAIN PIPE

2.06.1 WATER MAIN PIPE shall be Restrained Joint (RJ) Ductile Iron Pipe (D.I.P.) able to withstand 350 PSI hydrostatic pressure and thrust for fittings without thrust blocks and capable of being deflected 4° degrees. Restrained Joint pipe shall be "Lok-Ring" and "Flex-Ring" by American Cast Iron Pipe Company, "TR Flex" by U.S. Pipe Company, "Super-Lock" by Clow Company and "Snap-Lok" by Griffin Pipe Company.

2.06.2 WATER MAIN PIPE shall be Restrained Joint (RJ) PVC and shall comply with AWWA C900-07, Pressure Class 305, DR 14. Pipe materials and joints shall be rated for 300 psi or greater.

2.06.3 WATER MAIN PIPE shall meet ASTM D2241 and a minimum cell classification 12454 as defined by ASTM D1784. Pipe, couplings, and locking splines shall be completely non-metallic.

2.06.4 HIGH-STRENGTH, FLEXIBLE THERMOPLASTIC SPLINES shall be inserted into mating, precision-machined grooves in the pipe and coupling to provide full 360° restraint with evenly distributed loading

2.06.5 COUPLINGS shall be designed for use at or above the rated pressures of the pipe with which they are utilized, and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477.

2.06.6 APPROVED MANUFACTURER includes C900/RJ PVC Certa-Lok restrained-joint pipe or C905/RJ PVC restrained-joint pipe from CertainTeed Corporation.

2.06.1 WATER MAIN PIPE shall be HIGH DENSITY POLYETHYLENE (HDPE) Ductile Iron Pipe Size (DIPS) pressure class 160 (DR 11) PE3408 for municipal potable water conforming to ASTM D3350 with the cell classification of PE 345464C and is listed with the Plastic Pipe Institute (PPI) TR4 and American Water Works Association (AWWA) C906-07.

2.07 FITTINGS

2.07.1 HIGH DENSITY POLYETHYLENE FITTINGS shall be butt fusion conforming to ASTM D3261, electrofusion conforming to ASTM F1055 or flanged and mechanical joint adapters conforming to ASTM F 2206, shall be PE 3408 HDPE with the cell classification of PE 345464C and be Ductile Iron Pipe Size (DIPS).

2.08 SANITARY SEWER PIPE

2.08.1 SANITARY SEWER PIPE shall be Restrained Joint (RJ) PVC and shall comply with AWWA C900/C905, Pressure Class 235, DR 18. Pipe materials and joints shall be rated for 200 psi or greater.

2.08.2 SANITARY SEWER PIPE shall meet ASTM D2241 and a minimum cell classification 12454-B as defined by ASTM D1784. Pipe, couplings, and locking splines shall be completely non-metallic.

2.08.3 High-strength, flexible thermoplastic splines shall be inserted into mating, precision-machined grooves in the pipe and coupling to provide full 360° restraint with evenly distributed loading

2.08.4 COUPLINGS shall be designed for use at or above the rated pressures of the pipe with which they are utilized, and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477.

2.08.5 APPROVED MANUFACTURER includes C900/RJ PVC Certa-Lok restrained-joint pipe or C905/RJ PVC restrained-joint pipe from CertainTeed Corporation.

2.08.1 APPROVED MANUFACTURER includes C900/RJ PVC Certa-FLo Greeline restrained-joint pipe for gravity sewers or C905/RJ PVC restrained-joint pipe from North American Specialty Products.

2.09 SANITARY SEWER FORCE MAIN PIPE

2.09.1 SANITARY SEWER FORCE MAIN PIPE shall be Restrained Joint (RJ) Ductile Iron Pipe (D.I.P.) able to withstand 150 PSI hydrostatic pressure and thrust for fittings without thrust blocks and capable of being deflected 4° degrees. Restrained Joint pipe shall be "Lok-Ring" and "Flex-Ring" by American Cast Iron Pipe Company, "TR Flex" by U.S. Pipe Company, "Super-Lock" by Clow Company and "Snap-Lok" by Griffin Pipe Company.

3.0 EXECUTION

3.01 GENERAL

3.01.1 ENGINEER must be notified 48 hours in advance of starting work. The Directional Bore shall not begin until the Engineer is present at the job site and agrees that proper preparations for the operation have been made. The Engineer approval for beginning the installation shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the work as authorized under the Contract. It shall be the responsibility of Engineer to provide inspection personnel at such times as appropriate without causing undue hardship by reason of delay to the Contractor.

3.01.2 CONTRACTOR shall take all necessary precautions to ensure against damage to existing highway and road surfaces, or other work or facilities which are to remain in place. Repair of any damage shall be the responsibility of the Contractor.

3.01.3 CONTRACTOR shall be responsible for the protection of all utilities in and around the work to take place. Locate and mark, or have the respective utility companies locate and mark, all underground and overhead utilities. The Contractor shall be responsible for repairing all damage to utility lines caused by his operations.

3.01.4 NOTIFY ENGINEER IMMEDIATELY if obstruction stopping forward motion of operation is encountered during installation.

3.02 PREPARATION

3.02.1 CONTRACTOR shall be responsible for laying out and staking all of his work. Exercise care to establish all grades, lines, and levels in accordance with recognized surveying practices prior to digging bore pits and making horizontal bores. Locate all survey control, bench marks, monuments, and other reference points prior to beginning the work and provide protection throughout the construction period. Replace same if disturbed or destroyed.

3.02.2 BORE PATH shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings. If contractor is using a magnetic guidance system, drill path will be surveyed for any surface geo-magnetic variations or anomalies.

3.02.3 CONTACTOR SHALL NOTIFY ALL COMPANIES WITH UNDERGROUND UTILITIES in the work area via the state or local "one-call" to obtain utility locates. Once the utilities have been located Contractor shall physically identify the exact location of the utilities by vacuum or hand excavation, when possible, in order to determine the actual location and path of any underground utilities which might be within 20 feet of the bore path. Contractor shall not commence boring operations until the location of all underground utilities within the work area have been verified.

3.03 ENVIRONMENTAL PROTECTION

3.03.1 ENVIRONMENTAL PROTECTION: Contractor shall place silt fence between all boring operations and any drainage, wetland, waterway or other area designated for such protection by contract documents, state, federal and local regulations. Additional environmental protection necessary to contain any hydraulic or boring fluid spills shall be put in place, including berms, liners, turbidity curtains and other measures. Contractor shall adhere to all applicable environmental regulations. Fuel or oil may not be stored in bulk containers within 200' of any water-body or wetland.

3.03.2 EROSION AND SEDIMENTATION CONTROL measures and on-site containers shall be installed to prevent drilling mud from spilling out of entry and/or exit pits. Drilling mud shall be disposed of off-site in accordance with local, state, and federal requirements and/or permit conditions.

3.04 HIGHWAY UNDERCROSSING

3.04.1 HIGHWAY UNDERCROSSING shall meet the requirements of the local highway department.

3.05 PILOT HOLE

3.05.1 PILOT HOLE for water main and sewer force main bores shall be drilled on bore path with no deviations greater than 5% of depth over a length of 100'. In the event that pilot does deviate from bore path more than 5% of depth in 100', contractor will notify Engineer and Engineer may require contractor to pull-back and re-drill from the location along bore path before the deviation.

3.05.2 PILOT HOLE for gravity sanitary sewer or storm sewer bores shall be drilled on bore path with no deviations greater than ± 1 -inch from the plan grade. In the event the actual deviations exceed the ± 1 -inch tolerance, the Engineer may require the pilot hole to be re-drilled.

3.05.3 In the event that a boring fluid fracture, inadvertent returns or returns loss occurs during pilot hole boring operations, contractor shall cease boring, wait at least 30

minutes, inject a quantity of boring fluid with a viscosity exceeding 120 seconds as measured by a Marsh funnel and then wait another 30 minutes. If mud fracture or returns loss continues, contractor will cease operations and notify Engineer. Engineer and contractor will discuss additional options and work will then proceed accordingly.

3.06 REAMING

3.06.1 Upon successful completion of pilot hole, contractor will ream bore hole to a minimum of 25% greater than outside diameter of pipe using the appropriate tools. Contractor will not attempt to ream at one time more than the boring equipment and mud system are designed to safely handle.

3.07 PULL-BACK:

3.07.1 After successfully reaming bore hole to the required diameter, contractor will pull the pipe through the bore hole. In front of the pipe will be a swivel. Once pull-back operations have commenced, operations must continue without interruption until pipe is completely pulled into bore hole. During pull-back operations contractor will not apply more than the maximum safe pipe pull pressure at any time.

3.07.2 In the event that pipe becomes stuck, contractor will cease pulling operations to allow any potential hydro-lock to subside and will commence pulling operations. If pipe remains stuck, contractor will notify Engineer. Engineer and contractor will discuss options and then work will proceed accordingly.

3.08 INSTALLATION

3.08.1 INSTALLATION OF WATER MAIN PIPE shall be as specified in Section 02600, Water Mains and Appurtenances.

3.08.2 INSTALLATION OF TRACER WIRE as specified in Section 02600, Water Mains and Appurtenances.

3.08.3 INSTALLATION OF SANITARY SEWER PIPE shall be as specified in Section 02700, Sanitary Sewers and ASTM D2321 "Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications"

3.08.4 SEAL PIPE ENDS until they are connected to the remaining piping system.

3.08.5 BACKFILL EXCAVATIONS in accordance with Section 02250, Trench Excavation and Backfill compaction requirements.

3.09 FIELD QUALITY CONTROL

3.09.1 MAINTAIN LINE AND GRADE following tolerances:

.1 PRESSURIZED PIPE

- (a) Horizontal 6"
- (b) Vertical 3"

.2 GRAVITY PIPE

- (a) Horizontal 6"
- (b) Vertical 1-1/2"

- (c) Backfall on pipe will not be allowed

3.09.2 DEVIATION FROM LINE AND GRADE may be cause for rejection. Provide adequate clearances from other utilities or tracks for proper installation of the pipe.

3.10 ACCEPTANCE TESTING

3.10.1 ACCEPTANCE TESTING OF WATER MAIN CARRIER PIPE shall be as specified in Section 02600, Water Mains and Appurtenances.

3.10.2 ACCEPTANCE TESTING OF SANITARY SEWER CARRIER PIPE shall be as specified in Section 02700, Sanitary Sewers.

END OF SECTION

SECTION 02700

SANITARY SEWERS

1.0 GENERAL

1.01 DESCRIPTION

1.01.1 RELATED WORK SPECIFIED ELSEWHERE

Site Preparation	Section 02100
Trench Excavation and Backfill	Section 02250
Pipe Boring and Jacking	Section 02650
Horizontal Directional Drilling	Section 02655
Surface Restoration	Section 02900

1.02 SUBMITTALS

1.02.1 SHOP DRAWINGS shall be submitted to the Engineer. Submittals shall include, but are not limited to, the following:

- Piping & Fittings
- Manhole Sections & Tops
- Manhole Covers & Steps
- Bedding Material
- Trench Stabilization Material
- Combination Air & Vacuum Valves
- Gate Valves
- Ball Valves

2.0 PRODUCTS

2.01 SANITARY SEWER PIPING (FOR GRAVITY FLOW)

2.01.1 SANITARY SEWER PIPING (for all 8", 10", and 12" sewer mains) shall be polyvinyl chloride (PVC) pipe conforming to ASTM D 3034, minimum wall thickness SDR-35. Flexible gasketed joints shall be compression type with gasket confined in the bell end of the pipe, conforming to ASTM D 3212. The size of the sewer mains shall be as shown on the bid form.

2.01.2 PRIVATE SERVICE PIPING shall be 6-inch size (in the street R.O.W.) and 4-inch size (on private property) and shall be polyvinylchloride (PVC) pipe conforming to ASTM D3034, minimum wall thickness SDR 26. Joints may be either flexible gasketed

joints, or solvent cemented joints. Flexible gasketed joints shall be compression type with gasket confined in the bell end of the pipe, conforming to ASTM D 3212. Elastomeric seals (gaskets) shall meet requirements of ASTM F477. Solvent cemented joints shall require a cleaning primer and solvent cement conforming to ASTM D2564.

2.01.3 PVC PIPE FOR DIRECTIONAL DRILLING CONSTRUCTION shall be Certaineed Certa-Lok C900/RJ restrained joint PVC pipe. Sizes shall be 4, 6, 8, or 12 inch as required. Pipe shall meet AWWA C900 requirements. Joints shall be gasketed and shall be connected with restraining grooves and splines.

2.01.4 HDPE PIPE FOR DIRECTIONAL DRILLING CONSTRUCTION shall be Chevron Plexco PE 3408 heat-fusion joint pipe, conforming to AWWA C901 and C906 standards. Pipe shall be I.P. size and shall be DR17. Joints shall be formed by a butt fusion system to insure strong tight joints. Transition fittings shall be used to join up to PVC or other pipe materials where connections are required. Transition fittings shall be Fernco Series 5000 Strong Back RC stainless steel shear ring couplers.

2.01.5 FITTING FOR PVC SEWER MAINS AND PVC SERVICE LINES shall be standard gasketed PVC fittings conforming to ASTM D 3034, or solvent cement fittings in accordance with ASTM D2855. Accomplish 90 degree turns with two 45 degree fittings, located 2 feet apart, to allow for cleaning. Fittings shall be used for all direction changes. Couplings (such as FERNCO, etc.) shall not be allowed for direction changes.

