

WM - SPECIFICATIONS FOR WATER MAIN CONSTRUCTION

WM-1 SCOPE OF WORK

The Contractor shall furnish all the necessary labor, materials, equipment, tools and supplies that are necessary to install a complete water system, as shown on the plans and/or called for in these specifications or its addenda. It is the intent of these specifications to install a complete system or job; and the Contractor shall furnish everything necessary to do this, whether or not it may be specifically called for in these specifications or on the plans.

WM-2 TERM OF GUARANTEE

For utility construction activities, the guarantee shall cover the Contract as to workmanship and materials for a period of Two (2) years from the date of final acceptance for all projects, including private projects, or Substantial Completion for City bid projects. The Contractor shall maintain all trenches and backfill any settlement and provide and place any necessary base and/or surfacing (new or old) needed due to trench settlement for the maintenance/correction period which shall run for two (2) years after the completion and acceptance of the system.

For surface construction activity, the guarantee shall cover the Contract as to workmanship and materials for a period of One (1) year from the date of final acceptance for all projects, including private projects, or Substantial Completion for City bid projects. The Contractor shall maintain any deficiencies in workmanship and materials for the maintenance/correction period which shall run for One (1) year after the completion and acceptance of the system.

The Contractor shall repair and/or replace all defective workmanship and materials, and correct all deficiencies noted in the system(s) in a method approved by the Engineer. All such efforts to correct any defective Work, including but not limited to removal and replacement of surface construction activity Work necessary due to rectification of defective utility construction activity Work, shall be accomplished at no cost to the City.

Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this section, the correction period hereunder with respect to such Work will be extended for an additional period of one (1) year after such correction or removal and replacement has been satisfactorily completed.

The guarantee described above shall apply for all other related or referenced specification sections affected by Work..

WM-3 MATERIALS

All pipe shall be PVC materials designed to sustain a working pressure of 150 psi with a cover of six (6) feet. The PVC Pipe shall meet AWWA C-900 current standards. PVC Pipe shall be Class 150 with a DR 18 per AWWA standards.

Restrained joint PVC water pipe where specified shall meet the performance requirements of AWWA C-900 and shall be furnished in cast iron pipe equivalent outside diameters with an approved restrained rubber gasketed joint as manufactured by Certaineed Certa-Lok VIP or equivalent.

Fittings shall meet AWWA C110, AWWA C153, or AWWA C111 current standards. Fittings shall be provided with self-restraint connections and blocking. All bolts shall be cor blue bolts or approved equal. All ductile iron fittings shall be wrapped with polyethylene tube material to protect the pipe from any future corrosion. The poly material shall be installed as detailed in the ductile iron handbook from DIPRA and ANSI A21.5 (AWWA C105).

Non-standard pipe sizes are commonly encountered when tying onto existing pipe. Alternative fittings are allowed, at the discretion of the Contractor, at these locations and at any other locations for any reasons, including but not limited to, limiting or eliminating possible delays, having improper materials on-hand, or others, caused by encountering non-standard pipe sizes. These fittings shall be a self-restrained type and shall be the Alpha manufactured by Romac Industries, Inc. or an approved equivalent, installed according to manufacturer's installation instructions. No additional costs, including but not limited to those for, labor (for installation, shutoff notice, or other), substitute or replacement materials, restocking fees, transportation, standby time, or any other, shall be paid to the Contractor for any reasons related to non-standard pipe sizes.

The material for water main bedding shall be minus 1 inch with not more than 10 percent passing the No. 200 sieve. Water main bedding material shall be installed for both PVC and ductile iron water main.

Where groundwater in the bedding material is present and raising the moisture content of the first lift of backfill material or otherwise negatively impacting compaction, as determined by the Engineer, the Contractor shall utilize pea rock for bedding to be installed as Select Granular Backfill.

The material for trench stabilization shall consist of 3/4- to 4-inch crushed angular, well-graded material. Larger material may be used if necessary to stabilize the bottom of the trench. The trench stabilization material will be used as directed by the Engineer. The use of trench stabilization material will not eliminate the need for water main bedding material.

All underground fittings on service lines and main lines shall be wrapped in polywrap. Polyethylene encasement shall be Group 2, 8-mil nominal thickness, linear low density, flat tube polyethylene film, which meets the most current requirements of AWWA C105-10, ANSI A21.5-10, ASTM D4976 and NT 4112-10.

