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NOTE: *Latest revisions of Detail Drawings will apply at time of construction. Please check with District office for revision(s) prior to beginning any construction.*

I. GENERAL REQUIREMENTS

A. DEFINITIONS

A.S.M.E. American Society of Mechanical Engineers

A.S.T.M. American Society for Testing and Materials. All references to A.S.T.M. shall mean the current standards as revised or amended.

A.W.W.A. American Water Works Association. All references to A.W.W.A. shall mean the current standards as revised or amended.

Applicant. Any person, company, corporation, or other entity, or their agent or contractor, which has made application for service by the Longs Peak Water District

Project Engineer. Professional Engineer responsible for the project design.

I.C.C. Industrial Commission of Colorado

U.S.A.S. United States of America Standards Institute. All references to U.S.A.S. Standards shall mean the current standards as revised or amended.

B. PLANS

Four (4) copies of plans and profiles for the water distribution system to be installed under these Standards and Specifications shall be furnished to the District; one (1) copy will be returned to the applicant when approved and will bear evidence of such approval by the signature of an agent of the District.

All construction plans submitted to the District for review shall be on 24" x 36" sheets with legible lettering. All sheets except the cover sheet shall be numbered and have a title block which shall have the name of the owner, the project name, the location of the proposed improvements, the name, address, and phone number of the Design Professional, the date prepared, a north arrow and a legend of all utilities shown.

Record drawings and plans shall consist of the following:

1. A master utility plan on one 24 inch by 36 inch sheet, showing the entire area to be developed including existing and proposed streets, alleys, existing and proposed utility lines with appurtenances and all existing and proposed property lines, lot numbers, easements and rights-of-way.
2. On a second set of drawings the location, class, type of pipe and size of the proposed water main within the street, alley or easement with respect to all existing and currently planned utilities and property or easement lines shall be shown.
3. Also on the second set of drawings the location of all valves, fittings, and fire hydrants within the street, alley or easement, existing and proposed.
4. Detail sections of stream crossings, irrigation ditches, railroad and highway crossings, borings, etc. shall be shown.
5. Profiles shall be required by the District on all projects unless this requirement is waived, in writing, by the District. They shall give dimensions, grades, valve locations, location of proposed pipeline to the existing

surface and the proposed finish grade and other pertinent information.

6. The horizontal scale of the drawings shall be one (1) inch equals fifty (50) feet and the vertical scale shall be one (1) inch equals five (5) feet, unless otherwise approved by the District.
7. All plans shall be sealed and signed by a Professional Engineer registered in the State of Colorado. The Professional Engineer responsible for the design of the system shall be known as the Project Engineer, and shall be responsible for all plans and specifications and the field survey. Approval by the District shall in no manner relieve the Project Engineer from responsibility for errors or omissions in plans, specifications, or field surveys. Any errors shall be corrected by the Project Engineer to the satisfaction of the District and at no expense to the District.
8. A total cost estimate for the project shall be provided by the Project Engineer including material prices provided by a material supplier.

Plan Approval

Construction of the Project as approved, shall commence within six (6) months of the date of approval by the District as shown on the plans, or the plans must be re-submitted for review and approval. If the construction is halted for more than six (6) months, plans must be resubmitted for review and approval.

Plan Revisions

Should circumstances warrant changes from the approved plans or specifications, the proposed revision must be submitted to and approved by the District. No work shall proceed on that portion of the project being revised until said revisions are submitted and approved by the District. Minor changes from the plans or specifications may be approved by obtaining on-site written permission from the District.

Record Drawings

It is the responsibility of the Applicant to provide the District with the following drawings upon completion of the project:

- 1) One set of reproducible record drawings
- 2) One blue-line set of record drawings
- 3) An AutoCAD (R-14 or 2002) file of the record drawings on CD.

Final acceptance of the project additions will not be given until the required record drawings have been provided.

C. PIPE SIZE

Minimum pipe size shall be six (6) inches within subdivisions. Minimum pipe size shall be 12" for transmission mains, unless otherwise approved by the District. Generally, mains adjacent to and paralleling Section lines or major roadways are considered transmission mains, but the definition of a transmission main is at the sole discretion of the District. For pipe sizes greater than 12 inches the District shall determine the specifications.

Four (4) inch pipe may be allowed in cul-de-sacs less than four hundred (400) feet long, and with less than 10 lots or potential service locations and there is no fire hydrant, with written approval of the District.