2.01.6 CONNECTIONS BETWEEN SEWER MAINS AND SERVICE LINES shall be made with standard PVC wyes, tees, bends, or saddle tees, conforming to ASTM D 3034 and ASTM D 1784. Fittings shall be joined with rubber gasketed joints or solvent cemented joints. PVC fittings shall be SDR 35.

2.02 SANITARY SEWER PIPING (FOR PRESSURE FLOW)

2.02.1 DUCTILE IRON PIPE FOR SEWER FORCE MAIN PIPING shall be ductile iron pipe (D.I.P.), Class 350. D.I.P. shall conform to ANSI and AWWA Standards A21.1/C150 and A21.61/C151. Joints shall conform to ANSI/AWWA Standards A21.11/C111. D.I.P. and fittings shall be cement-mortar lined in accordance with ANSI/AWWA Standards A21.4/C104.

2.02.2 PVC PIPE FOR DIRECTIONAL DRILLING shall be Certaineed Certa-Lok C900/RJ restrained joint PVC pipe. Sizes shall match the force main piping shown.

2.02.3 POLYVINYL CHLORIDE (PVC) FORCE MAIN PIPING (WHEN ALLOWED) shall conform to AWWA C900, Class 305 (DR14) or Class 235 (DR18) as determined by GMU. All joints shall be gasketed, push-on type.

2.02.4 HDPE PIPE FOR FORCE MAINS (WHEN ALLOWED) shall be solid wall with butt fusion welded joints. Pipe shall be PE3408 high density, extra high molecular weight

polyethylene piping system as manufactured by Chevron Phillips, or equal. Pipe shall conform to the requirements of AWWA C906. Pipe shall be I.P. size and shall be DR 17. Cell classification shall be PE345434C, as specified by ASTM D3350. Dimensions and workmanship shall be in accordance with ASTM F714. Jointing of pipe shall be by butt fusion welded joints. Heat fusion welded joints in accordance with the pipe manufacturer's recommendations and ASTM D3261. The operator of the fusion machine shall be certified by the fusion machine manufacturer.

2.02.5 FITTINGS FOR FORCE MAINS shall be ductile iron, conforming to ANSI/AWWA C153/A 21.53, compact size.

2.02.6 GRINDER PUMP SERVICE LINE FORCE MAINS shall be 1½ -inch dia. Polyvinyl chloride (PVC) with push-on, rubber gasketed joints. Pipe shall conform to ASTM C2241 (pipe) and ASTM D1869 (gaskets), and shall be SDR 21 (Class 200 psi). Fittings shall be PVC with gasketed joints and shall be compatible with the pipe class. For service lines bored underneath highways, streets, railroads, creeks, lakes, wetlands, or other obstacles, HDPE pipe with heat fusion welded joints may be allowed. For 1-1/2 inch diameter service lines, the pipe classification shall be SDR 11, meeting 200 psi requirements.

2.02.7 PVC Pipe for low-pressure sewer collection systems shall be 200 psi, SDR-21, meeting the requirements of ASTM D_2241. Low-pressure collection system main sizes shall be 1 ½-inch, 2-inch, 2 ½-inch, 3-inch, 4-inch, and 6-inch as determined by GMU.

2.03 MANHOLES

2.03.1 PRECAST MANHOLE SECTIONS shall meet the requirements of ASTM C 478 with Class FL 60 M, regular concrete. Concrete shall have a minimum compressive strength of 3,500 pounds per square inch.

2.03.2 STANDARD MANHOLES shall be 54 inches inside diameter. Manhole tops shall be flat, eccentric cone, or concentric cone as detailed on the Drawings. Manhole bases shall be monolithic, with the base, sidewalls, and pipe openings cast together.

2.03.3 ALL MANHOLE SIZES, shapes, and configurations shall be in accordance with the details shown on the Drawings. Manholes shall be full diameter from the invert of the sewer to the transition cone section or flat top section at the top.

2.03.4 GRAY IRON CASTINGS shall conform to the requirements of ASTM A 48, "Specification for Gray Iron Castings." Class 30 castings shall be furnished unless otherwise specified. Castings shall be manufactured true to pattern with satisfactory fit of component parts. Castings shall be clean and whole and without blow or sand holes or any other surface defects which would impair serviceability. Plugging or filling of holes or other defects will not be permitted. Parting fins and pouring gates shall be removed. All round frames and covers shall be finished with machined bearing surfaces so fitting parts will not rattle or rock under traffic. All castings shall be smooth, cleaned by shot blasting, and painted, prior to being delivered to the site, with one coat of asphalt base paint of a quality which will produce a smooth coating.

2.03.5 MANHOLE RINGS AND COVERS shall be Deeter No. 1005 as manufactured by Deeter Foundry, Lincoln, Nebraska, or equal. Minimum weights of castings shall be as follows:

Ring	175 pounds
Cover	125 pounds

2.03.6 MANHOLE STEPS shall be 12 pounds as manufactured by Deeter Foundry, Lincoln, Nebraska, or equal. Steps shall be coated with a coal tar enamel protective covering, or approved equal.

2.03.7 MANHOLE OPENINGS shall be configured with A-Lok connectors meeting the requirements of ASTM C-923. Manhole bottoms shall be cast in place with the bottom manhole section. Manhole sections shall be joined together with Kent-Seal No. 2 flexible sealant, Ram-Nek flexible sealant, or PPG gaskets.

2.03.8 FRAME "CHIMNEY" SEAL shall be corrugated with an unexpanded vertical height of 6-inches and shall be capable of being mechanically locked to the base flange of the manhole frame casting. The Frame Seal shall be made from high quality EPDM rubber suitable for above and below grade applications conforming to ASTM C-923. Minimum rubber thickness shall be 3/16-inches. Compression bands shall be formed from 16-gauge stainless steel bands and with stainless steel hardware.

2.04 PIPE BEDDING MATERIAL

2.04.1 PIPE BEDDING MATERIAL shall consist of clean, well-graded, crushed stone, meeting the requirements of ASTM C 33, Gradation 67 (3/4 inch to No. 4), or well graded gravel meeting the same requirements. Bedding shall be placed to a depth as detailed on the Drawings.

2.05 TRENCH STABILIZATION MATERIAL

2.05.1 TRENCH STABILIZATION MATERIAL shall consist of clean, sharp, and well-graded crushed stone. Size shall 3/4 inch to 1-1/2 inches in diameter.

2.06 THRUST BLOCKING

2.06.1 THRUST BLOCKING for unbalanced thrust forces in pressurized piping shall be cast-in-place concrete with a compressive strength of 4,000 pounds per square inch at 28 days. Tie rods shall be provided as shown on the Drawings and shall be coated steel to prevent corrosion.

2.07 FLEXIBLE TRANSITION COUPLINGS

2.07.1 FLEXIBLE TRANSITION COUPLINGS for non-pressure piping shall be natural, synthetic rubbers with a stainless steel, shielded coupling conforming to ASTM C 195 and ASTM C 1173-10. Couplings shall be used when joining pipe made of different materials, pipes of different sizes, new to existing pipes or pipe repair. Flexible transition couplings shall be 5000 Series RC as manufactured by Fernco Inc. or equal with stainless Steel hardware.

2.08 SEWAGE COMBINATION AIR RELEASE/AIR AND VACUUM VALVES

2.08.1 COMBINATION SEWAGE AIR VALVES shall consist of one sewage air release valve and one sewage air and vacuum valve. The air release valve shall automatically release air, gas, or vapor under pressure during system operation. The valve shall have a 2-inch inlet and a 1/2-inch outlet and a 5/16-inch venting orifice for a maximum working pressure of 150 pounds per square inch. Valve shall be constructed of cast iron body and cover, stainless steel trim and float, with an adjustable Viton orifice button to insure positive seating. The air and vacuum valve shall automatically exhaust large quantities of air during the filling of the system and allow air to reenter during draining or when a vacuum occurs. The valve shall have a 2-inch inlet with a 1-inch outlet. The valve shall be constructed of cast iron body and cover, stainless steel trim and float, with a Buna-N seat for positive seating. Backwash accessories shall be furnished and assembled to the valves consisting of 2 inlet-shutoff valves, 2 blow-off valves, 2 clear-water inlet valves, rubber hose, and quick disconnect couplings. Discharge piping shall be carried to the outside of the manhole in accordance with the standard details. Discharge piping shall be Schedule 80 PVC.

2.09 GATE VALVES

2.09.1 GATE VALVES shall be of the resilient wedge type, conforming to the requirements of AWWA Standard C 509, for sewage application. Valves shall have a nonrising stem and shall open by turning to the left with a 2-inch square operating nut. The valve shall be cast iron, completely encapsulated with polyurethane rubber, in accordance with ASTM D 429. Valve boxes shall be as specified in Section 2600, except covers shall be identified with the word "sewer".

2.10 BALL VALVES

2.10.1 BALL VALVES shall be rubber seated, tight closing shaft-mounted type, complying with AWWA Standard C 507, for sewage application. Valve body shall be cast iron. Valves shall be equipped with manual hand wheels.

2.11 CLEANOUTS

2.11.1 CLEANOUTS shall be eight (8)-inch size constructed as shown on the Drawings or as directed by the Engineer. Piping shall be PVC pipe, and shall conform to the material requirements of the sewer line to which it is connected. Connect to sewer line and bring to grade using "Y" connection and 1/8 bends. Cleanout cover shall be cast iron and shall be of the screwed type. Cover shall be water and gas tight. An 18-inch by 18-inch by 6-inch thick, cast-in-place concrete pad shall be poured around the cleanout cover at finished grade.

2.11.2 A minimum of one (1) cleanout shall be provided on all private service lines to homes and businesses.

2.12 SEWER PIPE AND REPAIR COUPLINGS

2.12.1 SEWER PIPE REPAIR COUPLINGS shall be appropriate for the type of sewer pipe being repaired. Repair work shall consist of carefully removing the cracked, broken or damaged pipe section and replacing the section with a new section of current length and diameter. Repair sleeves shall be placed over each joint of the new and existing pipe to form a strong, watertight joint. Types of repair couplings shall be as follows:

- .1 Vitrified Clay Pipe (VCP). For plain end pipe, use new VCP pipe of correct length and make new joints with PVC compression sleeves. As an alternative, use Fernco couplings, with stainless steel bands, at each joint.
- .2 Vireified Clay Pipe (VCP). For bell and spigot pipe, remove damaged pipe to each joint, replace with two pipe nipples whose length is the same as the removed section with plain end pipe, and secure joints with new PVC compression sleeves. As an alternative, use Fernco couplings at each joint.
- .3 Polyvinyl Chloride Pipe (PVC). Use standard PVC repair couplings of correct length and size. Fernco repair couplings may be used at each joint.
- .4 Ductile Iron Pipe (DIP). Use stainless steel repair clamps or replacement pipe sections with Dresser couplings of the correct size.
- .5 Pipe to Pipe of Different Type. Use Fernco transition couplings of the proper type, or a specific coupler or coupling method specific to the pipe material.

2.12.2 SEWER PIPE COUPLINGS shall be appropriate for the size and type of sewer pipe being coupled together. Couplings shall not be used in place of pipe fittings. Rather they shall only be used to couple straight sections of pipe together, or they shall be used to correct minor mis-alignments of pipe. Couplings shall be FERNCO flexible couplings with gaskets, shear ring, and stainless steel tightening bands and bolts.

2.13 TAPS, CORPS, AND CURB STOPS FOR GRINDER PUMPS

2.13.1 GRINDER PUMP SERVICE LINE taps on pressure mains shall be made with a 1½ inch pressure tap on the main. Tap shall include a saddle with stainless steel clamps and a 1½ -inch brass corporation stop. Taps shall be made by the contractor under the supervision of the GMU. All materials shall be purchased from the GMU. Taps on HDPE pipe will require heat-fusion welded saddles in accordance with the manufacturer's recommendations. Any alternative tapping methods will require prior approval by G.M.U.

2.13.2 GRINDER PUMP SERVICE LINES, which discharge into pressure mains, shall be equipped with a 1½ -inch curb stop and box located at the property line. Curb stop lid shall be protected with a 12-inch square by 6-inch thick concrete pad. Curb box lid shall have the word "sewer" cast in it, or shall be painted green with epoxy paint. All materials shall be purchased from the GMU.

2.13.3 GRINDER PUMP SERVICE LINES, which discharge into gravity sewer manholes, shall not be required to have curb stops and boxes at the property line.

2.14 GREASE TRAPS AND INTERCEPTORS

2.14.1 GREASE TRAPS AND INTERCEPTORS shall be provided on all commercial, industrial, and/or institutional establishments which generate fats, oils, grease, sand, and other substances harmful or hazardous to the public sanitary sewer system.

2.14.2 GREASE TRAPS AND INTERCEPTORS shall not be used for toilets, urinals, lavatory, tubs, shower, or similar fixtures. Wastes from these fixtures are prohibited from draining through a grease trap or interceptor.