WM-4 GATE VALVES

Gate valves shall be manufactured by Waterous, by AVK, by American Flow Control or by an approved equal and shall be of the resilient wedge design and conform with the current AWWA C515 standards. Valves shall be designed for a working pressure of 175 psi minimum.

The valves shall open counterclockwise and have a non-rising stem & two-inch (2") o-rings to provide seating. All internal ferrous surfaces shall be coated with an epoxy coating. The exterior of the valve shall be coated with a corrosion resistant coating.

WM-5 VALVE BOXES

Valve boxes shall be of an approved design and manufacture and be heavyweight 35,000-pound tensile strength. Each valve box shall have a rubber or approved equal valve box adjuster/adaptor that mounts to the valve.

Valve boxes shall be cast iron, have screw-type adjustment, be two or three piece type, 5-1/4" shaft, standard drop covers marked "WATER" with a 1- 1/2 inch long skirt, and be adjustable for a six foot (6') to eight foot (8') trench. Valve boxes shall be component number 666-S manufactured by Tyler or an approved equal.

WM-6 FIRE HYDRANTS

Fire hydrants shall be 6" MJ Waterous Pacer WB-67 with traffic flanges or an approved equal that conform to AWWA specifications and be designed for 150 psi working pressure. There shall be required 7.0 feet of cover on the hydrant leg and the bottom of the traffic flange shall be 2 to 4 inches above ground level. The Contractor shall take necessary measures at all hydrant installation locations to confirm proper traffic flange elevations and where circumstances do not allow for traffic flange to be installed 2 to 4 inches above ground level, the Contractor shall immediately advise the Engineer and take necessary measures at no cost to the City, such as installing a hydrant with a shorter or longer hydrant leg or installing a hydrant extension, to install at aforementioned orientation to ground level. The fire hydrant shall be painted red; have valve opening shall be at least 5-inch diameter; shall be equipped with a break off traffic flange; and have two (2) – 2-1/2" nozzles NST and one – 4-1/2" pumper nozzle NST.

Fire hydrants shall be set truly vertical upon a flat rock on slab of concrete, 4 to 6 inches in thickness and 16 to 18 inches square. Base of hydrant below and above "weep holes" shall be surrounded with approximately 10 cubic feet of washed stone which is free from cementing material. Ground like grade should be set in all cases at such a location and such a grade that a spanner wrench will rotate freely counterclockwise to open on all hose connections to the hydrant. Care shall be taken to clean thoroughly valves and hydrants of sticks, stones, dirt, or trash of any kind prior to setting.

Fire hydrants will be measured by units of one, in place and location and in accordance with details shown on the plans and in accordance with the specifications. The price bid for each fire hydrant shall be full compensation for the fire hydrants, concrete or stone base, all labor, materials, equipment, excavations, and backfill necessary to set the hydrants in place and ready for use.

WM-7 CASING PIPE SPACERS AND END SEALS

Casing spacers shall be Model SSI-8 for carrier pipes 24 inches in diameter and smaller and Model SSI-12-2 for carrier pipes 30 inches in diameter and greater as manufactured by Advance Products & Systems, Inc., Lafayette, Louisiana, or an approved equal. Casing spacers shall be constructed of circular T-304 stainless steel segments, which bolt together forming a shell around the carrier pipe. The spacers shall be designed with risers (when needed) and runners to support and center the carrier pipe within the casing pipe and maintain a minimum clearance of 1 inch between the casing pipe inside diameter (ID) and the spacer outside diameter (OD). On carrier pipes with an OD of 16 inches or less, each spacer shall have four riser/runner combinations—two on each half. On carrier pipes with an OD of 20 inches and greater, the number of riser/runner combinations shall be as recommend by the manufacturer, with four being the minimum. T-304 stainless steel bolts and nuts shall be supplied with the spacers.

The band shall be manufactured of 8-inch (SSI-8) or 12-inch (SSI-12-2) wide, 14 gauge T-304 stainless steel. The risers shall be constructed of T-304 stainless steel having a minimum length of 6 inches (SSI-8) or 10 inches (SSI-12-2). Abrasion-resistant runners, having a minimum length of 7 inches (SSI-8) or 11 inches (SSI-12-2), and a minimum width of 2 inches, shall be attached to each riser to minimize friction between the casing pipe and the carrier pipe as it is installed. Runner material shall be of glass reinforced plastic with the following minimum properties: compression strength of 25,000 psi, flexural strength of 32,000 psi, and tensile strength of 22,000 psi. The ends of all runners shall be beveled to facilitate installation over rough weld beads or the welded ends of misaligned or deformed casing pipe.