D. FIRE HYDRANT LOCATION

The applicant shall provide fire hydrants which conform to the requirements of these Specifications. Fire hydrant location and spacing shall be as required by the governing Fire Protection Authority, and is subject to the review and approval of the District.

E. DEPTH

Water mains shall have not less than four and one half feet of cover over the top of the main to the final finished grade of the area, including borrow pits.

F. ALIGNMENT

Water mains shall be laid under the pavement on the uphill side of the street opposite of any proposed sewer line installation. In commercial/industrial developments, water mains may be laid outside, but adjacent to, the pavement to allow future tapping without the need for pavement cuts. Final alignment shall be as approved by the District.

G. SERVICE LINES

All existing or proposed lots or potential service sites either, residential or commercial shall have a service line extended to the site from the main line before paving. The service line shall terminate with the installation of a meter pit and appurtenances by the contractor. The meter pit and appurtenances materials shall be as specified by the District. The pit shall be placed 5 feet inside the property line and shall be marked by a 2 x 4 or such other stake which shall extend 3 feet above the surface and shall be painted blue. The top of the meter pit dome shall be 3" above final grade to accommodate landscape materials. In no case shall the top of the meter pit dome be located below the final grade INCLUDING landscape materials.

Service lines shall be of a size which is adequate to supply the requirements of the property being served. The minimum size service line shall be 3/4 inch. The proposed service line size shall be approved by the District.

The District is responsible for ownership and maintenance of the service line from the main line to the meter pit and including the meter and any other devices in the pit. The tap owner is responsible for ownership and maintenance of the service line past the meter pit.

H. VALVE SPACING

Valves shall be placed at locations to minimize water outages in case of a line break or repair. In general, valves shall be placed on lines of twelve (12) inch or smaller diameter no more than five hundred (500) feet apart. Each fire hydrant shall have a hydrant valve. For lines larger than 12" the valve location and spacing will be determined by the District.

A minimum of three (3) valves shall be installed at every tee and four (4) valves installed at every cross, unless approved by the District.

I. AIR/VACUUM VALVES

Air and vacuum valves shall be required at extreme high points on water lines twelve (12) inches and larger. The District may require installation on smaller lines as deemed necessary.

J. LOOPING

Subdivision water systems should be designed to provide looping to existing or proposed mains and minimize dead-ends where ever possible. The District shall determine the final location of loops.

K. FIRE LINES AND FIRE HYDRANT LINES

A fire hydrant connection line shall extend from the hydrant tee and valve on the main water line to the fire hydrant. This line shall be a 6 inch line.

A private service line for the use on an internal fire suppression system shall require a valve at the main line and a meter 5 feet inside the property line. The valve, service line and meter shall be owned and maintained by the District. The tap owner shall own and maintain the fire service line from the meter to the fire suppression system. Fire service lines shall be connected to the main with a swivel tee if a wet tap is not required. Joint restraint is required from the main to the hydrant.

Bends are not allowed on fire lines except when necessary due to location of existing stub, angle of existing main, or location of joint on existing main. If a bend is necessary, pipe must be restrained for two (2) joints either side of the bend.

Fire hydrant lines and fire service lines shall separate from each other and all other service connections. No domestic taps shall be made on a fire service or fire hydrant line.

Electrical insulation is required if the District main is ductile iron or steel pipe.

L. BACKFLOW CONTROL

All work and materials shall be inspected and accepted by the District.

The District shall have the sole right to determine the rated size, kind, type, make, location, and component configuration of all backflow devices. The District shall determine the fees and other costs associated with backflow devices.

All testing, installation and repair of backflow devices shall be done by the District or under the supervision of the District at the cost of the property owner.

The District may require the installation of any of the following devices depending on the degree of hazard at the service location.

- Air Gap
- Reduced Pressure devices
- Double Check Valve devices
- Double Check Detector Check Valves
- Pressure Vacuum Breakers
- Atmospheric Vacuum Breakers

Backflow prevention devices will be required on private fire suppression lines. These devices will be either reduced pressure or double check detector devices or a device as directed by the District.

M. TEMPORARY WATER USE PERMIT REQUIREMENTS

Temporary use of potable water from the Districts water distribution system by means of a temporary water tap, a temporary service line, a fire hydrant, or other devices is generally prohibited. If the District determines that such use can occur without disruption to its customers, without risk or disruption to the Districts infrastructure, and can be coordinated with District staff activities, than a permit shall be required from the District. Said permit shall include provisions for measuring, form of payment, cost of water and backflow prevention methods if needed.