2.14.3 GREASE TRAPS AND INTERCEPTORS shall be appropriately selected and sized by credentialed plumbers or engineers, and shall be submitted to the GMU for prior approval. Traps and interceptors may be constructed of concrete, fiberglass-reinforced polyester, or polyethylene, and shall be liquid-tight. Traps and interceptors may be constructed on either the interior or exterior of an establishment and must be accessible for inspection. Traps and interceptors must follow industry-wide acceptance standards for sizing, construction, access, inspection, and maintenance.

2.14.4 GREASE TRAPS AND WASTE INTERCEPTORS shall be of the following types:

- .1 Type A Grease Interceptors: Use with restaurants, kitchens, caterers, school cafeterias, bars, hospitals, factory cafeterias, institutions, and commercial cooking facilities, that in the preparation of food will produce grease laden waste. The purpose of the grease interceptor is to prevent grease, fat, oil, wax, or debris from entering the public sanitary sewer system.

- .2 Type I Waste Interceptor (Flammable): Use at gas filling and service stations, repair garages, and in all structures where automobiles, motor vehicles, construction equipment, or similar equipment is stored, washed, serviced, and repaired. The purpose of the waste interceptor is to prevent grease, oils, lubricants, fuels, solvents, flammable substances, mud, sand, organic and inorganic debris, and any other harmful or hazardous waste from entering the public sanitary sewer system.
- .3 Type II Waste Interceptor (Non-Flammable): Use at all location where there is not possibility of flammable substances entering the system. Examples of uses would be barns, stables, veterinary clinics, animal shelters, kennels and pet boarding.
- .4 Type III Mud and Sand Interceptor: Use at all locations where mud, sand, and debris are present such as car washes. The purpose of the mud and sand interceptor is to prevent mud, sand, soil, and inorganic materials from entering the public sanitary sewer.
- .5 Combination Type I and Type III Interceptor: Use at locations with combined use activities. Wastes from a Type III interceptor may enter a sealed Type I interceptor 4 inches above the water level. The connection shall turn down a minimum 12 inches to form a trap.

2.14.5 REFER TO GMU's STANDARD DETAILS for specifications regarding the construction details of the traps and interceptors.

2.15 LINE TRACING WIRE

2.15.1 LINE TRACING WIRE shall be required on all low-pressure sewer collection mains and on all sewage force mains. The type of wire shall be 10-gauge type TW or THHN, orange insulated solid strand with approved watertight twister grease-filled wirenut splice connectors for wet, direct bury locations. Locator access shall be placed adjacent to a valve box, air release manhole, manhole, etc., and shall consist of a stand-alone access box (see paragraph 2.14 and 3.11). Access shall not exceed one block intersections or 800 feet whichever is less. Tracing wire shall be taped to the top of the main during installation to prevent separation in the trench. For directional-bored pipe, the Contractor shall tape two (2) separate tracing wires to the pipe (at separate locations).

2.16 TRACER WIRE ACCESS BOX

2.16.01 TRACER WIRE ACCESS BOX shall be by VALVCO, INC. Access box shall allow for easy access to the tracer wire, and shall contain a protective box complete with a tamper-proof lid. The box shall be opened with a standard pentagonal head key. Tracer wire shall be attached to the lid with stainless steel terminal bolts. The collar and cover

shall be cast iron. The word ASEWER® shall be cast in the lid. Access box shall be obtained from C.P. TEST SERVICES - VALVCO, INC., New Berlinville, PA (888-482-5826).

3.0 EXECUTION

3.01 PIPE HANDLING, INSTALLATION, BEDDING, AND JOINTING

3.01.1 HANDLE PIPE MATERIALS and fittings in a manner to insure installation in sound and undamaged condition and in accordance with the manufacturer's recommendation. Do not drop or bump. Use slings, lifting lugs, hooks, and other devices designed to protect pipe, joint elements, and coatings. Use a sling for handling pipe 12 inches in diameter or larger when the pipe section is 10 feet in length or longer. A double sling will be required unless otherwise approved by the Engineer. Ship, move, and store with provisions to prevent excessive deflection and movement or shock contact with adjacent units.

3.01.2 PIPE INSTALLATION shall be in accordance with the following standards:

ASTM "Standard Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe," Designation D 2321

AWWA "Installation of Cast Iron Water Mains," Designation C600

3.01.3 UTILIZE EQUIPMENT, METHODS, AND MATERIALS to insure the installation is in conformity with the lines and grades shown on the Drawings or as directed by Engineer. The Contractor shall be required to use laser beam equipment for construction of all gravity sewer piping.

.1 Maintain the following tolerances from true alignment and grade:

Alignment	3" from the proposed line
Grade	±1" from the proposed grade

Joint deflection shall not exceed the maximum allowable deflection per joint according to ASTM "Specification for Compression Joints for Vitrified Clay Bell-and-Spigot Pipe," Designation C 425, ASTM "Specification for Compression Coupling for Vitrified Clay Plain-End Pipe," Designation C 594, and AWWA "Installation of Cast Iron Water Mains," Designation C600. Only 1 correction for alignment/grade shall be made between adjacent manholes.

.2 Except where pipe sections are being encased in concrete, no pipe is to be supported by concrete blocks.

- .3 All main line and service line gravity sewer piping shall be installed to the minimum grades necessary to maintain a sewer liquid velocity rate of 2.0 feet per second. This velocity rate is equivalent to a service line grade of 2.0 percent (i.e. 1/4 inch per foot).

3.01.4 INSTALL PIPE of size, material, strength class, and joint type with embedment as shown on the Drawings. Reinforced-concrete pipe with elliptical reinforcement shall be installed and positioned in accordance with the pipe manufacturer's pipe markings indicating top and bottom of pipe.

3.01.5 COMMENCE LAYING at downstream end of line and install pipe with spigot or tongue end downstream.

3.01.6 CLEAN INTERIOR of all pipe, fittings, and joints prior to installation. Prevent entrance of foreign matter during discontinuance of installation. Close open ends of pipe with snug-fitting cap. Do not let water fill the trench. The Contractor shall conduct his operation in such a manner to prevent flotation should water control measures prove inadequate. Remove water, sand, mud, and other undesirable materials from trench before removal of end cap.

3.01.7 INSTALL PIPE only when weather and soil conditions are suitable. Brace or anchor pipe as required to prevent displacement after establishing final position.

3.01.8 BEDDING OF PIPE shall be as follows unless otherwise noted on the Drawings:

- .1 In all ordinary pipe laying in firm soils and where bedding material is not required or shown on the Drawings, the Contractor shall shape the bottom of the ditch to fit the lowest 90 degrees, 45 degrees each side of the centerline, of the circumference of the pipe, taking care to secure an extra firm bearing near the outer edges of the 90-degree arc. Upon the concave surface so prepared, the Contractor shall spread a layer, one inches to two inches thick, of pulverized soil. Each pipe shall be bedded to line and grade thereon, taking special care to provide depressions for bell ends of each pipe. Care shall be taken not to excavate below the depths indicated and any excessive over depths shall be backfilled with crushed rock at the Contractor's expense.
- .2 Where bedding material is required (either shown on the Drawings or directed by the Engineer), the Contractor shall over-excavate the trench bottom to permit the placement and compaction of bedding material. The Contractor shall shape the bedding material as described above to provide even bearing of the pipe barrel. Provide depressions for bell ends of each pipe.

- .3 If unstable trench bottom subgrade conditions are encountered, and it is determined by the Engineer that the bedding specified will not provide suitable support for the pipe, additional excavation to the limits determined by the Engineer will be required. This additional excavation shall be backfilled with crushed stone stabilization material as herein specified and approved by the Engineer. The Engineer will direct the Contractor, as to the extent and locations of areas requiring crushed stone stabilization not shown on the Drawings.

3.01.9 JOINTING OF PIPE shall be accomplished as directed by the Engineer, in accordance with the manufacturer's recommendations in conformance with Paragraph 3.01.2 of this Section 2700 and the following general requirements:

- .1 Locate joints to provide for differential movement at changes in type of pipe embedment, concrete collars, and structures. However, in all pipe installations, the first pipe beyond the wall of any manhole shall be supported by a concrete cradle constructed structurally continuous with the manhole base slab or footing.
- .2 Utilize methods and equipment capable of fully homing and making up joints without damage.
- .3 Check joint opening and deflection for specification limits.
- .4 Examine each piece of pipe prior to installation for specification compliance.
- .5 Check gasket position and condition after assembly prior to installation of the next pipe.
- .6 For HDPE pipe, use manufacturer=s standard heat weld fusion jointing methods.

3.01.10 CUT PIPE in neat workmanlike manner utilizing approved methods and equipment. Observe Specifications and Drawings regarding joint locations. Smooth cuts by power grinding to remove burrs and sharp edges and repair lining as directed by the Engineer.

3.01.11 PROVIDE AND INSTALL TEMPORARY PLUGS for gravity sewer piping, as manufactured by pipe supplier or as fabricated by Contractor if approved. Plugs shall be watertight against heads up to 20 feet of water. Secure plugs in place in a manner to facilitate removal when required to connect pipe.

- .1 Plugs shall be installed as specified or where shown on the Drawings. Also the open end of the sewer shall be plugged at the end of the work day with

a snug fitting closure to prevent entry of foreign material until work is resumed.

- .2 Plugs for lines permanently plugged shall be completely sealed and water tight up to 20 feet of water head pressure.

3.01.12 CONNECT PIPE TO EXISTING STRUCTURES and pipelines where indicated. Observe pertinent articles of Specifications pertaining to joint locations. Use adaptors with concrete collar where shown on the Plans or directed by the Engineer.

- .1 Prepare structure by making an opening with at least two inches of clearance all around fitting to be inserted. The concrete structure shall be initially cut with a concrete saw. Opening between pipe and manhole wall shall be filled with an expansive non-shrink grout in such a manner that a watertight condition will result. Install water stops (i.e. flexible boot or sleeve, O-ring or gasket) on all plastic pipe (PVC, ABS, and RPM pipe) as approved by the Engineer.
- .2 Manholes to be built on an existing sewer shall be constructed in such a manner as will not disrupt service of the existing sewer. The manhole base, walls and invert shall be completed before the top half of the sewer pipe is cut or broken away. Rough edges of the pipe thus exposed shall be covered with expansive grout or ground in such a manner as to produce a smooth and acceptable finish. Any portion of the existing sewer damaged by the Contractor shall be repaired at no expense to the Owner.

3.01.13 LAY SEWER MAINS at least 10-feet horizontally from water mains. Where conditions prevent a separation of 10 feet, the sewer may be laid closer to the water main if the elevation of the crown of the sewer is at least 18-inches below the invert of the water main and it is laid in a separate trench.

3.01.14 LAY SEWER MAINS that cross water mains so that the top of the sewer pipe is at least 18-inches below the bottom of the water pipe. When the sewer line cannot be buried to meet the above requirement, relocate with slip-on or mechanical joint cast iron pipe for a distance of ten feet on each side of the sewer. Center one full length of water main over the sewer so that both joints will be as far from the sewer as possible. Lay water and sewer service lines so that there will be no joints in the water service lines within 10 feet of the sewer lines.

3.02 MANHOLES

3.02.1 MANHOLES shall be constructed of precast concrete sections or cast-in-place concrete with cast iron frames, covers, and steps. Construction shall conform to the Drawings.

3.02.2 MANHOLE FOOTINGS AND BASES shall be concrete cast in place monolithically. Where sewer lines pass through or enter manholes, the invert channels shall be smooth and semicircular in cross section and may be formed directly in the concrete of the manhole base, may be half pipe laid in the concrete, or may be constructed by laying the sewer lines continuously through the manhole and breaking out the top exposed section after the surrounding concrete has hardened and neatly trimming the edges. Changes of direction of flow within the manholes shall be made with a smooth curve with as long a radius as possible. The floor of the manhole outside the channels shall be smooth and slope toward the channel not less than one inch per foot. Particular care shall be exercised to prevent constrictions of flows at manholes. Brick may be used to complete the manhole or to a point where cast-in-place concrete or precast concrete manhole sections may be used. All pipe entering manhole must be fully supported by a concrete cradle and shall be cut and ground smooth with the inside face of the manhole.

3.02.3 PRECAST CONCRETE WALL AND REDUCING CONE SECTIONS shall be handled with care to avoid damage to joint ends of each section. Damaged sections shall be subject to rejection at the discretion of the Engineer. All precast sections shall be constructed to conform to the Drawings.

- .1 When using O-ring joints, care shall be exercised in placing the O-ring on the spigot end, and lowering the bell section on to the spigot end so that a watertight seal is obtained.
- .2 When using bitumastic joints, both spigot and bell end shall be primed with solvent material compatible to the adhesive in the mastic. Approved bitumastic material shall completely fill the joints so that a minimum 1/4-inch bead of material is visible after jointing, to be smoothed off after completion of the jointing operation.
- .3 When a flexible preformed butyl rubber or bituminous polymer compounded with modifiers is used to seal jointed sections of manholes, the extrusion of sealant from the joint is not required.

3.02.4 THE VERTICAL SPACING BETWEEN MANHOLE SECTIONS shall not exceed 1/4 inch. Precast sections shall be constructed as follows:

- .1 The cone (taper section) shall be a maximum of three feet in height, and shall taper smoothly from 48-inches to 26-inches inside diameter.
- .2 The 48-inch inside diameter pipe used in the base section shall be furnished in sections 16-inches, 32-inches, and 48-inches long.
- .3 The 26-inch inside diameter precast sections shall be furnished in lengths of 4 inches and 8 inches.