Interior surfaces of the stainless steel shell shall be lined with EPDM having a minimum thickness of 0.090 inches with a hardness of durometer “A” 85-90. Placement of the spacers shall be a maximum of one foot on each side of the bell joint and one every 6–8 feet thereafter. End seals shall be Model AW Wraparound casing end seals as manufactured by Advance Products & Systems, Inc., Lafayette, Louisiana, or an approved equal. Full conical-shaped wraparound seals made of 1/8-inch-thick neoprene rubber shall be provided for each end of the casing pipe. T-304 stainless steel banding straps with a 100 percent nonmagnetic worm gear mechanism and pressure sensitive butyl mastic strips shall be provided to seal edges.

WM-8 WATER SERVICE MATERIAL

WM-8.1 Service Tube

All copper service tube shall conform to U.S. Government Type K soft copper tubing and AWWA Standard C800 and ASTM B62 for Type K soft copper (no lead). Copper service tube shall be connected to the main by a corporation-type stop and double strap brass saddle with a service stop below frost line. Joints for underground work shall be made with fittings meeting approved standards. Tube ends shall be square cut and expanded with a flaring tool.

All polyethylene service pipe 2 inches in diameter and smaller shall be Cross-Linked High Density Polyethylene (HDPE) Pressure Pipe that conforms to AWWA Standard C 904-06, AWWA C901 250 PSI, PE 4710, SIDR 7 Iron Pipe Size (IPS) for pipe and fittings. PE service tube shall be connected to the main by a corporation-type stop and double strap brass saddle with

a service stop below frost line. Joints for underground work shall be made with compression type fittings meeting approved standards.

WM-8.2 Corporation Stops

Corporation stops shall conform to AWWA Standard C 800-05. Corporation stops shall be as manufactured by Mueller, Ford, or AY McDonald.

WN-8.3 Curb Stops & Boxes

Curb stops shall be of the ball valve design with packed end joints and be of the Minneapolis pattern. Curb stops shall be as manufactured by A Y McDonald #76100, or Ford B66-444M. Curb boxes shall be as manufactured by A Y McDonald #5614 or #5615 or Ford Meter Box EM Series of the extension type, specifically designed for the Minneapolis pattern curb boxes and of suitable length for the required depth.

WM-9 WATER TRACER WIRE

WM-9.1 Installation Requirements

Tracer wire shall be installed with PVC and ductile iron water mains and service lines. The wire shall be installed along the lower quadrant of the pipe, but the pipe shall not be laid directly on the wire. Ground rods shall be installed adjacent to connections to the existing piping and in the locations specified on the plans. The tracer wire shall be brought to each fire hydrant and connected to a 60-inch ground rod that extends up to the bottom of the breakaway flange. The tracer wire shall be brought to each curb stop and connected to a terminal box installed adjacent to the curb stop. Should work include installation of service lines to any structure, the Contractor shall also install the tracer wire from the curb stop to the structure. The ground rod shall be taped to the fire hydrant barrel in at least four locations below the ground surface. The tracer wire shall be spliced only if approved by the Engineer. All underground splices shall be inspected by the Engineer prior to backfilling. The tracer wire system is considered to be part of the price bid for water mains.

The Contractor shall be responsible for testing the tracer wire system for conductivity. Testing for conductivity shall be complete after the service lines have been tapped. If the tracer wire system does not function as intended, the Contractor shall repair the system to the satisfaction of the Engineer. Fire hydrants and the tracer wire system shall be installed in conformance with Standard Details.

WM-9.2 Tracer Wire

The components of the tracer wire system shall be suitable for direct bury applications. The conductor shall be 12 AWG, solid-strand, soft-drawn copper per ASTM B3. The conductor shall be insulated with high molecular weight polyethylene. The minimum insulation thickness shall be 0.045 inches and the color shall be blue. Acceptable manufacturers of the tracer wire are Coleman Cable, Kris-Tech Wire, or an approved equal.

WN-9.3 Ground Rods

Ground rods shall be a 3/8-inch diameter, 60-inch-long steel rod uniformly coated with metallically bonded electrolytic copper. Ground rod clamps shall be a high-strength, corrosion-resistant copper alloy.