N. INSPECTION

Inspections shall be required during all phases of the installation.

The District's office shall be notified at least forty-eight (48) hours in advance when pipe is to be laid in any trench. No pipe or joints shall be covered until they have been inspected and deemed acceptable by the District or written approval to backfill is obtained from the District.

District representative shall have the authority to issue "stop-work" order. A "stop-work" order may be either verbal or in writing. Where a situation exists that a District representative determines that a problem exists, or work is proceeding in an unacceptable manner, that representative may issue a "stop-work" order to the person who is on site and in charge of the installations. No work may continue until the issue(s) have been resolved to the satisfaction of the District.

The right of the District to inspect the installations (or replacements) shall be solely for the benefit of the District and shall not be deemed to be a waiver of the District to enforce the obligation of the Developer to construct the installations in accordance with District Specifications and the "Approved for Construction" plans and drawings submitted to and approved by the District by the Applicant. Plans shall not be deemed to estop the

District for the Developer's failure to install or properly design its Installation.

CONSTRUCTION WORK SHALL NOT START UNTIL THE APPLICANT HAS RECEIVED WRITTEN APPROVAL FROM THE DISTRICT.

O. MANUFACTURER'S CERTIFICATES AND RECOMMENDATIONS

1. Certificate from Manufacturers

When deemed necessary by the District, the Applicant shall secure from the manufacturer of all material used as a permanent part of the project, a certificate stating that their product as used on the project conforms to all specifications stated and shall submit the certificate to the District for approval. No material shall be used until the certificates are approved.

2. Manufacturer's Specifications and Recommendations

All manufacturer's recommendations, instructions, or specifications regarding installation and use of products shall be considered a part of these specifications and of equal force. Any conflict between manufacturer's instructions and these specifications shall be decided and settled by the District, and shall not be open to arbitration. All such manufacturer's instructions shall be presented to the District for approval at the same time as the certificates of quality are presented.

P. CONNECTION TO EXISTING MAINS

1. At locations where connections to existing water mains are to be installed, the Contractor shall locate the existing mains both vertically and horizontally and shall verify their exact size and type of material in advance of the time scheduled for making the connections.

2. All connections to existing mains in service that cannot be isolated so that no customer will be out of water shall be wet

taps. **No tapping shall be done without a District Representative present.**

3. If it is impossible to make the connection without a shut down, the Contractor shall notify and schedule the connection with the District. Any customer who may be affected by the shutting off of water shall be given 24-hour notice by the Contractor as to when and for how long service will be interrupted. All existing valves shall be operated only by District employees. In case of emergency interruptions, the Contractor shall inform all affected water users of the cause and estimated time for repairs as soon as possible.

Prior to connecting to existing water mains, the Contractor shall have all labor, materials and equipment ready to connect the fitting to the existing main, so as to keep the shutoff time to a minimum. As soon as possible after making the connections, the Contractor shall flush the connection so as to prevent any contamination of the existing facilities. The Contractor shall take every precaution necessary to prevent dirt or debris from entering the main.

Connections to the existing water system shall be completed in a neat workmanlike manner. The District shall be notified at least forty eight (48) hours in advance and be present at the time of connection to the existing system. All connections shall be valved to separate new construction from the existing system.

Q. OPERATION OF EXISTING VALVES

Operation of all existing and connecting valve shall be operated by District personnel only. The District shall be notified at least 48 hours prior to needing valves operated.

R. FUTURE CONNECTIONS

When future main extensions are possible, the main which can be extended must be valved such that only one valve will need be closed when the main is extended. The valve must be restrained so that when the one valve is closed and the line to be extended is exposed, the valve will remain in place. The restraint shall be

with mega-lugs. A minimum of 2 lengths of pipe shall be placed beyond the valve.

S. WATER LINE ACCEPTANCE PROCEDURES

After the water facilities constructed by the Applicant are built to District specifications, the Applicant shall send a letter to the District requesting an inspection to be made for construction acceptance. If the construction work meets all District specifications, including all work done constructing the waterline, all testing, disinfection, surface restoration and any other work contemplated by the job specifications, and the District has received an accounting of construction costs and record drawings from the Applicant, the District will issue a letter of construction acceptance stating that the one (1) year warranty period for the water system construction work will commence.