- .4 The throat section of the manhole shall be adjustable up to 16 inches in height.

3.02.5 ALIGNMENT OF THE INVERT CHANNELS shall be as shown on the Drawings. When no specific details and dimensions are given, changes in flow direction shall be smooth, uniform, and made with the longest radius possible. The cross sectional shape of invert channels shall match the lower halves of the entering and exiting pipes. The surfaces of the channels shall be steel-troweled to produce a dense, smooth surface.

3.02.6 WHEN FILLING OPENINGS AROUND PIPES through the manhole walls, mortar/masonry units shall be placed so that the resulting joints are watertight. Mortar used in the joint closure shall not interfere with the invert channel. Prior to filling openings around plastic pipe, a rubber manhole water stop (circular rubber gasket with fingers protruding and means of clamping to pipe) shall be secured to the pipe at a location near the center of the manhole wall with the gasket fingers pointing to the outside of the manhole.

3.02.7 ALL MASONRY, PLASTER COATING, AND CAST-IN-PLACE CONCRETE shall be adequately protected from freezing and loss of moisture for the first 24 hours. The curing methods and materials to be used shall conform to the requirements of Division 3 Specifications.

3.02.8 ALL RINGS FOR MANHOLE COVERS shall be carefully set to match existing surfaces, except in flood plains where the Drawings indicate that the ring is to be set at an elevation higher than existing ground. Each ring shall be set on a full mortar bed.

3.02.9 MANHOLES TO BE BUILT ON AN EXISTING SEWER shall be constructed in such a manner as will not disrupt service of the existing sewer. The manhole base, walls and invert shall be completed before the top half of the sewer pipe is cut or broken away. Rough edges of the pipe thus exposed shall be ground smooth or covered with expansive grout, in such a manner as to produce a smooth and acceptable finish. Any portion of the existing sewer damaged by the Contractor shall be repaired or replaced at no expense to the Owner.

3.02.10 INSTALL MANHOLE STEPS where the depth from the top of the manhole to the invert of the sewer exceeds four feet.

3.02.11 STUB PIPE shall be built into the manhole for future sewer lines when directed by the Engineer and/or as shown on the Drawings. The manhole floor shall be shaped to correspond to the invert of the stub pipe, and the pipe shall be stoppered as set forth for wye branch stoppers.

3.03 ACCEPTANCE TESTING

3.03.1 VISUAL INSPECTION shall be performed on all segments of the sewer pipe prior to acceptance.

- .1 Contractor shall clean pipe of excess mortar, joint sealant, earth, and other debris prior to inspection.
- .2 Gravity sewers shall be inspected with the use of sewer televising inspection equipment and/or by physical passage where space permits. Inspection shall locate the presence of any misaligned, displaced, or broken pipe and the presence of visible infiltration or other defects.
- .3 Copies of all sewer video inspection tapes or CD=s shall be submitted to the GMU, along with a printed copy of the inspection report.
- .4 Contractor shall correct defects as required prior to conducting leakage tests.

3.03.2 LEAKAGE TEST shall be performed on the full length of all gravity sewer lines prior to acceptance.

- .1 Contractor shall perform leakage testing by ex-filtration on sewer pipe when directed by the Engineer. Contractor shall:
 - .a Furnish all labor, equipment, tools, and materials, including bulkheads, water, and all miscellaneous items required to perform the tests.
 - .b Test all sewer pipe after either the completed backfill or partial backfill sufficient to stabilize the position of the pipe in both alignment and grade is accomplished.
 - .c Perform at depths of water, as measured above centerline of pipe, of not less than 2 feet nor more than 10 feet (consideration shall be given for water table above said centerline).
 - .d Maintain test as necessary to locate all leaks, but not less than 2 hours.
 - .e Repeat as necessary after repair of leaks and defects until leakage, as measured, does not exceed 0.15 gallons per inch of internal diameter per hour per 100 feet of pipe length (200 gal/inch of I.D./day/miles).
 - .f Protect manholes and other structures by means of bulkheads to prevent bursting pressures from being applied inside the structure.

- .g Dewater pipe upon completion of testing.
- .2 Contractor shall perform air leakage tests for all gravity sewer pipe, except reinforced concrete pipe and vitrified clay pipe, when directed by the Engineer.
- .a Contractor shall furnish all facilities required, including necessary piping connections, test pumping equipment, pressure gauges, bulkheads, regulator to avoid over-pressurization, and all miscellaneous items required.
 - .b The pipe plug for introducing air to the sewer line shall be equipped with two taps. One tap will be used to introduce air into the line being tested through suitable valves and fittings so that the input air may be regulated. The second tap will be fitted with valves and fittings to accept a pressure test gauge indicating internal pressure in the sewer pipe. An additional valve and fitting will be incorporated on the tap used to check internal pressure so that a second test gauge may be attached to the internal pressure tap. The pressure test gauge will also be used to indicate loss of air pressure to leaks in the sewer line.
 - .c The pressure test gauge shall meet the following minimum specifications:

Size (diameter)	4 1/2"
Pressure Range	0-15 pounds per square inch
Figure Intervals	1 pound per square inch increments
Minor Subdivisions	0.05 pounds per square inch
Pressure Tube	Bourdon Tube or diaphragm
Accuracy	± 0.25% of maximum scale reading
Dial	White coated aluminum with black lettering, 270 F Arc and mirror edge.
Pipe Connection	Low male 1/2" N.P.T.

- .d Calibration data will be supplied with all pressure test gauges. Certification of pressure test gauge will be required from the gauge manufacturer. This certification and calibration data will be available to the Engineer whenever air tests are performed.
- .e Test each segment of sewer pipe between manholes after completion of the installation of pipe and appurtenances and the backfill of sewer trench.
- .f Plug ends of line and cap or plug all connections to withstand internal pressure. One of the plugs provided must have two taps for connecting equipment. After connecting air control equipment to the air hose, monitor air pressure so that internal pressure does not exceed 5.0 pounds per square inch gauge. After reaching 4.0 pounds per square inch gauge, throttle the air supply to maintain between 4.0 and 3.5 pounds per square inch gauge for at least two minutes in order to allow equilibrium between air temperature and pipe walls. During this time, check all plugs to detect any leakage. If plugs are found to leak, bleed off air, tighten plugs, and again begin supplying air. After temperature has stabilized, the pressure is allowed to decrease to 3.5 pounds per square inch gauge.

At 3.5 pounds per square inch gauge, begin timing to determine the time required for pressure to drop to 2.5 pounds per square inch gauge. If the time, in seconds, for the air pressure to decrease from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge is greater than that shown in the table below, the pipe shall be presumed free of defects.

<u>Pipe Size (Inches)</u>	<u>Test Segment Length (Feet)</u>	<u>Minimum Type (Min.-Sec.)</u>
8	0-298	7:34
	300	7:36
	350	8:52
	400	10:08
	450	11:24
10	0-239	9:26
	250	9:53

12	300	11:52
	350	13:51
	400	15:49
	450	17:48
	0-199	11:20
	200	11:24
	250	14:15
	300	17:05
	350	19:56
	400	22:47
	450	25:38

- .g If air test fails to meet above requirements, repeat test as necessary after all leaks and defects have been repaired. Prior to acceptance, all constructed sewer lines shall satisfactorily pass the low pressure air test.
- .h In areas where ground water is known to exist, install a 1/2-inch diameter capped pipe nipple, approximately ten-inches long, through manhole wall on top of one of the sewer lines entering the manhole. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the line acceptance test, groundwater level shall be determined by removing pipe cap, blowing air through pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to pipe nipple. The hose shall be held vertically and a measurement of height in feet of water shall be taken after the water stops rising in this plastic tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings.

3.03.3 DEFLECTION TEST shall be performed on all flexible gravity sewer pipe installations (PVC, ABS, ABS composite, and RPM).

- .1 All pipelines constructed of flexible materials shall be measured for vertical ring deflection after the backfill has been in place at least 30 days. Maximum ring deflection of the pipeline under load shall be limited to five percent of the vertical internal pipe diameter. All pipe exceeding this deflection shall be considered to have reached the limit of their serviceability and shall be relaid or replaced by the Contractor at no additional cost to the Owner.

- .2 The cost of all deflection testing shall be borne by the Contractor and shall be accomplished by using a deflectometer, which will produce a continuous record of pipe deflection, or by pulling a mandrel, sphere, or pin-type go/no-go device through the pipeline. The diameter of the go/no-go device shall be 95% of the undeflected inside diameter of the flexible pipe.

3.03.4 INFILTRATION TEST of gravity sewer lines shall be conducted upon completion of a section of wastewater line. Plug the upper section of the line while installing a suitable flow measuring device at the lower end. Measure the amount of water flowing through the lower end for a specific period of time as approved by the Engineer. The maximum allowable infiltration of each section, including all manholes, is 200 gallons per inch of diameter per mile of pipe per day.

3.03.5 PRESSURE TEST all pressure sewer lines and force mains upon completion of construction. The Engineer shall specify the test pressure, but it shall not be less than 1-1/2 times the normal operation pressure at the lowest point in the pipe section. The test pressure shall be maintained by the Contractor for no less than 2 hours to permit a complete inspection of the pipe sections and joints for leaks. Should any leaks be detected, the Contractor shall repair the leaks or replace defective pipe, fittings, valves, and appurtenances or defective work. The pressure test shall then be repeated until the pipe section is acceptable to Engineer. Pressure testing shall be in conformance with AWWA C600.

3.03.6 LEAKAGE TESTS shall be conducted on all pressure sewer lines and force mains concurrently with the pressure test in accordance with AWWA C600. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{NDP \frac{1}{2}}{7,400}$$

L = Allowable leakage (amount of water in gallons per hour that must be supplied into the newly-laid pipe section to maintain pressure within five pounds per square inch of the specified test pressure after air has been expelled and the pipe filled with water)

N = Number of joints in pipe section under test

D = Nominal pipe diameter (inches)

P = Average test pressure (psig)

The Contractor shall, at his own expense, locate and repair the defective material until the leakage is within the specified allowance. The leakage test shall then be repeated until the pipe section is acceptable to the Engineer.

3.03.7 ALIGNMENT TEST. An alignment test shall be performed on each section of gravity sewer completed. The alignment test shall be performed with either a lamp or a laser beam. The light or laser beam shall be visible through the sewer between adjacent manholes.

3.04 WYE BRANCHES

3.04.1 WYE BRANCHES for new construction shall be installed in the sewer main as shown on the Drawings or at locations required to connect existing service line to the new sewer main. Accomplish all connections with fittings of 45 degrees or less. Avoid bends requiring 90 degree fittings so that cleaning equipment can access all parts of a sewer service line.

3.05 SPECIAL PROVISIONS

3.05.1 CONTRACTOR shall connect the new sanitary sewers into the existing sewer manholes at the locations shown on the Drawings and as directed by the Engineer as part of his Unit Price for constructing the sanitary sewer lines.

3.05.2 CONTRACTOR shall compact trench backfill for sewers, including backfill around manholes. Backfill and tamping work shall conform to the applicable provisions contained in Section 2250, Trench Excavation and Backfill, and the compaction shall also conform to the following requirements:

- .1 Backfilling shall be made in layers not to exceed 6-inch thickness of loose material.
- .2 Each layer shall be mechanically tamped with an air hammer until the degree of compaction is equal at least to the density of the surrounding undisturbed earth, but not less than 90% of maximum density as determined by ASTM D 698. The top 12 inches of backfill in street right-of-way shall be compacted to a minimum density of 95% of maximum density as determined by ASTM D 698.
- .3 Where it is possible to use a Hydro-hammer, or a machine of that type, layers of backfill 1-foot deep may be compacted above a level 4-feet above the top of the pipe. The compaction around the pipe shall be done by hand or with an air hammer.
- .4 All work, equipment, and materials for compacting the backfill shall be included in the Contractor's bid and Contract price for constructing the sewer pipe.

3.05.3 IN NEW CONSTRUCTION AREAS all sewer service stubs shall be extended to the property line and capped for future extension into the lot. The sewer stub shall be

marked with a treated wood 2x4 or a steel post extended to above the ground service and a steel rebar.

3.05.4 SEWER SERVICE LINES between the public sewer main and the house or building being served must be constructed in a trench separate from any other utility. In no case shall there be less than two (2) feet of clear horizontal separation between any two parallel lines, whether they be water, sewer, storm sewer, or gas lines.

3.05.5 ABANDONMENT OF SEWER MAINS AND SERVICE LINES shall consist of capping the end of abandoned pipe with watertight caps. In some cases, removal of an abandoned main or service line shall be required. In no cases shall an abandoned pipe be left open to allow ground water to enter the sanitary sewer system.

3.05.6 TAPPING SERVICE LINES ON EXISTING SEWER MAINS shall require GMU approved tapping tees of the appropriate materials and sizes. Appropriate clamps shall be installed. Breaking into existing sewer mains and installing service pipes with concrete grout will not be allowed. Service taps may be no closer than 4 feet from any other tap or connection. Gravity service connections will not be allowed into manholes, unless approved by GMU. Pressure force mains shall be connected to a manhole in accordance with the standard details.