WN-9.4 Splice Kits/Connectors

Splices and/or connectors shall be capable of handling from two to four wires per connection and be designated as “water proof.” Splice kits/connectors shall be Scotchlok DBY by 3M, LV 9000 by SNAPLOC, or an approved equal.

WN-9.5 Terminal Boxes

The tracer wire boxes shall be placed at no more than 1,000 feet apart (along the line of the line of the Tracer Wire) or as specified on the drawings. Terminal Boxes shall be metal and be Light-Duty Snakepit tracing wire access box, Tracer Wire Access Box by Drainage & Water Solutions, Inc., or an approved equal at when not installed in concrete driveways. Terminal Boxes shall be metal and be Concrete/Driveway Snakepit tracing wire access box, Tracer Wire Access Box by Drainage & Water Solutions, Inc., or an approved equal at when installed in concrete driveways.

WM-10 INTERRUPTION OF SERVICE

No valve or other control on the existing system shall be operated for any purpose by the Contractor. The Contractor shall notify all consumers affected by an interruption of water service and contact the City Water Department for any valve operation.

Except for individual residential house(s) and notwithstanding any other specifications or plan notes, the Contractor shall provide adequate temporary water service, as determined solely by the Engineer, without interruption to each customer being served by any water lines being shut down for any reason, including but not limited to, adjacent inoperable valves, related to the project.

The Contractor shall provide a temporary water service plan to the Engineer for review and approval at least 7 days prior to water shutdown or utilization of said temporary water service.

Individual residential house(s) interruptions shall be dealt with according to other specified standards and each failure by Contractor to comply with said standards will allow the Engineer to require the Contractor to provide adequate temporary water service to individual residential house(s) at no cost to the City and/or may be subject to liquidated damages.

All costs for providing adequate temporary water service shall be borne by the Contractor and shall incidental to various contract items unless otherwise specified.

WM-11 UNDERGROUND INTERFERENCE

The location of underground public or private utilities may or may not be shown on the plans, as reported by the various utility companies and the City, but this does not relieve the Contractor of the responsibility of determining the accuracy or completeness of said locations. The Contractor shall determine the location of all underground ducts, conduits, pipes, cables or structures which will be affected by his excavation, and shall take steps necessary to support, protect, remove, or relocate said structures by any means suitable to the owners of the structure involved and the Engineer. In those instances where their relocation or reconstruction is impracticable, a deviation from line and grade may be ordered by the Engineer.

The Contractor shall be responsible for notifying the various utility companies when his work will expose, affect or endanger any existing utility. All cost of investigation and any necessary protection, support, removal, or relocation of said structures shall be included in the contract bid price for laying pipe. The Contractor SHALL NOT begin construction until all utility companies have been contacted and their respective underground utilities have been located/spotted.

WM-12 EXCAVATION

All trenches shall be excavated to provide a minimum of six (6) feet of cover for water main and water services. Except for emergency situations excavation will not be permitted between November 10 and May 1 unless specific permission is granted by the City Engineer.

Excavation shall be classed as either earth or rock excavation. Rock excavation shall consist of solid rock lying in its natural bed which requires fracturing for its removal, and boulders of one-half yard or more in volume. All other material shall be classed as earth excavation.

WM-13 EARTH EXCAVATION

All water mains shall be built in open cut, except that where conditions warrant, the Engineer may permit the use of short tunnels. In unstable soil the trench shall be supported by shoring or sheeting as required, to prevent caving. Sheeting shall be withdrawn after the pipe has been properly covered.

Whenever in the opinion of the Engineer the bottom of the trench does not afford a reliable or suitable foundation, the trench shall be excavated to such additional depth, as is required and replaced with trench stabilization material.

WM-14 PIPE INSTALLATION

Pipes and fitting shall be laid in the location as shown on the plans, the exact location being designated by the Engineer during construction. Concrete blocks shall be used under fittings to insure proper alignment.

Before laying any pipe, it shall be cleaned of all foreign matter and kept clean thereafter. Open ends shall be protected at all times to prevent the entrance of dirt, trench water, animals or foreign matter into the pipe. The bell and spigot shall be wiped clean and sufficient lubrication placed on the gasket and spigot before the pipe is pushed fully into the bell. Field cut spigot ends of push-on joints shall be beveled prior to being pushed into the bell. Every pipe shall be bedded uniformly throughout its length and care shall be taken to not have any part of the pipe bearing on rocks or stones.