1. Record Drawings

Before a letter of Construction acceptance is issued by the District, the Applicant must provide the District with one REPRODUCIBLE set, one blue-line set, and an AutoCad (R-14 or 2002) file of record drawings showing water line locations and details **as constructed**.

2. Cost of Construction

Prior to final acceptance of the newly constructed facilities, the District shall receive from the Applicant documentation of the actual cost of the water system design and construction.

3. Applicant's Guarantee of Workmanship, Material, and Equipment

The contractor and his/her Surety on the Performance Bond shall be jointly responsible for a period of one year following the construction acceptance of all work performed for the satisfactory repair or replacement of all work, material, services and equipment which becomes defective during this period, as a result of faulty materials, faulty installation, or improper handling of material and equipment installed by the Contractor as determined by the District.

Contractor shall be responsible for any and all settling which occurs during the one year warranty period.

4. Property Owner Approval

Before acceptance by the District, the contractor shall provide, in writing, to the District a statement from all private property owners on whose property work was done stating that they are satisfied with the manner in which the property was left after construction was complete. The District has provided a sample statement for the contractors use in the appendix of this document.

T. TRAFFIC CONTROL

All traffic control and signs shall be in accordance with the latest edition of the Manual on Uniform Traffic Control Devices. If the work is to be performed in a public easement or right-of-way the applicant shall prepare a traffic control plan to be presented to and have approved in writing by the public entity having jurisdiction.

U. CATHODIC PROTECTION

If ductile iron or steel pipe is to be installed, tests will be required to determine the resistivity of the soil to ascertain if cathodic protection is required. If cathodic protection is required a cathodic protection system shall be designed by a qualified, licensed corrosion engineer. Test stations for metallic main lines shall be located in vehicular accessible areas no more than 500 feet apart.

Whenever it is necessary to join pipe of dissimilar metal, an approved insulation joint shall be installed. A resistivity test shall be conducted across the joint. The test shall indicate the insulation of the joint is complete.

V. DEAD ENDS

All dead-end lines shall be properly plugged and blocked in accordance with the horizontal thrust block detail drawing. All dead-end lines shall be provided with a properly sized blow-off and flushing assembly approved by the District.

W. DUAL WATER SYSTEMS

When the District has approved a dual water system contract, the non-potable irrigation system shall, at a minimum, meet the following design requirements:

1. The design shall be certified by a Registered Professional Engineer.
2. The irrigation system shall be located outside the paved portion of the street where possible.
3. The irrigation system pipe shall be purple.
4. The irrigation pipe shall be laid with a plastic identification ribbon stating "non-potable irrigation water" or words to that effect.
5. Irrigation system valve box covers shall be imprinted with "non-potable irrigation water" or words to that effect. An acceptable alternative is the use of valve boxes which significantly differ in their shape or construction so as to easily identify that valve as an irrigation valve as opposed to a domestic valve. All alternative valve boxes must be approved in writing by the District prior to installation.
6. Separate design criteria and specifications for irrigation systems will be promulgated and be incorporated into District Bylaws, Policies and Regulations.

II. MATERIAL SPECIFICATIONS

A. STEEL PIPE

Steel Pipe will generally not be used in the District. If a situation occurs wherein the District decides to allow Steel Pipe, the following will apply:

Specifications for steel pipe shall be submitted by Applicant for approval by the District's Engineer. All material, manufacturing operations, testing and inspection of pipe shall be in conformity with the requirements of AWWA C200. Design and installation shall be in accordance with AWWA M11.

B. P.V.C. PRESSURE PIPE (SMALLER THAN 4 INCH)

PVC pipe smaller than four (4) inch shall be Schedule 40 with an SDR of 21 and shall meet ASTM D2241 standards. The pipe shall have rubber ring gaskets and integral wall thickened bell ends. Solvent weld joints or couplings will not be accepted.

C. P.V.C. PRESSURE PIPE (4 INCH AND LARGER)

All P.V.C. pipe and fittings shall be marked with clear, clean markings specifically identifying the manufacturer's name or trademark, type of material from which it is made, grade, size and pressure rating and N.S.F. seal of approval for potable drinking water.

All P.V.C. pipe and fittings used shall meet A.W.W.A. Standard C900 for pipe diameters through twelve (12) inch, and AWWA C-905 for pipe diameters larger than twelve (12) inch. The pipe used shall be Class 150 - DR18 unless otherwise determined by the District. The pipe shall have rubber ring gaskets. Solvent weld joints will not be accepted.

The pipe shall have integral wall thickened bell ends. Couplings will not be accepted.