3.06 VERTICAL RISERS

3.06.1 WHERE SERVICE CONNECTIONS are 12 feet or more below the ground surface, a vertical 6-inch riser may be constructed in the side of the trench using a 45-degree bend in the wye and 6-inch pipe installed vertically with a plug or cap at a height of approximately 10-feet below the ground surface or as otherwise directed by the Engineer. Concrete shall be placed under the riser branch as detailed on the standard details. Vertical risers shall be paid for at the bid price per foot.

3.07 TESTING

3.07.1 THE CONTRACTOR shall be responsible for all acceptance testing, including closed-circuit video television testing, leakage testing (water and air), deflection testing, and infiltration testing. All tests shall be performed by the Contractor or approved testing laboratory. The costs of these tests shall be paid for as part of the unit bid price for piping. No separate remuneration shall be allowed and these costs shall not be paid for from the testing allowance. Copies of all testing reports and video tapes shall be furnished to the Engineer in accordance with the General Requirements.

3.08 LINE TRACING WIRE AND LOCATOR ACCESS BOXES (Pressure Mains and Force Mains)

3.08.1 LINE TRACING WIRE shall be taped to the top of the sewer main pipe in the trench, prior to backfill. Locator access boxes shall be located adjacent to valve boxes, air release manhole, manholes, etc., and shall be secured in concrete to prevent movement. Locator access boxes shall also be located at stand-alone locations with a 2-foot square concrete pad, where valve boxes, fire hydrants, or blowoffs are not available and the distance between access points exceeds 800 feet. Refer to Paragraph 2.13 and 2.14 of this section for further reference.

3.09 SEPERATION BETWEEN WATER AND SEWER LINES

3.09.1 REFER TO PARAGRAPH 3.06 OF SECTION 2600 for separation requirements between water and sewer lines.

SECTION 02900

SURFACE RESTORATION

1.0 GENERAL

1.01 DESCRIPTION

1.01.1 RELATED WORK SPECIFIED ELSEWHERE

Site Preparation	Section 02100
Site Grading	Section 02210
Trench Excavation and Backfill	Section 02250
Subgrade Reconstruction, Compaction, and Trimming	Section 02280
Concrete Pavement Reconstruction	Section 02410
Asphalt Concrete Pavement	Section 02500
Water Mains and Appurtenances	Section 02600
Boring and Jacking	Section 02650
Horizontal Directional Drilling	Section 02655
Sanitary Sewers	Section 02700

1.02 SUBMITTALS

1.02.1 SUBMIT the following information to the Engineer as Shop Drawings:

Seed Mixture
Concrete Mix
Asphalt Mix
Crushed Rock Mix
Sod
Fertilizer

1.03 CERTIFICATES OF COMPLIANCE

1.03.1 CERTIFICATES OF COMPLIANCE shall be submitted prior to product delivery stating that the following products meet the requirements specified:

Sod
Seed Mixture
Fertilizer
Concrete Mix
Asphalt Mix

1.04 SEEDING SEASON

1.04.1 PERFORM SEEDING OPERATIONS only at times of the year when temperature, moisture, and climatic conditions are correct to promote germination of seed and plant growth. Seeding operations may be accomplished during the following periods of the year:

- .1 Spring - From March 1st through May 31st
- .2 Fall - From August 10th through September 30th

The Contractor may perform seeding operations at other times of the year provided that approval is given by the Owner and Engineer. However, the Contractor shall not be relieved of his responsibility to assure compliance with these Specifications regarding acceptance and guarantee of seeding operations.

2.0 PRODUCTS

2.01 GRASS SEED

2.01.1 GRASS SEED FOR RESIDENTIAL AREAS shall be "Super Turf II-LS" as supplied by United Seeds Inc., Ralston, Nebraska. The seed mixture shall be "certified Blue Tag," superior quality. Purity of mixture shall be 98.5% and the germination shall be a minimum of 90%. The seed mixture shall be comprised of the following:

<u>Kind/Variety</u>	<u>Percent of Mix</u>	<u>Percent Germination</u>
Firecracker LS Turf Fescue	21.5	90
Summer Turf Fescue	21.5	90
Snyder Turf Fescue	21.5	90
Turbo Turf Fescue	26.35	90
Blue Chip Plus Kentucky Bluegrass	3.67	90
Nu Blue Plus Kentucky Bluegrass	<u>3.68</u>	90
Total	100.00	

2.01.2 GRASS SEED FOR RURAL AREAS shall be "City/County NRD Mixture" as supplied by United Seeds Inc., Ralston, Nebraska. Purity of the mixture shall be 96.5% and the germination shall be a minimum of 90%. The seed mixture shall be comprised of the following:

<u>Kind/ Variety</u>	<u>Percent of Mix</u>	<u>Percent Germination</u>
Fawn Tall Fescue	29.4	90
Smooth Bromegrass	27.9	90

Linn Perennial Ryegrass	19.6	90
Jerry Seed Oats	<u>19.6</u>	90
Total	100.00	

2.01.3 ALL SEED specified for the project shall be thoroughly mixed prior to placing the seed in the seed hopper. All seed shall be mixed at the project site.

2.01.4 ACCEPTABLE SEED SUPPLIERS are United Seeds Inc., Ralston, Nebraska, or equal.

2.02 CONCRETE

2.02.1 Refer to Specifications For Street Repair and Rehabilitation, City of Glenwood Public Works Department, latest edition.

2.03 ASPHALT

2.03.1 Refer to Specifications For Street Repair and Rehabilitation, City of Glenwood Public Works Department, latest edition.

2.04 CRUSHED ROCK

2.04.1 CRUSHED ROCK surfacing used for surface restoration shall meet the following gradation:

<u>Sieve Size</u>	<u>Percent Passing By Weight</u>
1 1/2"	100
1 "	90 - 100
1/2"	60 - 90
No. 4	35 - 55
No. 16	10 - 40
No. 200	4 - 12

2.05 GRASS SOD

2.05.1 GRASS SOD shall be Certified Turfgrass Sod. It shall be vigorous, well-rooted, healthy, fescue sod, (or bluegrass sod if appropriate) free from disease, insects, weeds, other grasses, stone, and any other harmful or deleterious matter. Sod shall be machine stripped at a uniform soil thickness of 1 inch \pm 1/4 inch. Measurement of thickness shall exclude top growth and thatch.

2.05.2 TOPSOIL shall be placed on all graded or disturbed areas which are to receive sod. Top soil shall be rich, fine, and well-drained material which has previously been stripped and stored on site or which has been hauled on site from other acceptable areas. Six inches of topsoil shall be in place prior to the installation of sod.

2.06 FERTILIZER

2.06.1 FERTILIZER shall be of the grade, type, and form specified and shall comply with the rules of the Iowa Department of Agriculture and the requirements stated herein.

2.06.2 THE GRADE OF FERTILIZER shall be identified according to the percent nitrogen (N), percent available phosphoric acid (PO), and percent water soluble potassium (KO), in that order.

2.06.3 FERTILIZER FOR SEED BED shall be a commercial product, 16-16-16 formula, chemically combined.

2.07 MULCHING MATERIAL

2.07.1 STRAW MULCH shall be reasonably free from weeds, foreign matter detrimental to plant life, and be in a dry condition. Mulch shall be wheat straw, oats straw, prairie hay, or other approved material.

2.08 EROSION CONTROL FABRIC

2.08.1 EROSION CONTROL FABRIC shall be as noted on the Plans and/or in Section 2930, Erosion Control.

3.0 EXECUTION

3.01 GENERAL PROVISIONS

3.01.1 ALL OBSTRUCTIONS to the work removed to facilitate construction or to excavate the trench shall be replaced with equal or better materials. The Contractor is responsible for all damage to items not specified for removal or demolition.

3.02 SEEDING

3.02.1 SEED ALL AREAS as shown on the Drawings or as directed by the Engineer. Apply at a rate of 8 pounds per 1,000 square feet.

3.02.2 PREPARE SEED BED prior to seeding operations. Place 6 inches of topsoil over area to be seeded and grade to provide drainage. In areas where topsoil already exists, disc the upper 3 inches to loosen soil and harrow to provide a smooth seed bed. If weed growth develops sufficiently to interfere with proper seed bed preparation, the Contractor shall mow or dispose of all weed growth at his expense prior to seed bed preparation.

3.02.3 PLANT SEED by using a seed drill to incorporate the seed uniformly over the areas to be seeded and within the seed bed. Plant seed shall be drilled to a depth of 3/8-inch to 1½-inches deep.

3.02.4 MULCH SEEDED AREA with wheat straw, oats straw, or prairie hay, which is free of weed seed, to hold the seed bed against erosion until the grass plants are established.

3.03 FERTILIZATION OF SEED BED

3.03.1 FERTILIZER SHALL BE SPREAD over the areas to be seeded. All fertilizer shall be spread with a mechanical spreader, which will secure a uniform rate of application.

3.03.2 FERTILIZER SHALL BE SPREAD after the seed bed preparation, but prior to the sowing of any seed. The fertilizer shall be disced in and the area rolled prior to the application of permanent seed. If a roller cannot be operated satisfactorily, substitution of harrowing may be permitted by the Engineer.

3.03.3 APPLY FERTILIZER at a rate of 15 pounds per 1,000 square feet.

3.04 SODDING

3.04.1 SOD ALL AREAS as shown on the Drawings or as directed by the Engineer.

3.04.2 PREPARE SOD BED by tilling the upper 3 inches of topsoil after the topsoil has been placed on the areas to be sodded. If topsoil already exists, till or disc, and harrow the upper 3 inches to loosen the soil. Incorporate the fertilizer uniformly into the top 2 inches of the prepared bed. Harrow or rake the sod bed to provide a uniform and smooth surface that conforms to the indicated grades.

3.04.3 PLANT SOD by laying strips solid. Roll sod to provide a bond with the sod bed. Water the sod completely and sufficiently to thoroughly wet the sod bed to a depth of 2 inches.

3.04.4 MAINTAIN AND REPAIR sodded areas for a 60-day period after completion of the planting. During this period, the sod shall be watered, and any areas damaged due to erosion, trespass, or other cause, shall be repaired and resodded by the Contractor, as originally specified, at no additional cost.

3.05 SIDEWALK REPLACEMENT

3.05.1 REPLACE REMOVED SIDEWALKS with new, 4-inch thick, Portland cement concrete. Finish to match existing work and reconstruct joints to match existing work.

3.06 CURB AND GUTTER REPLACEMENT

3.06.1 REPLACE REMOVED CURBS AND GUTTERS with new Portland cement concrete sections to match existing cross section. Finish to match existing work and reconstruct joints to match existing work.

3.07 STREET, ROAD, AND DRIVEWAY REPLACEMENT

3.07.1 Refer to Specifications For Street Repair and Rehabilitation, City of Glenwood Public Works Department, latest edition.

3.08 ASPHALT PAVEMENT REPLACEMENT

3.08.1 Refer to Specifications For Street Repair and Rehabilitation, City of Glenwood Public Works Department, latest edition.

3.09 CRUSHED ROCK SURFACING REPLACEMENT

3.09.1 REPLACE REMOVED CRUSHED ROCK SURFACING over restoration areas with new crushed rock, spread and compacted to a 4-inch thickness.

3.10 SEALCOAT REPLACEMENT

3.10.1 Refer to Specifications For Street Repair and Rehabilitation, City of Glenwood Public Works Department, latest edition.

3.11 TEMPORARY SURFACE OVER TRENCHES

3.11.1 CONTRACTOR shall provide 6 inches of compacted gravel or crushed rock temporary surfacing over trenches which cross traveled roadways and driveways immediately following satisfactory completion of backfill. Grade temporary surface smooth to meet grade of adjacent undisturbed surface.

3.12 CLEAN-UP

3.12.1 CONTRACTOR shall clean up each portion of construction as it is completed. Clean-up operations in public right-of-way shall be kept within 400 feet of construction operations. Clean up and remove all rubbish, debris, and surplus material. Leave site in neat condition acceptable to Owner and Engineer. Reopen backfilled areas to traffic as soon as practical.

3.13 EROSION CONTROL FABRIC INSTALLATION

3.13.1 INSTALL EROSION CONTROL FABRIC on highly erosive surfaces as shown on the Drawings and as directed by the Engineer. Installation of fabric shall be in accordance with the manufacturer's recommendations.

3.14 GUARANTEE

3.14.1 THE CONTRACTOR SHALL GUARANTEE that seeded areas will germinate and establish in a uniform manner as determined by the Engineer.

3.14.2 MAINTAIN AND REPAIR seeded areas for a 60-day period after completing the operations. During this period, the seeded areas shall be watered, and any areas damaged due to erosion, trespass, or other cause, shall be repaired and reseeded by the Contractor, as originally specified, at no additional cost.

SECTION 03100

CONCRETE FORM WORK

1.0 GENERAL

1.01 WORK INCLUDED

1.01.1 THE WORK INCLUDED in this Section consists of form work for cast-in-place concrete with shoring, bracing, and anchorage.