Install restrained joint PVC water pipe in accordance with the pipe manufacturer's recommendations. Special care shall be exercised to level the bottom of the trench to provide a uniform bedding for the pipe. Excavate under joints to provide support for the entire pipe length. Place selected backfill in increments less than 6-inches and carefully tamp into place to the springline of the pipe. Keep stones larger than 1-1/2" away from the pipe to a minimum of 6-inches over the top of the pipe.

Install all pipe in a relatively dry bottom trench condition to assure quality installation. The Contractor shall dewater the trench with suitable equipment in an approved workmanlike manner when directed by the Engineer. The cost of dewatering shall be absorbed in the contract bid price for laying pipe.

Piping shall be installed in accordance with the latest version of AWWA C-600 Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances or AWWA C-605 Standard for Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water, as applicable depending on pipe type.

WM-15 DISINFECTION

All water mains installed shall be chlorinated as set forth by the AWWA Standard C651 or as directed by the Engineer. Sufficient chlorine tablets or chlorine powder shall be placed in each pipe to furnish a resultant solution of 50 to 100 parts per million of available chlorine. The chlorinated water shall remain in the pipe line at least 24 hours and after this time have a residual chlorine content of at least five (5) parts per million. Any additional cost for placing the chlorine tablets shall be included in the unit bid price for pipe.

The highly chlorinated water used for disinfection shall not be discharged to a lake, stream, or other waterway where danger to fish or other aquatic life may occur. Adequate disinfection shall be demonstrated through bacteriological monitoring. Two samples collected & analyzed by an approved laboratory at the expense of the Contractor for two (2) periods of time 24 hours apart shall show negative for coliform bacteria.

WM-16 TESTING

Upon completion of the pipe laying, the Contractor shall pump the pipe up to a pressure of 120 psi, turn the pump off and retain this 120 psi pressure on the gauge for a period of two (2) hours. The Engineer or Inspector shall observe the pressure gauge before acceptance of the job.

If the Contractor is unable to maintain a pressure of 120 psi for two hours, he shall then measure the leakage rate by pumping water into the line at 120 psi. The allowable rate of leakage for PVC pipe under this test shall be determined by the following formula:

$$L = \frac{ND (P)^{1/2}}{7400}$$

Where: L = Allowable Leakage, gallons per hour
 N = Number of joints in length of pipeline
 D = Nominal diameter of pipe
 P = Test Pressure, PSI Gauge

If any section of pipe will not meet the pressure test or leakage test, the Contractor shall at his own expense locate and repair the defects and retest the line until it meets the specified test. The Contractor shall furnish all pumping equipment, labor and gauges required for this pressure test and any added costs for this test shall be included in the unit price bid for pipe.

WM-17 BACKFILLING

WM-17.1 Hand Backfilling

All water pipe laid in an open trench is to be backfilled, hand tamped, and mechanically tamped to at least 12 inches above the top of the pipe. The backfill is to be placed and tamped evenly on both sides of the pipe so as not to disturb the grade or line of the pipe. The remaining backfill material can be machine placed. Material for this part of the backfilling is to be free of rock and frozen materials. Where no suitable backfill material is available, this part of the backfilling shall be done with pit run gravel that is free from large rocks. Excess material not required for backfilling shall be removed by the Contractor or otherwise disposed of as ordered by the Engineer.

WM-17.2 Backfill Material

All material obtained from the project excavations, except for in bedding areas, may be used as backfill unless otherwise shown on the Drawings or specified in these Specifications, provided that all organic material, rubbish, debris, rocks greater than six (6) inches in any dimension, and other objectionable materials are first removed. Broken portland cement concrete and bituminous type pavements obtained from the project excavations will not be permitted in the backfill.

The top three (3) inches of backfill in gravel surfaced street areas shall be compacted granular material conforming to the requirements of the South Dakota Department of Transportation, Division of Highway, Standard Specifications for Gravel Surfacing, unless otherwise shown on the Drawings or approved by the Engineer.

The top of the compacted backfill below improved surfaced street areas shall be held to the depth of the existing surface treatment, including base course, or twelve (12) inches below

finished surface grade, whichever is greater. The surfacing improvements shall be replaced in kind in accordance with the provisions herein. Base course material for use in surfacing improvements shall conform to the requirements of the South Dakota Department of Transportation, Standard Specification for Base Course.