The pipe shall conform to cast iron outside diameter specifications.

D. DUCTILE IRON PIPE

All ductile iron pipe shall be manufactured and designed in accordance with AWWA Specification C-151. Minimum design thickness shall be Pressure Class 50.

All pipe joints shall be an approved push-on type AWWA C-111 or mechanical joint with rubber gasket as approved by the District. Gaskets shall be molded rubber rings made expressly for the joint used. Lubricant shall be furnished by the pipe manufacturer.

Pipe shall be cement lined on the inside. Cement mortar lining for ductile iron pipe and fittings shall be in conformance with AWWA Specification C-104. The pipe interior and exterior shall be a bituminous seal coating AWWA 151 at least one (1) mil thick. It shall adhere tenaciously to the cement mortar and pipe. Spotty or thin coating, or poor adhesion, shall be cause for rejection of the pipe.

Polyethylene encasement will be required for ductile iron pipe. Polyethylene encasement shall be eight (8) mils thick and shall be manufactured and installed in accordance with AWWA Standard Specification C-105, latest revision.

Each length of pipe shall be plainly stamped or indelibly marked or coded to an acceptable standard specification as to the length, weight, class and type thereof, and the manufacturer's trademark or name. Prior to ordering pipe materials, approval of the manufacturer will be obtained from the District. Standard laying lengths shall be eighteen (18) to twenty (20) feet. Random lengths are not acceptable unless required for fitting installation.

E. FITTINGS

Fittings shall be ductile iron conforming to AWWA Specification C104, C110, C111 and C153. Fittings shall be

designed and manufactured for a pressure rating of one hundred twenty five (125) psi.

Fittings shall be epoxy coated, inside and out, and shall be cement-lined in accordance with ANSI Specification A-21.4- (AWWA C-104).

Fitting joints shall be mechanical joints conforming to ANSI Specification A-21.11- (AWWA C110 and C111), or as approved by the District.

Joint restraint for fittings or specials shall be EBBA Iron Inc. MEGALUG pressure rated at 250 psi.

Mechanical couplings shall be solid mechanical joint sleeves restrained with mega-lugs.

F. GATE VALVES

Valves three (3) inch to twelve (12) inch shall be resilient seat gate valves with non-rising stem, two (2) inch square operating nut, with epoxy coated interior and exterior and conforming to AWWA C509. Valves shall be the same size as the line which they serve and shall open left (counter-clockwise). Valve ends shall be mechanical-joint, and shall also have mega-lugs. All buried bolts shall be stainless steel.

Valves smaller than three (3) inch shall be a ball valve, have a heavy cast bronze body and a bronze tee-head and stem. Lock rings shall be bronze and watertight seals and rubber seats shall be Buna-N material. The ball shall be a spherical fluorocarbon-coated brass ball. The valve shall have a two (2) inch square operating nut and shall conform to AWWA C800.

Tapping valves shall conform to the above standards.

G. VALVE BOXES

Valve boxes shall be two-piece, five and one-quarter (5¼) inch shaft, screw type.

H. PRESSURE REGULATING VALVES

The District shall determine the size and location of pressure regulating valves. The pressure regulating valve shall be a hydraulically operated, pilot controlled valve with a flanged globe body, as manufactured by the Roll-Seal Company or District approved equal. Valves shall be furnished with flanged ends in accordance with ANSI B16.1 class 250.

I. AIR VACUUM RELIEF VALVES

The air vacuum relief valves shall be sized and located by the District and shall be of the combination air release - air vacuum type. They shall be in accordance with AWWA C512 and shall be as shown on the drawings. These valves shall be rated to withstand a maximum operating pressure of three hundred (300) psi and be constructed of cast iron bodies and covers, stainless steel float, bronze trim and Buna-N seat. The vent pipe for air vacuum valves shall be sized to fit the valve and shall be galvanized cast iron pipe. They shall be Apco Combination air release valve by Valve and Primer Corporation or District approved equal. Guard valves to be bronze ball valve with female iron pipe thread ends, Mueller H15204 or approved equal.

J. SWING CHECK VALVES

Valves in this specification shall be iron body, epoxy coated, bronze mounted, swing check valves with outside weight and lever as required. These valves shall be designed and manufactured in accordance with AWWA C508. These valves shall be sized by the District and shall be designed for an operating pressure of 200 psi.