1.02 RELATED WORK

1.02.1 RELATED WORK SPECIFIED ELSEWHERE

Concrete Reinforcement
Cast-In-Place Concrete

Section 03200
Section 03300

1.03 SYSTEM DESCRIPTION

1.03.1 CONTRACTOR shall design, engineer, and construct form work, shoring, and bracing to meet design and code requirements so that resultant concrete conforms to required shapes, lines, and dimensions.

1.04 QUALITY ASSURANCE

1.04.1 CONTRACTOR shall construct and erect concrete form work in accordance with ACI 301 and 347.

1.05 REFERENCES

1.05.1 REFERENCE standards include the following:

- .1 ACI 301 - Specifications for Structural Concrete for Buildings.
- .2 ACI 347 - Recommended Practice for Concrete Form Work.

2.0 PRODUCTS

2.01 FORM MATERIALS

2.01.1 ALL FORMS AND SHORING MATERIALS to be used shall be as determined and selected by the Contractor.

2.02 FORM ACCESSORIES

2.02.1 FORM RELEASE AGENT shall be material which will not stain concrete and will not absorb moisture.

2.02.2 NAILS, SPIKES, LAG BOLTS. Through bolts and anchorages shall be sized as required of strength and character to maintain form work in place while placing concrete.

2.02.3 FORM TIES shall be removable, snap-off metal of adjustable length, free of defects that will leave holes no larger than one-inch diameter in concrete surface, with weatherproofing washer.

3.0 EXECUTION

3.01 INSPECTION

3.01.1 CONTRACTOR shall verify lines, levels, and measurements before proceeding with form work.

3.02 PREPARATION

3.02.1 EARTH FORMS may be used as a form for footings.

3.02.2 HAND TRIM sides and bottoms of earth forms; remove loose dirt prior to placing concrete.

3.02.3 MINIMIZE form joints. Symmetrically align joints and make watertight to prevent leakage of mortar.

3.02.4 ARRANGE AND ASSEMBLE form work to permit dismantling so that concrete is not damaged during its removal.

3.02.5 ARRANGE FORMS to allow stripping without removal of principal shores, where required to remain in place.

3.03 ERECTION

3.03.1 PROVIDE bracing to ensure stability of form work. Strengthen form work liable to be overstressed by construction loads.

3.03.2 CONSTRUCT form work to maintain tolerances in accordance with ACI 301.

3.04 APPLICATION OF FORM RELEASE AGENT

3.04.1 APPLY form release agent on form work in accordance with manufacturer's instructions. Apply prior to placing reinforcing steel, anchoring devices, and embedded items.

3.05 INSERTS, EMBEDDED PARTS, AND OPENINGS

3.05.1 PROVIDE formed openings where required for work embedded in or passing through concrete.

3.05.2 COORDINATE work of other sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

3.05.3 INSTALL accessories in accordance with manufacturer's instructions, level and plumb. Ensure items are not disturbed during concrete placement.

3.06 FORM REMOVAL

3.06.1 DO NOT REMOVE FORMS, shoring, and bracing until concrete has sufficient strength to support its own weight, and construction and design loads, which may be imposed upon it. Forms, shoring, and bracing must be left in place for a minimum of seven days in all cases.

3.06.2 REMOVE FORM WORK progressively so no unbalanced loads are imposed on the structure.

3.06.3 DO NOT DAMAGE concrete surfaces during form removal.

SECTION 03200

CONCRETE REINFORCEMENT

1.0 GENERAL

1.01 WORK INCLUDED

1.01.1 WORK INCLUDED in this Section consists of reinforcing steel bars, welded steel wire fabric and fabricated steel bar or rod mats for cast-in-place concrete.

1.02 RELATED WORK

1.02.1 RELATED WORK SPECIFIED ELSEWHERE

Concrete Form Work
Cast-In-Place Concrete

Section 03100
Section 03300

1.03 QUALITY ASSURANCE

1.03.1 CONTRACTOR shall perform concrete reinforcement work in accordance with the CRSI Manual of Standard Practice and CRSI Documents 63 and 65.

1.03.2 CONFORM to ACI 301 and 315.

1.04 REFERENCES

1.04.1 REFERENCE standards include the following:

- .1 ACI 301 - Specifications for Structural Concrete for Buildings.
- .2 ACI 315 - Details and Detailing of Concrete Reinforcement.
- .3 CRSI - Manual of Practice.
- .4 CRSI 63 - Recommended Practice for Placing Reinforcing Bars.
- .5 CRSI 65 - Recommended Practice for Placing Bar Supports, Specifications and Nomenclature.

1.05 SHOP DRAWINGS

1.05.1 SHOP DRAWINGS shall be prepared by the Contractor in accordance with ACI 315, and submitted in accordance with the General Conditions and General Requirements. Indicate sizes, spacings, locations, and quantities of reinforcing steel, wire fabric, bending and cutting schedules, splicing, stirrup spacing, supporting and spacing devices.

1.06 CERTIFICATES

1.06.1 UPON REQUEST, submit mill test certificates of supplied concrete reinforcing, indicating physical and chemical analysis.

2.0 PRODUCTS

2.01 MATERIALS

2.01.1 REINFORCING STEEL shall be ASTM A 615, 60 ksi yield grade billet-steel deformed bars with uncoated finish.

2.01.2 WELDED STEEL WIRE FABRIC shall be ANSI/ASTM A 185 plain type in coiled rolls with uncoated finish.

2.01.3 STIRRUP/STEEL shall conform to ANSI/ASTM A 82.

2.02 ACCESSORY MATERIALS

2.02.1 TIE WIRE shall be minimum 16-gauge annealed type.

2.02.2 CHAIRS, BOLSTERS, BAR SUPPORTS, AND SPACERS shall be sized and shaped for strength and support of reinforcement during installation and placement of concrete. Chairs shall be epoxy coated to protect against corrosion.

2.03 FABRICATION

2.03.1 FABRICATE in accordance with ACI 315, providing concrete cover specified in Section 3300, Cast-In-Place Concrete.

2.03.2 LOCATE reinforcing splices not indicated on Drawings at points of minimum stress. Indicate location of splices on Drawings.

2.03.3 WELD reinforcing bars in accordance with ANSI/AWS D1.4.

3.0 EXECUTION

3.01 INSTALLATION

3.01.1 BEFORE PLACING CONCRETE, clean reinforcement of foreign particles or coatings.

3.01.2 PLACE, SUPPORT, AND SECURE reinforcement against displacement. Do not deviate from alignment or measurement.

3.01.3 DO NOT DISPLACE or damage vapor barrier as may be required by Section 3300, Cast-In-Place Concrete.

SECTION 03300

CAST-IN-PLACE CONCRETE

1.0 GENERAL

1.01 WORK INCLUDED

1.01.1 WORK INCLUDED in this Section consists of cast-in-place concrete pavements, floors, foundation walls, supported slabs, floors and slabs on fill, and thrust blocks.

1.02 RELATED WORK

1.02.1 RELATED WORK SPECIFIED ELSEWHERE

Concrete Form Work
Concrete Reinforcement

Section 03100
Section 03200

1.03 QUALITY ASSURANCE

1.03.1 CONTRACTOR shall perform work in accordance with ACI 301.

1.03.2 OBTAIN MATERIALS from same source throughout the work.

1.04 TESTS

1.04.1 TESTING and analysis of concrete will be performed in accordance with Section 1400, Quality Control.

1.04.2 SUBMIT proposed mix design to Engineer for review prior to commencement of work.

1.04.3 THREE CONCRETE TEST CYLINDERS will be taken for every 75 or less cubic yards of concrete placed each day.

1.04.4 ONE ADDITIONAL test cylinder will be taken during cold weather and cured on site under same conditions as concrete it represents.

1.04.5 ONE SLUMP TEST will be taken for each set of test cylinders taken.

1.05 REFERENCES

1.05.1 REFERENCE standards include the following:

- .1 ACI 301 - Specifications for Structural Concrete for Buildings.
- .2 ASTM C 33 - Concrete Aggregates.
- .3 ASTM C 94 - Ready-Mixed Concrete.
- .4 ASTM C 150 - Portland Cement.
- .5 ASTM C 260 - Air-Entraining Admixtures for Concrete.
- .6 ASTM C 494 - Chemical Admixtures for Concrete.

1.06 SUBMITTALS

1.06.1 SUBMIT CONCRETE MIX to the Engineer as Shop Drawings in accordance with the General Conditions and General Requirements for the following:

Source of Aggregate
Aggregate Gradation
Pounds of Aggregate Per Cubic Yard
Pounds of Water Per Pound of Cement
Slump in Inches
Percent Air Content
Type & Quantity of Admixtures Used
Compressive Strength

2.0 PRODUCTS

2.01 CONCRETE MATERIALS

2.01.1 CEMENT. ASTM C 150, normal - Type I Portland.

2.01.2 FINE AND COARSE AGGREGATES. ASTM C 33. (Use fractured limestone for coarse aggregate. Use sand/gravel for fine aggregate.)

2.01.3 WATER. Clean and not detrimental to concrete.

2.02 ADMIXTURES

2.02.1 AIR ENTRAINMENT. ASTM C 260.

2.03 ACCESSORIES

2.03.1 CURING AND SEALING COMPOUNDS shall be acrylic base compounds, and shall be one of the following types and manufacture:

Surfaseal	L & M Construction Chemicals, Inc.
Acryseal	Protex Industries, Inc.
Kure-N-Seal	Sonneborn Division of Contech, Inc.
CS-309	W. R. Meadows, Inc.
Acrylic Curing Compound	Nebraska Builders Products

2.04 CONCRETE MIX

2.04.1 MIX CONCRETE in accordance with ASTM C 94.

2.04.2 PROVIDE CONCRETE of the following characteristics:

- .1 Compressive Strength (7 days) - 2,800 pounds per square inch.
- .2 Compressive Strength (28 days) - 4,000 pounds per square inch.
- .3 Concrete Mix - FL 65 AE, defined as follows:

FL	=	Fractured Limestone Aggregate
65	=	6-1/2 Sack Cement Mix
AE	=	Air Entrained (6.0% ± 1.0% by volume)

- .4 Mix Design Proportions shall be as follows:

Cement - 611 pounds per cubic yard
Total Aggregate - 460 to 500 pounds per 100 pounds of cement
Ratio of Coarse Aggregate to Total Aggregate - $0.30 \pm .03$
Type of Aggregate:
 Fine - Sand and Gravel
 Coarse - Fractured Limestone
Air Entrainment - $6\% \pm 1$
28-Day Compressive Strength - 4,000 pounds per square inch

2.04.3 USE ACCELERATING admixtures in cold weather only when approved by the Engineer. Use of admixtures will not relax cold weather placement requirements.

2.04.4 USE SET-RETARDING admixtures during hot weather only when approved by the Engineer.

2.04.5 ADD AIR ENTRAINING AGENT to concrete mix for concrete work subject to freeze-thaw cycling.

3.0 EXECUTION

3.01 INSPECTION

3.01.1 CONTRACTOR shall verify anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, held securely, and will not cause hardship in placing concrete.

3.02 EQUIPMENT

3.02.1 ALL EQUIPMENT, TOOLS, AND MACHINERY shall be adequate for the purpose for which it is to be used and shall be maintained in a satisfactory working condition at all times. The Contractor shall be responsible for furnishing and maintaining all equipment necessary for the job conditions, including trimmers, concrete spreaders, finishing machines, foot bridges, vibrating equipment, joint cutting saws, and joint filling machines.

3.03 PREPARATION

3.03.1 PREPARE previously placed concrete by cleaning with steel brush and applying bonding agent. Apply bonding agent in accordance with manufacturer's instructions.

3.03.2 AT LOCATIONS where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels, and pack solid with nonshrink grout.

3.04 PLACING CONCRETE

3.04.1 NOTIFY Engineer a minimum of 24 hours prior to commencement of concreting operations.

3.04.2 PLACE CONCRETE in accordance with ACI 301.

3.04.3 HOT WEATHER PLACEMENT. ACI 301.

3.04.4 COLD WEATHER PLACEMENT. ACI 306.

3.04.5 ENSURE reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.

3.04.6 MAINTAIN concrete cover around reinforcing as follows (unless indicated otherwise on the Drawings):

<u>Item</u>	<u>Coverage</u>
Walls (Exposed to Weather or Backfill)	1-1/2"
Footings and Concrete (Formed Against Earth)	3"
Slabs on Fill	2"

3.04.7 PLACE CONCRETE continuously between predetermined construction and control joints.

3.04.8 SAW CUT control joints at an optimum time after finishing. Use 3/16 inch thick blade, cutting 1/3 into depth of slab thickness.

3.04.9 SEPARATE exterior slabs on fill from vertical surfaces with joint filler. Extend joint filler from bottom of slab to within 1/4 inch of finished slab surface.