The Contractor shall remove available top soil to surface embankments and excavation backfills of trenches and around structures on the site of the work at the locations requiring top soil. This top soil shall be stockpiled separately and placed on the embankments and backfill after all construction across, over or above such embankments and backfill has been completed. The minimum total depth of top soil shall be 6 inches or of greater depth as may be specified or indicated on the plans.

WM-17.3 Compaction of Backfill

The Contractor shall utilize an independent testing agency to inspect and test each subgrade and each fill or backfill layer as directed by the Engineer. For contract projects with city only, this shall only be required and paid for if specific bid items are included as part of contract. The Contractor shall not proceed until test results for previously completed work verify compliance with requirements.

Backfill shall be mechanically compacted by means of tamping rollers, sheepfoot roller, pneumatic tire rollers, vibrating rollers, or other mechanical tampers. All such equipment shall be of a size and type approved by the Engineer.

Permission to use specific compaction equipment shall not be construed as guaranteeing or implying that the use of such equipment will not result in damage to adjacent ground, existing improvements or improvements installed under the contract. The Contractor shall make his own determination in this regard.

Mechanically compacted backfill shall be placed in horizontal layers of thickness (not exceeding those specified below) compatible to the material being placed and the type of equipment being used. Each layer shall be evenly spread, moistened (or dried, if necessary), and then tamped or rolled until the specified relative compaction has been attained.

Compaction adjacent to all manholes, catch basins, valve boxes, curb boxes, end of services and similar structures shall be performed by the use of hand-directed mechanical tampers with lifts not exceeding that specified above.

Materials, prior to incorporation in the work, must be inspected, tested, and approved for use by the Engineer. In lieu thereof, the Engineer may permit or require the Contractor to furnish certification for certain materials. Work in which unapproved materials are used shall be performed at the Contractor's risk and are subject to inspection, test, or rejection. Copies of tests will be furnished to the Contractor's representative when requested.

Samples taken and tests made will be in accordance with the most recent standard or tentative standard methods of AASHTO, ASTM, and the "South Dakota Department of

Transportation, Materials Manual-Sampling and Testing Procedures,” which are current on the date of advertisement for bids. All references herein shall be referenced to the Material Manual test number – for example SD 105 – and all tests referenced in any particular test number shall be considered required and part of the named test for payment and all other purposes.

If a discrepancy exists, the order of precedence is as follows:

- (1) Notes included herein below
- (2) Department’s Materials Manual
- (3) AASHTO
- (4) ASTM

Backfill in and across parking lots, driveways and roadway areas to include road shoulder areas shall be placed in lifts not to exceed eight-inches (8”) in loose depth and shall uniformly compacted to a minimum of 95% maximum dry density as defined by SD 105 before successive lifts are placed. Backfill in ditches, easement areas, areas behind curb lines (boulevard areas) shall be placed in lifts not to exceed twelve-inches (12”) in loose depth and shall be uniformly compacted to a minimum of 90% maximum dry density as defined by SD 105 before successive lifts are placed.

Optimum moisture content determinations for in-place material shall be the content determined in SD 105 and all backfill material shall be compacted at a moisture content of no more than two percentage (2%) points above or less than four percentage (4%) points below the optimum moisture content. Copies of all tests shall be on forms specified in SD 105 and shall be promptly provided to the Engineer. Excess moisture shall be removed by drying operations.

Compaction and density test locations shall be randomly selected by the Engineer at an estimated rate of one test per 400 lineal feet of trench length per each two feet of fill bounded by the top of pipe and the top of the subgrade. If failing tests are experienced the Engineer reserves the right to require additional tests at the Contractor’s expense to assure that satisfactory results are obtained. If any of the compaction and density tests indicate that the material has not been compacted to the required density, the Contractor shall recompact the material at no additional cost to the Owner. The Engineer shall have the right to require additional compaction tests to insure that the recompacted material is compacted to the required density.

The independent testing agency shall perform the above referenced field in-place density and moisture tests. Field in-place density tests may also be performed by the nuclear method according to SD 114, provided the correction determination is accomplished and documented as outlined in SD 114 and prior written approval is provided by the Engineer.

A schedule of density tests shall be submitted to the Engineer for approval. This test frequency may be reduced at the discretion of the Engineer. Reduction in or increase in the number of tests shall not be cause for adjustment in unit prices for testing.

Lack of strict adherence to this section may result in withholding of payment, including but not limited to, the cost of testing but may also cause for further reduction in payment due to Contractor as determined by the Engineer.