K. FIRE HYDRANTS

Hydrants shall be Mueller Super Centurion 200 or 250 or Waterous and shall comply with AWWA Specification C-502. Hydrants shall have a two-way hydrant valve opening of five and one-quarter (5¼) inches. Each fire hydrant shall be provided with two (2) two and one-half (2½) inch hose nozzles

and one (1) four and one-half inch (4½) pumper nozzle, all having a National Standard Thread.

The shoe connection shall be mechanical joint and shall be six (6) inches. The opening nut shall be National Standard Pentagon one and one-half (1½) inch point to flat.

The valve shall open left (counter-clockwise). The color shall be orange. All extension sections shall be ductile iron. Depth of bury shall be minimum of five (5) feet.

There must be a six (6) inch valve between the hydrant and the main line and installation shall be in accordance with the detail drawing. All bolts that are buried shall be stainless steel.

Hydrant gravel shall be 1-1/2 inch minus washed crushed rock with no more than 5% passing a 3/8 screen.

All hydrants shall be equipped with traffic knock-off type sections.

L. BLOW OFF ASSEMBLIES

Blow off assemblies that are not located within the street shall be Aquarius one-o-one manufactured by the Gill Company.

M. WATER SERVICES

1. Service lines shall be Poly tube Service line CTS - SDR9.
2. Corporation Stops: Corporation stops shall be Ford F-1000 series or Mueller H-15000 series, brass, with compression type joint for service pipe and threaded on inlet end with AWWA corporation stop thread. Corporation stops shall be equipped with a Gripper Ring.
3. Curb Stops: Curb stops are not normally installed. When approved by the District, curb stops shall be Mueller Company or equivalent. Three-quarter (3/4) inch and one (1) inch curb stops shall have iron pipe thread fittings.

4. Tapping Saddles: All service taps two (2) inch and smaller require a tapping saddle. Tapping saddles shall be bronze with stainless steel bolts with AWWA standard thread. Direct tapping is not allowed.
5. Tapping Sleeves: Full circle tapping sleeves designed for 200 psi working pressure shall be used for wet taps greater than two (2) inch. Tapping sleeves for taps on all pipe shall be ductile iron mechanical joint split tapping sleeve, epoxy coated or fabricated steel mechanical joint split tapping sleeve, epoxy coated.
6. Tapping Valves must conform to the District Specifications for gate valves.

N. CONCRETE VAULTS

All concrete manholes to be used as vaults shall have minimum wall thickness of six (6) inches and shall be sized for the equipment to be placed in the vault. The vault shall have 6 feet headroom. Tops shall be flat, reinforced concrete slabs with a flush mounted or raised square hatch 36" x 36" and shall be Bilco or equal.

Concrete used for vaults shall contain Type II cement and have a minimum strength of three thousand (3,000) psi at twenty eight (28) days. When constructed, the top of the vault shall be at finished grade of the project. Vaults which are in an area subject to high groundwater shall be sealed both inside and outside and shall be water tight, and unless otherwise approved by the District, shall have a concrete sump pit measuring 16" in diameter and 12" deep.

Detailed plans for rectangular vaults must be submitted to the District for review and approval prior to the start of construction.

Round manholes may be used for air-vacuum valves if approved by the District.

O. PIPING IN VAULTS

All piping within manholes or rectangular vaults such as those containing pressure regulating valves, air vacuum valves or other installations shall be flanged ductile iron pipe. All vent pipes from such vaults shall be glued six (6) inch PVC Schedule 40 pipe below grade, coupled to a six (6) inch galvanized steel vent pipe above grade.

P. METERS, PITS, DOMES AND YOKES

All meters will be provided by the District and cost of the meter(s) will be included in the tap fee. In the case of a subdivision or development consisting of multiple taps, all pits, domes and yokes shall be purchased and installed by developer or developer's contractor at the time of water line infrastructure installation within the subdivision or development in accordance with District specifications and detail drawings. Meters shall be located in pits for residential services. Pits/domes shall be installed so that top of meter pit lid is 2 to 3 inches above final grade. Final grade shall not be changed. However, if landscaping of the area requires a change in grade, owner shall be responsible for the cost of raising the dome and meter set to acceptable level with approved equipment.

Q. CONCRETE

All concrete shall contain not less than five (5) sacks of cement per cubic yard and shall have a twenty eight (28) day field strength of not less than three thousand (3,000) psi when tested in six - by - twelve (6 x 12) inch cylinders. Sampling and curing shall be in accordance with the ASTM C31, and testing shall be in accordance with ASTM C39. Slump shall be between two (2) inches and four (4) inches when placed. The District shall be notified twenty-four (24) hours in advance of all concrete placement.