3.04.10 EXCESSIVE HONEYCOMB or embedded debris in concrete is not acceptable. Notify Engineer upon discovery.

3.04.11 CONCRETE shall be placed only on a subgrade or form which has been prepared in accordance with the requirements of this Specification and approved by the Engineer. Concrete shall be deposited on the prepared subgrade in a manner which will minimize the disturbance of the steel reinforcement, and so that there shall be no separation of the mortar and the aggregate, and then shall be spread to the required depth and for the entire width of the pavement by approved methods, struck off and finished, as hereinafter provided. Rakes shall not be used in handling concrete. The concrete shall be deposited on the subgrade between the forms in position and in such quantity as to make a uniform layer about one inch greater than the required finished thickness. After being deposited, the concrete shall be consolidated for its full depth and width and along all joints, except planes of weakness, in accordance with the requirements stipulated elsewhere in these specifications. The operations of depositing, spreading, and consolidating the concrete shall be conducted so that the concrete shall be smooth and dense, free from honeycomb and free from pockets of segregated aggregate. At the end of the day, or in case of an unavoidable interruption of more than thirty minutes, a transverse keyed construction joint shall be placed, provided that such joint is located to correspond and line up with the jointing plan shown on the Drawings. Construction joints shall not be allowed which do not align with the joint pattern shown.

3.04.12 CONCRETE shall not be placed when stormy or inclement weather prevents good workmanship. Unless authorized in writing by the Engineer, mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 40 degrees Fahrenheit and shall not

begin until an ascending air temperature in the shade and away from artificial heat reaches 35 degrees Fahrenheit. In no case shall concrete be placed upon a frozen subgrade. The pavement shall be protected against freezing as directed by the Engineer. Any concrete showing injury by freezing shall be considered unacceptable. Calcium chloride will not be used in any concrete mix to be placed with reinforcement.

3.04.13 CONCRETE shall not be placed when darkness would prevent good workmanship in placing and finishing operations. Special authorization from the Engineer must be secured if it is desired to place concrete with the aid of artificial light.

3.04.14 HOT WEATHER CONCRETING requires special limits to insure quality control of the finished pavement. Hot weather concreting shall be limited in accordance with the following criteria:

- .1 Concrete shall not be placed when the ambient air temperature exceeds 100 degrees Fahrenheit. No concrete placement may start if the ambient air temperature is 90 degrees Fahrenheit or above.
- .2 If concrete placement has begun and the ambient air temperature rises to 90 degrees Fahrenheit or above during concrete placement or at any time during the day of the placement, the curing compound or other curing method shall be applied immediately after the final finishing of the concrete.
- .3 When the ambient air temperature is between 75 degrees Fahrenheit and 100 degrees Fahrenheit, the maximum allowable temperature for the concrete mixture being placed shall be 90 degrees Fahrenheit, unless otherwise authorized by the Engineer. The Contractor shall take necessary steps to control the temperature of the concrete mix by causing the concrete mix plant to chill the water and/or aggregate to insure delivery and placement of the concrete at a temperature of 90 degrees Fahrenheit or below.
- .4 In the event that humidity and wind conditions are such that the concrete surface may be damaged, the Engineer may halt or prohibit the placement of concrete at any temperature during hot weather.
- .5 Admixtures to retard initial set of the concrete shall be used only if authorized by the Engineer.

AND/OR

3.04.15 COLD WEATHER CONCRETING requires special limits to insure quality control of the finished pavement. Cold weather concreting shall be limited in accordance with the following criteria:

- .1 The Contractor shall furnish sufficient canvas and framework, or other type of housing, to enclose and protect the structure in such a way that the concrete and air surrounding it shall be maintained at a temperature between 50 degrees Fahrenheit and 100 degrees Fahrenheit for the first 72 hours after the concrete has been placed, and at a temperature between 40 degrees Fahrenheit and 100 degrees Fahrenheit for the next 48-hour period. The temperature of the air surrounding the concrete shall be gradually reduced to the outside air temperature at a rate not faster than five degrees Fahrenheit in any one hour.
- .2 The Contractor shall furnish such heating equipment as stoves or steam equipment and necessary fuel. When dry heat is used, means of maintaining atmospheric moisture shall be provided. The use of salamanders or other type of open flame heating unit is prohibited. A shield shall be provided on heating equipment involving combustion, so that no metal exposed to the surface will be in contact with the source of heat.
- .3 The Contractor shall assume all risk connected with the placing of concrete during freezing weather, and permission given by the Engineer to place concrete during such time will in no way relieve the Contractor of his responsibility for satisfactory results. Any concrete showing injury by freezing shall be considered unacceptable. It is understood that the Contractor is responsible for the quality and strength of concrete placed under any weather conditions.

3.05 FINISHING

3.05.1 PROVIDE concrete surfaces to be left exposed with sack-rubbed finish. Trowel finish all floors and roof slabs.

3.06 PATCHING

3.06.1 NOTIFY Engineer immediately upon removal of forms. Patch imperfections.

3.07 DEFECTIVE CONCRETE

3.07.1 MODIFY OR REPLACE concrete not conforming to required levels and lines, details, and elevations.

3.07.2 REPAIR OR REPLACE concrete not properly placed or not of the specified type.

3.08 FIELD QUALITY CONTROL

3.08.1 FIELD INSPECTION and testing will be performed in accordance with Section 1400, Quality Control.

3.08.2 MAINTAIN RECORDS of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.09 PROTECTION

3.09.1 IMMEDIATELY AFTER PLACEMENT, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

3.09.2 MAINTAIN CONCRETE with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.09.3 PROTECTION AND CURING of finished concrete surfaces shall consist of wet burlap, liquid membrane-forming compounds, or polyethylene film. The Contractor's method of protection and curing must be approved by the Engineer prior to start of construction.

3.10 QUALITY CONTROL

3.10.1 ALL CONCRETE shall be ready-mixed concrete and shall be mixed and delivered to the job site by truck mixers. Mixing truck drivers shall carry tickets for each load of concrete, which shall include the name of the producer, the date, the location of the plant, name of customer, class of concrete, quantity delivered, and the time the truck was charged. The ticket shall be delivered to the Engineer or Job Foreman at the time of arrival at the placement site.

3.10.2 CONCRETE shall be delivered to the job site and discharged completely within 1-1/2 hours after the introduction of mixing water to the cement and aggregates. In hot weather, the time shall be reduced to one hour. In the event these time limits are exceeded, the concrete shall be rejected.

3.10.3 DELIVERED CONCRETE shall be tested in the field for slump, temperature, and entrained air content. The slump requirements shall be two inches \pm one inch. The air content shall be 6.0 percent \pm 1.0 percent. Concrete which does not meet these requirements shall be rejected.

3.10.4 STRENGTH TEST CYLINDERS shall be taken in the field for later testing by a laboratory. Cylinders shall be made by a testing laboratory, unless otherwise approved by the Engineer. Three cylinders shall be made for each test sample. One cylinder shall be broken at seven days, and a second cylinder shall be broken at 28 days to determine compressive strengths. Samples for strength tests shall be taken for each class of concrete not less than once a day, nor less than once for each 75 cubic yards of concrete. Samples may be taken more frequently if determined to be necessary by the Engineer.

3.10.5 THE CONTRACTOR shall be responsible for all concrete samples and tests. All sampling and testing shall be performed by an approved testing laboratory. Copies of all tests shall be furnished to the Engineer in accordance with the General Requirements.

3.10.6 IF ADDITIONAL WATER IS ADDED to the concrete mix after the test cylinders have been made and after slump and air-entrainment tests have been run, the cylinders shall be discarded, along with slump and air data. New test cylinders shall be made and new slump and air-entrainment data generated for the adjusted concrete mix that is placed in the work.

SECTION 11800

GRINDER PUMP UNITS – CENTRIFUGAL TYPE

1.0 GENERAL

1.01 DESCRIPTIONS

1.01.1 GRINDER PUMP UNITS shall be required where sanitary sewer service to homes and businesses is not possible by gravity flow methods, or where gravity sewer collection systems are not readily accessible. Grinder pump units may be required to replace on-site treatment systems, or to provide service to structures which are at elevations below available sewer collection mains. Grinder Pump Units may also be required as part of a low-pressure/grinder pump collection system which is constructed in areas where conventional gravity collection systems are not feasible.

1.01.2 GRINDER PUMP UNITS shall be one of the two approved types authorized for use within the Glenwood Municipal Utilities service area. The two types approved are 1) centrifugal type as manufactured by Myers, and 2) progressive cavity type manufactured by E-One. The specifications and requirements for the Myers centrifugal pumping unit are contained in this Section. Refer to Section 11850 for the specifications and requirements for the E-One progressive cavity pumping unit.

1.01.3 THE INSTALLATION of Grinder Pump units shall be complete, and shall consist of the furnishing of all labor, materials, equipment, and services required to install grinder pump units where required or which may be shown on the construction drawings.

1.01.4 GRINDER PUMP UNITS shall consist of the centrifugal pump, submersible motor, grinder assembly, fiberglass basin, lift-out assembly, check valves, shutoff valves, piping, fittings, level controls, control panel with electrical equipment, alarms, wiring, connection to the building power supply, and all other incidental and miscellaneous appurtenances required to provide a complete and workable system.

1.01.5 REFER to the Glenwood Municipal Utilities standard details for other specific requirements.

1.01.6 RELATED WORK SPECIFIED ELSEWHERE

Site Preparation	Section 2100
Trench Excavation and Backfill	Section 2250
Sanitary Sewers	Section 2700
Surface Restoration	Section 2900
Cast-In-Place Concrete	Section 3300
Electrical	Division 16

1.01.7 ACCEPTABLE MANUFACTURER of the grinder pump units shall be Myers Series WGL20. No other manufacturers are approved. The Myers grinder pump units are represented by Hutcheson Engineering Products Inc., 6405 John J. Pershing Drive, Omaha, NE 68112 (telephone 402-455-2000). Because the pumping conditions of an individual's home or business may vary, home and business owners (or their plumber) wishing to connect to GMU's gravity mains or low pressure force mains, are instructed to contact GMU or Hutcheson Engineering Products for guidance on the size and scope of grinder system required for each particular property. Hutcheson will provide, at no charge, design and installation guidelines for each property based on the estimated sewer usage and specific pumping requirements.

1.01.8 GRINDER PUMP UNITS shall be purchased through the GMU. Contact the GMU to confirm pumping requirements and size of unit needed for the specific home or business application. In addition, all connection saddles, corporation stops, service fittings, curb stop and curb box shall be purchased through the GMU.

1.01.9 IF MORE THAN ONE (1) GRINDER PUMP UNIT is required for a project, GMU will approve the Contractor or Plumber purchasing multiple units directly from Hutcheson Engineering Products.

1.01.10 APPLICATION FOR SEWER SERVICE shall be made with the GMU before any work is performed. Applicant shall also pay all required connection and sewer impact fees before service will be approved.

1.02 RESPONSIBILITY OF OWNERSHIP AND MAINTENANCE

1.02.1 THE OWNER OF A HOME, BUSINESS, OR OTHER ESTABLISHMENT shall be solely responsible for the purchase (through GMU), installation, operation, and all future maintenance (including replacement) of each grinder pump system, and the individual service line, consisting of curb stops, and pressure line. The GMU shall assume no responsibility for any of the Owner responsibilities of installation, operation, maintenance, or future replacement.

1.02.2 ELECTRICAL POWER to operate each grinder pump system shall be the responsibility of the Owner of the home, business, or establishment, including connection to the service panel, proper sizing of breakers, wiring and conduit, and payment of monthly power bills.

1.02.3 THE OWNER of the home, business or establishment using a grinder pump system shall be responsible for repairing any component of the system, including replacement of equipment, required to keep the system operational.

2.0 PRODUCTS

2.01 GRINDER PUMP UNITS

2.01.1 THE MYERS GRINDER SYSTEMS shall consist of the following major components:

- .1 WGL20 centrifugal pump with built-together submersible motor. Capacity shall range up to 40 gpm, and discharge heads shall range up to 106 feet.
- .2 Motor shall be rated at 2.0 Hp @ 3,450 rpm, single phase, 230 volt, 60 Hz operation.
- .3 Bronze pump impeller.
- .4 Air- activated floatless level control system.
- .5 30-inch diameter by 8'-0" deep fiberglass reinforced polyester resin basin, with epoxy coated steel cover.
- .6 Standard lift-out assembly for removal of the pump, controls, valves, etc.
- .7 Check valve and shut-off valve.
- .8 1 1/2 -inch discharge piping.
- .9 Remote audible alarm (to be located inside the house or business).
- .10 Basin inlet flange of 4 1/2" OD for connection to the gravity influent service line from the house or business.
- .11 Electrical control box (NEMA 3R enclosure)
- .12 All other equipment and accessories.

3.0 EXECUTION

3.01 INSTALLATION

3.01.1 INSTALL GRINDER PUMP UNITS in accordance with the manufacturer's recommendations. Consult with Hutcheson Engineering Products for specific questions regarding unique design and operating conditions.

3.01.2 THE LOCATIONS for all grinder pump units shall be reviewed by GMU. For units replacing septic tanks, the units shall be installed between the house or business and existing septic tank. Each unit shall be installed, tested, and accepted prior to cutting off

sewage flow to the septic tanks and placing the unit on line. The units shall be connected to the main sewer service line leaving the house or business. Abandonment of the septic tank and drain field shall be in accordance with Mills County standards.

3.01.3 VERIFY THE DEPTHS of the sewer service lines to insure that the standard 8'-0" deep unit is compatible.

3.01.4 PROTECT PRIVATE PROPERTY during installation of the grinder pump units. Exercise extreme care to avoid any unnecessary removal or destruction of property, including lawns, gardens, flowers, shrubs, trees, sidewalks, driveways, structures, or other buildings.