WM-18 PROTECTION OF EXCAVATION

The Contractor shall provide suitable sheeting, shoring, and bracing to protect all excavations to provide safe working conditions, and in strict conformance with safety regulations. Damage or injury resulting from settlement, slides, cave-ins, water pressure, or other causes shall be the responsibility of the Contractor and damage shall be repaired at his own expense.

The Contractor shall provide the necessary signs, barricades, yellow lights, watchmen, and take all necessary precautions for the protection of the work and the safety of the public. All barricades and obstructions shall be protected at night by yellow signal lights which shall be kept lit from sunset to sunrise. Suitable warning and traffic signs in conformance with the construction & location requirements of the Manual Uniform Traffic Control Devices (MUTCD) shall be so placed as to properly advise the public for safety purposes.

The Contractor shall at all times so conduct his work as to insure the least possible obstruction to traffic and inconvenience to the general public and the residents in the vicinity of the work, and to insure the protection of persons and property. No road or street shall be closed to the public except with the permission of the proper authority. Any police or other traffic control shall be arranged for by the Contractor and be at his expense. Fire hydrants on or adjacent to the work shall be kept accessible to fire-fighting equipment at all times. Temporary provision shall be made by the Contractor to insure the use of sidewalks and the proper functioning of all gutters, sewer inlets, drainage ditches, which shall not be obstructed except as approved by the Engineer.

WM-19 SURFACE RESTORATION AND CLEANUP

Unless stated specifically to the contrary in the Special Information the Contractor shall (1) replace all surface materials, (2) dispose of excess material in a manner and location approved by the Engineer, (3) level gutters & repair fences, sod, topsoil, and other items disturbed to a condition equal to that before the work began; furnishing all labor, materials, and equipment necessary to do this work. Traveled streets shall be kept open and maintained by the Contractor after backfilling and before surfacing or final inspection.

WM-20 CONSTRUCTION SITE EROSION AND SEDIMENT CONTROL MEASURES

Every effort shall be made by the Contractor and Subcontractors to prevent and correct problems associated with erosion and runoff processes which could occur during and after project construction. The efforts should be consistent with and as required by South Dakota Department of Environment and Natural Resources (DENR) guidelines.

Wherever appropriate, the Contractor's efforts shall reflect the following engineering principles:

1. When appropriate, land grading and excavating should be kept at a minimum to reduce the possibility of creating runoff and erosion problems which require extensive measures.
2. Whenever possible, topsoil should be removed and stockpiled before grading begins.
3. Land exposure should be minimized in terms of area and time.
4. Exposed areas subject to erosion should be covered as quickly as possible by means of mulching or vegetation.
5. Natural vegetation should be retained whenever feasible.
6. Appropriate structural or agronomic practices to control runoff and sediment should be provided during and after construction.
7. Early completion of stabilized drainage system (temporary and permanent systems) will substantially reduce erosion potential.
8. Roadways and parking lots should be paved or otherwise stabilized as soon as feasible.
9. Clearing and grading should not be started until a firm construction schedule is known and can be effectively coordinated with the grading and clearing activity.

WM-21 USE AND REPAIR OF STREET

The Contractor shall carry on the work in such a manner as to interfere as little as possible with the use of the street for public travel.

Wherever any paved gutters, pavements, graveled highways or street crossings or other improvements are interfered with or removed, they must be replaced by the Contractor and left in as good condition as previously. The Contractor shall also remove all surplus materials leaving the streets clean and in good order.

No more than three hundred feet (300') of trench will be opened at any one time in advance of the complete construction of the water mains, and the backfilling and restoring of streets shall follow up the building of the water mains at a distance not to exceed two hundred feet (200'), and in any event not more than one intersecting street shall be obstructed at any time on any one line of water main.

All street repairs and cleaning shall be promptly done as the work progresses. The Contractor shall not obstruct any street gutters but shall provide for the passage of surface water along the same at all times.

WM-22 ASPHALT REMOVAL & REPLACEMENT

Where streets are asphalt surfaced, the Contractor shall cut the asphalt surfacing full depth by an approved method to a width of twelve inches (12") wider than the trench excavation, unless otherwise specified.

When asphalt surfacing has a concrete base, the asphalt shall be cut in the previously described manner and the concrete base removed with a pneumatic or mechanical type hammer or by similar means.