R. CASING MATERIALS

1. Casing Pipe

The casing pipe shall be of smooth design and shall be in accordance with the highway department specifications and standards. The pipe shall be ¼ inch wall unless approved by the District. The pipe shall conform to AWWA C-201.

The inside diameter of the casing pipe and wall thickness required shall be noted on the drawings.

2. Casing Insulators (Skids)

Casing insulators shall be as manufactured by Pipeline Seal and Insulator Company, or approved equal.

Casing insulators shall be placed a maximum distance of ten (10) feet on centers. The insulators shall prevent any portion of the carrier line from touching the casing.

3. Casing End Seals

The casing end seals shall be Model S as manufactured by Pipeline Seal and Insulator Company or approved equal.

S. TRACER WIRE

Tracer Wire shall be twelve (12) or fourteen (14) gauge single strand UF-UL wire.

Splices should be made utilizing waterproof silicone filled wire nuts.

Tracer wire shall be brought up into test station boxes behind fire hydrants, as shown in the hydrant detail drawing. Where this is not possible, tracer wire may be installed in valve boxes, in a continuous loop, if approved by the District.

III. CONSTRUCTION SPECIFICATIONS

A. GENERAL

The materials, methods, and operations for the installation of the potable water line or system shall conform to these specifications and to the standard requirements of the local controlling entity, city, county, and State of Colorado. No construction shall begin until a pre-construction meeting has been held. Attendees at the pre-construction meeting shall include District staff - including the primary contact person of the District responsible for oversight of that particular project, the contractor representative(s) including key people to be on-site during construction and the primary contact of both the contractor and developer.

B. HANDLING OF PIPE AND MATERIAL

All pipe, fittings, valves, hydrants, and accessories shall be loaded and unloaded by lifting with hoists, spreader bars, skidding, or by hand so as to avoid shock or damage. Under no circumstances shall such material be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground. Cast iron, ductile iron, and steel pipe shall be handled so that the coating and lining will not be damaged. All pipe, fittings, valves and hydrants shall be inspected for cracks, flaws, broken or loose lining, dents, holes, or abrasions. All material found to be defective shall be separated from the other material until it can be repaired or it shall be discarded. If any part of the coating or lining is damaged, the repair shall be made by the Applicant at his expense in a manner satisfactory to the District.

C. ALIGNMENT AND GRADE

The potable water line shall be constructed according to the location and grade as shown on the plans. In any event, the minimum cover over the top of the pipe shall be four and one-half (4-1/2) feet at the end of construction. Any deviation from the plans to maintain four and one-half (4-1/2) feet of cover shall be brought to the attention of the District. The

minimum cover for a sleeve or casing in which the potable water main is installed shall be three (3) feet unless otherwise directed by the District in writing.

D. SEPARATION OF WATER AND SEWER MAINS

1. Parallel Installation

Water mains shall be laid at least ten (10) feet horizontally from any existing or proposed sanitary sewer. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten (10) foot separation, a deviation may be allowed on a case-by-case basis, if approved in writing by the District. Such deviation may allow installation of the water main closer to sanitary sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least eighteen (18) inches above the top of the sewer.

2. Crossings

Water mains crossing above sewers shall be laid to provide a minimum vertical distance of eighteen (18) inches between the outside of the water main and the outside of the sewer. At all such crossings, one full length of water pipe (minimum eighteen (18) feet long) shall be located so both joints will be as far from the sewer as possible. Special structural support for the water and sewer pipes may be required.

3. Special Conditions

When it is impossible to obtain proper horizontal or vertical separation, as stated above, or whenever the water main crosses under the sewer line, the waterline shall be placed in casing as described in other sections of this specification. The end of such casing shall terminate 10 feet from the sewer where proper separation can be achieved.

4. Construction Changes

If during construction, it is found that a water or sewer line cannot meet these requirements, the Project Engineer shall change the alignment to comply and get approval for such change from the District.

E. EXCAVATION AND PREPARATION OF TRENCH

1. Length of Open Excavation

Not more than four hundred fifty (450) linear feet of trench shall be dug in advance of the completed pipe laying operations.

2. Width of Trench

The maximum clear width of trench at the top of the pipe shall be not more than the outside diameter of the barrel of the pipe plus two (2) feet. Greater width of trench at the top of the pipe shall be permitted only on written approval by the District.