3.01.5 INSTALL ELECTRICAL CONTROL BOXES, panels and alarms on the outside of the house or building wall as indicated on the Drawings. All locations for the proposed control box installation shall be approved by the property owner prior to performing the work. If necessary, install the control box on a service pole near the power source and/or as near to the grinder pump unit as possible.

3.01.6 PERFORM ALL ELECTRICAL WORK in accordance with applicable codes and standards.

3.01.7 POUR CONCRETE completely around the basin hold-down flange to prevent flotation due to the high water table. The amount of concrete required may vary from basin to basin depending upon the ground water level at each location. However, a minimum of 1/4 cubic yard of cast-in-place concrete shall be placed around each basin.

SECTION 11850

GRINDER PUMP UNITS – PROGRESSIVE CAVITY TYPE

1.0 GENERAL

1.01 DESCRIPTIONS

1.01.1 GRINDER PUMP UNITS shall be required where sanitary sewer service to homes and businesses is not possible by gravity flow methods, or where gravity sewer collection systems are not readily accessible. Grinder pump units may be required to replace on-site treatment systems, or to provide service to structures which are at elevations below available sewer collection mains. Grinder Pump Units may also be required as part of a low-pressure/grinder pump collection system which is constructed in areas where conventional gravity collection systems are not feasible.

1.01.2 GRINDER PUMP UNITS shall be one of the two approved types authorized for use within the Glenwood Municipal Utilities service area. The two types approved are 1) centrifugal type as manufactured by Myers, and 2) progressive cavity type manufactured by E-One. The specifications and requirements for the E-One progressive cavity pumping unit are contained in this Section. Refer to Section 11800 for the specifications and requirements for the Myers centrifugal pumping unit.

1.01.3 THE INSTALLATION of Grinder Pump units shall be complete, and shall consist of the furnishing of all labor, materials, equipment, and services required to install grinder pump units where required or which may be shown on the construction drawings.

1.01.4 GRINDER PUMP UNITS shall consist of the progressive cavity pump, submersible motor, grinder assembly, fiberglass basin, lift-out assembly, check valves, shutoff valves, piping, fittings, level controls, control panel with electrical equipment, alarms, wiring, connection to the building power supply, and all other incidental and miscellaneous appurtenances required to provide a complete and workable system.

1.01.5 REFER to the Glenwood Municipal Utilities standard details for other specific requirements.

1.01.6 RELATED WORK SPECIFIED ELSEWHERE

Site Preparation	Section 2100
Trench Excavation and Backfill	Section 2250
Sanitary Sewers	Section 2700
Surface Restoration	Section 2900
Cast-In-Place Concrete	Section 3300
Electrical	Division 16

1.01.7 ACCEPTABLE MANUFACTURER of the progressive cavity pumping units shall be Environment One Corporation (E-One), represented by Electric Pump Company of Des Moines, Iowa (telephone 515-265-2222). Because the pumping conditions of an individual home or business may vary, home or business owners (or their plumber) wishing to connect to GMU's gravity mains or low pressure force mains, are instructed to contact GMU or Electric Pump for guidance on the size and scope of the grinder system required for each particular property.

1.01.8 GRINDER PUMP UNITS shall be purchased through the GMU. Contact the GMU to confirm pumping requirements and size of unit needed for the specific home or business application. In addition, all connection saddles, corporation stops, service fittings, curb stop and curb box shall be purchased through the GMU.

1.01.9 IF MORE THAN ONE (1) GRINDER PUMP UNIT is required for a project, GMU will approve the Contractor or Plumber purchasing multiple units directly from Electric Pump Company.

1.01.10 APPLICATION FOR SEWER SERVICE shall be made with the GMU before any work is performed. Applicant shall also pay all required connection and sewer impact fees before service will be approved.

1.02 RESPONSIBILITY OF OWNERSHIP AND MAINTENANCE

1.02.1 THE OWNER OF A HOME, BUSINESS, OR OTHER ESTABLISHMENT shall be solely responsible for the purchase (through GMU), installation, operation, and all future maintenance (including replacement) of each grinder pump system, and the individual service line, consisting of curb stops, and pressure line. The GMU shall assume no responsibility for any of the Owner responsibilities of installation, operation, maintenance, or future replacement.

1.02.2 ELECTRICAL POWER to operate each grinder pump system shall be the responsibility of the Owner of the home, business, or establishment, including connection to the service panel, proper sizing of breakers, wiring and conduit, and payment of monthly power bills.

1.02.3 THE OWNER of the home, business or establishment using a grinder pump system shall be responsible for repairing any component of the system, including replacement of equipment, required to keep the system operational.

2.0 PRODUCTS

2.01 GRINDER PUMP UNITS

2.01.1 THE E-ONE GRINDER PUMP SYSTEM shall consist of a Model WH101 or DH071 for single dwelling units. (Larger models or duplex models may be needed for other applications).

2.01.2 Type: Completely submersible, vertical, progressing cavity.

2.01.3 Pump: The pump shall be a vertical rotor, motor driven, solids handling pump of the progressing cavity type. The rotor shall be through-hardened, highly polished, stainless steel. The rotor shall be of a specifically compounded ethylene propylene synthetic elastomer. The material shall be suitable for domestic wastewater service.

2.01.4 Grinder: The grinder shall be placed immediately below the pumping elements and shall be direct-driven by a single, one-piece motor shaft. The grinder impeller assembly shall be securely fastened to the pump motor shaft by means of a threaded connection attaching the grinder impeller to the motor shaft. Attachment by means of pins or keys will not be acceptable. The grinder will be of rotating type with a stationary hardened and ground stainless steel shredding ring spaced in close annular alignment with the driven impeller assembly, which shall carry two hardened type 400 series stainless steel cutter bars.

2.01.5 This assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed so as to eliminate clogging and jamming under all normal operating conditions including starting. Sufficient vortex action shall be created to scour the tank free of deposits or sludge banks which would impair the operation of the pump. These requirements shall be accomplished by the following, in conjunction with the pump:

1. The grinder shall be positioned in such a way that solids are fed in an upward flow direction.
2. The maximum flow rate through the cutting mechanism must not exceed 4 feet per second. This is a critical design element to prevent jamming and as such must be adhered to.
3. The inlet shroud shall have a diameter of no less than 5 inches. Inlet shrouds that are less than 5 inches in diameter will not be accepted due to their inability to maintain the specified 4 feet per second maximum inlet velocity which by design prevents unnecessary jamming of the cutter mechanism and eliminates blinding of the pump by large objects blocking the inlet shroud.
4. The impeller mechanism must rotate at a nominal speed of no greater than 1800 rpm.

2.01.6 The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of "foreign objects," such as paper, wood, plastic,

glass, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the 1-1/4" diameter stainless steel discharge piping.

2.01.7 Electric Motor: 1 HP, 1725 RPM, 240 Volt, 60 Hz, Single Phase. Capacitor start, ball bearing, air-cooled induction type with a low starting current not to exceed 30 amperes and high starting torque of 8.4 foot pounds. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector incorporated into the motor.

2.01.8 Mechanical Seal: The pump/core shall be provided with a mechanical shaft seal to prevent leakage between the motor and pump. The seal shall have a stationary ceramic seat and carbon rotating surface with faces precision lapped and held in position by a stainless steel spring.

2.01.9 Tank and Accessway: Tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth. All station components must function normally when exposed to 150 percent of the maximum external soil and hydrostatic pressure.

1. The tank shall be furnished with one EPDM grommet fitting to accept a 4.5"OD DWV or Schedule 40 pipe.
2. Tank Capacities: 70 gallons for homes without hot tubs, 150 gallons for homes with hot tubs. Tank diameter shall be 24 inches.
3. Accessway shall include a lockable cover assembly providing low profile mounting and watertight capability. Accessway design and construction shall enable field adjustment of station height.
4. The station shall have all necessary penetrations molded in and factory sealed. To ensure a leak free installation no field penetrations shall be acceptable.
5. All discharge piping shall be constructed of 304 Series Steel and terminate outside the accessway bulkhead with a stainless steel, 1 1/4th inch female NPT fitting. The discharge piping shall include a stainless steel ball valve rated for 200 psi WOG; PVC ball valves will not be accepted. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.
6. The accessway shall include a single NEMA 6P electrical quick disconnect (EQD) for all power and control functions, factory installed with accessway penetrations warranted by the manufacturer to be watertight. Plug-type connections of the power cable onto the pump housing will not be acceptable due to the potential for leaks and electrical shorts. The accessway shall also include a 2-inch PVC vent to prevent sewage gases from accumulating in the tank.

2.01.10 Check Valve: The pump discharge shall be equipped with a factory installed, gravity operated, flapper-type integral check valve built into the stainless steel discharge piping. The check valve will provide a full-ported passageway when open, and shall introduce a friction loss of less than 6 inches of water at a maximum rated flow. Moving parts will be made of a 300 series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic

hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low back-pressure. The valve body shall be an injection molded part made of glass filled PVC.

2.01.11 Anti-Siphon Valve: The pump discharge shall be equipped with a factory-installed, gravity-operated, flapper-type integral anti-siphon valve built into the stainless steel discharge piping. Moving parts will be made of 300 series stainless steel and fabric-reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly, providing a maximum degree of freedom to ensure proper operation even at a very low pressure. The valve body shall be injection-molded from a glass-filled thermoplastic resin. Holes or ports in the discharge piping are not acceptable anti-siphon devices, due to their tendency to clog from the solids in the slurry being pumped.

2.01.12 Controls: All necessary controls, including motor level controls, shall be located in the top housing of the core unit. The top housing will be attached with stainless steel fasteners.

1. Non-fouling wastewater level controls for controlling pump operation shall be accomplished by monitoring the pressure changes in an integral air column connected to a pressure switch. The level detection device shall have no moving parts in direct contact with the wastewater. High-level sensing will be accomplished in the manner detailed above by a separate air-bell sensor and pressure switch of the same type. Closure of the high-level sensing device will energize an alarm circuit as well as a redundant pump-on circuit. For increased reliability, pump ON/OFF and High-level alarm functions shall not be controlled by the same switch. Float switches of any kind, including float trees, will not be accepted due to the periodic need to maintain (rinsing, cleaning) such devices.
2. To assure reliable operation of the pressure switches, each core shall be equipped with a breather assembly, complete with a suitable means to prevent accidental entry of water into the motor compartment. The grinder pump will be furnished with a 6 conductor 14 gauge, type SJOW cable, pre-wired and watertight to meet UL requirements with a factory installed NEMA 6P EQD half attached to it.

2.01.13 Alarm Panel: Each grinder pump station shall include a NEMA 3R, UL-listed Alarm Panel suitable for wall or pole mounting.

1. The alarm Panel shall include the following features: external audible and visual alarm; push-to-run switch; and redundant pump start with high level alarm capability.

2.01.14 Serviceability: The grinder pump core unit shall have two lifting hooks complete with nylon lift-out harness connected to its top housing to facilitate easy core removal when necessary. All mechanical and electrical connections must provide easy disconnect capability for core unit removal and installation. A push-to-run feature will be provided for field trouble shooting. All motor control components shall be mounted on a readily replaceable bracket for ease of field service.

2.01.15 Performance:

1. Flow: 15 gal/min. at 0 psi
2. Flow: 11 gal/min. at 40 psi
3. Flow: 7.8 gal/min. at 80 psi

3.0 EXECUTION

3.01 INSTALLATION

3.01.1 Install in accordance with manufacturer's instructions and as specified.

3.01.2 Coordinate with plumbing piping and related electrical work to achieve operating system.

3.01.3 Install line sized check valve and ball valve in discharge piping as shown on the drawings. Flanges or unions shall be used when installing valves for ease of maintenance.

3.01.4 Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in operation.

3.01.5 Factory trained representative to certify installation of sump pumps and provide operator training as required.

3.01.6 THE LOCATIONS for all grinder pump units shall be reviewed by GMU. For units replacing septic tanks, the units shall be installed between the house or business and existing septic tank. Each unit shall be installed, tested, and accepted prior to cutting off sewage flow to the septic tanks and placing the unit on line. The units shall be connected to the main sewer service line leaving the house or business. Abandonment of the septic tank and drain field shall be in accordance with Mills County standards.

3.01.7 VERIFY THE DEPTHS of the sewer service lines to insure that a standard unit is compatible. If necessary, provide deeper units or provide extensions.

3.01.8 PROTECT PRIVATE PROPERTY during installation of the grinder pump units. Exercise extreme care to avoid any unnecessary removal or destruction of property, including lawns, gardens, flowers, shrubs, trees, sidewalks, driveways, structures, or other buildings.

3.01.9 INSTALL ELECTRICAL CONTROL BOXES, panels and alarms on the outside of the house or building wall as indicated on the Drawings. All locations for the proposed control box installation shall be approved by the property owner prior to performing the work. If necessary, install the control box on a service pole near the power source and/or as near to the grinder pump unit as possible.

3.01.10 PERFORM ALL ELECTRICAL WORK in accordance with applicable codes and standards.

3.01.11 POUR CONCRETE completely around the basin hold-down flange to prevent flotation due to the high water table. The amount of concrete required may vary from basin to basin depending upon the ground water level at each location. However, a minimum of 1/4 cubic yard of cast-in-place concrete shall be placed around each basin.