Unless otherwise specified, the Contractor shall place a six-inch (6") gravel base under the concrete base; replace the concrete base with a minimum of six inches (6") of 5-bag concrete and then place a minimum of two inches (2") of asphalt surfacing meeting City Specifications on top of the concrete base, or as otherwise specified in the Special Information.

Unless otherwise specified, on all excavations in asphalt surfaces without concrete base, there shall be a minimum of twelve-inch (12") gravel base and a minimum of four-inch (4") asphalt mat. The new mat shall be the same thickness or greater than the depth of existing asphalt.

All asphalt surfacing shall be replaced and rolled in accordance with standard City of Madison Bituminous Paving Specifications.

The cost of cutting, removing, and replacing asphalt surfaces and concrete and gravel base shall be included in the unit price bid for pipe, unless otherwise specified in the Special Conditions.

All street surfacing cuts, asphalt or concrete, shall be in a straight line parallel to the existing curb and gutter or perpendicular to the centerline of the street. No jagged, skewed or irregular cuts will be allowed. All asphalt cuts shall be in approved manner, and not ripped-out with the bucket. Such work lifts the remaining mat away from the base material and shall be cause for widening the street cut and increasing the amount of surfacing replaced at the Contractor's expense.

WM-23 CONCRETE PAVEMENT REMOVAL AND REPLACEMENT

Unless otherwise specified, the surface of all concrete pavements shall be sawed with a concrete saw to a depth of a minimum of 1-1/2" before concrete is removed. The width of pavement removed shall be twelve inches (12") wider than the trench excavation to provide a shoulder on each side, unless otherwise specified.

The Contractor shall place a six-inch (6") gravel base unless otherwise specified and replace the concrete pavement to the same thickness as the original pavement, with a minimum thickness of six inches (6"). The concrete shall be a six-bag (6) mix meeting City Specifications and shall be finished the same as the existing pavement.

The cost of pavement removal, replacement, and sawing of the concrete shall be included in the unit price bid for pipe unless otherwise provided for in the proposal or specified in the Special Conditions.

WM-24 MEASUREMENT & PAYMENT

WM-24.1 Water Main

The length of main to be paid for will be determined by measurement along the centerline of the various types and sizes of pipe furnished and installed from center of fitting to center of fitting and from center of main to center of hydrant. The per foot cost for water main shall include cost for water main bedding material unless otherwise specified. No deduction will be made for the space occupied by valves or fittings.

WM-24.2 Water Main Fittings

Payment for water main fittings shall be made at the unit bid price based on the number actually furnished & installed, for furnishing and installing all materials, equipment, and labor necessary to complete the item of work in accordance with these specifications.

WM-24.3 Water Service

Water services shall be measured by the number actually constructed. New water services shall include a curb stop and valve box along with the water service line as shown on the plans.

Payment for this item shall be at the Contract unit price for each "Water Service" as stipulated in the Bid, which price and payment shall be full compensation for all labor, tools, equipment and materials including piping, corporation stops, saddles, curb valves, valve boxes, and any other incidentals required to complete the work.

WM-24.4 Fire Hydrants

Fire hydrants will be measured by the number actually constructed in place at the locations and in accordance with the details shown on the plans and the written specifications. The bid price for each fire hydrant shall be full compensation for the fire hydrant, stone base, blocking, and other necessary incidentals as well as all labor, equipment, excavation, and backfill necessary to install the hydrant in place and ready for use. Laterals will be measured and paid for as water main.

Payment for this item shall be at the Contract unit price for "Fire Hydrant".

WM-24.5 Trench Stabilization Material

The furnishing and installing of trench stabilization material shall be measured as tons of trench stabilization material to the nearest 0.1 ton. The accepted quantities of furnished and installed trench stabilization material will be paid for at the contract unit price per ton. Payment for trench stabilization material will be full compensation for furnishing and installing the trench stabilization material, excavation, removal and disposal of unstable soils, and all appurtenances necessary for the proper installation of the material.

WM-24.6 Select Granular Backfill

The furnishing and installing of select granular backfill material shall be measured as tons of select granular backfill material to the nearest 0.1 ton. The accepted quantities of furnished and installed will be paid for at the contract unit price per ton. Payment for material will be full compensation for furnishing and all appurtenances necessary for the proper installation of the material. No separate measurement and payment shall be accomplished for this item if proposed standard backfill intended for use by Contractor is pea rock.