3. Excavation

The trench shall be excavated to the depth required so as to provide a uniform and continuous bearing and support for the pipe. Any part of the bottom of the trench excavated below the specific grade shall be brought back to grade with approved material, and thoroughly compacted as directed by the District. The finished subgrade shall be prepared accurately by means of hand tools.

Where the bottom of the trench at subgrade is found to consist of material that is unstable to such a degree that, in the opinion of the District, it cannot be removed and replaced with an approved material thoroughly compacted in place to support the pipe properly, the Applicant shall construct a foundation for the pipe, consisting of piling, timbers, or other materials as required.

4. Rock Excavation

Shale, ledge rock, boulders, and large stones shall be removed to provide six (6) inches of clearance on each side of and below all pipe and accessories. Excavation below subgrade in rock or in boulders shall be refilled to subgrade with sand, and thoroughly compacted. Blasting for excavation will be permitted only after the approval of the District has been secured and only when proper precautions have been taken for the protection of persons and property. The hours of blasting shall be fixed by the District. Any damage caused by blasting shall be repaired by the Applicant at his expense. Blasting shall be done only by a licensed blasting contractor licensed by the entity in which the blasting is to occur. The Applicant's procedures and methods of blasting shall conform to all Federal, State and local laws. It shall be the responsibility of the Applicant to obtain all permits, licenses and approvals needed to conduct blasting.

5. Special Trenches or Installations

Special trenches or installations such as railroad, highway, or utility crossings shall conform to the specifications and instructions of the utility or agency whose rights-of-way are involved. The Applicant shall confer with the representative of the utility or agency concerned to arrange for the details of construction. The Applicant shall be responsible for repairing all damage incurred to property during construction. All work shall be completed to the satisfaction of the utility involved. The Applicant shall provide to the District, all permits, easements and approvals, in writing, required by the agency concerned. The applicant shall also provide to the District approval, in writing, from the entity involved indicating the work is complete and accepted by the entity.

6. De-watering of Trench

Pipe trenches shall be kept free from water during excavation, fine grading, pipe laying and joining, and pipe embedment operations, in an adequate and acceptable manner. Where the trench bottom is mucky or otherwise unstable because of the presence of ground water, and in all cases where the static ground water elevation is above the bottom of any trench or bell hole excavation, such ground water shall be lowered by means of well points and pumps, or by other means acceptable to the District, to the extent necessary to keep the trench free from water and the trench bottom stable at all times when work within the trench is in progress. Surface water shall be diverted, and otherwise prevented from entering trenches, to the greatest extent practicable, without damage to adjacent property from dikes, ditches, or impounded water.

7. Braced and Sheeted Trenches

All trenches and trenching operations shall conform to the current "Rules and Regulations Governing Excavation Work" adopted by the Industrial Commission of Colorado and all applicable O.S.H.A. requirements.

8. Bedding

a. Bedding material is usually the native material taken from the trench. If this material is not suitable, as determined by the District, the bedding shall be a clean, free draining well-graded sand or squeegee sand and shall conform to the following limits when tested by means of laboratory sieves:

Well Graded Sand

<u>Sieve Size</u>	<u>Total Percent Passing by Weight</u>
3/8 inch	100
No. 4	70 - 100
No. 8	36 - 93
No. 16	20 - 80

No. 30	8 - 65
No. 50	2 - 30
No. 100	1 - 10
No. 200	0 - 3

Squeegee Sand

	Total percent
<u>Sieve Size</u>	<u>Passing by Weight</u>
3/8 inch	100
No. 200	0 - 3

b. When soft, wet, or unstable conditions are encountered in the bottom of the trench, this material shall be removed and stabilization material shall be placed in the bottom of the trench. Under most conditions 2 inch-minus gravel will be acceptable and a minimum of six (6) inches will be required.

2 inch-minus gravel shall be defined as granular material which will comply with the sieve analysis of:

<u>Sieve Size</u>	<u>Percent Passing</u>
2"	90 - 100
1"	35 - 70
½"	10 - 30
No.4	0 - 5

or shall comply with the sieve analysis as set by the Colorado State Highway specification for Filter material Section 703.09 Class A.

If conditions are severe enough, washed rock gravel will be called for by the District.

9. Preparation of Trench Bottom

If the bedding requirement is waived, pipe shall be laid directly on the trench bottom containing bell or coupling holes and shaped to provide continuous contact with the pipe between the bell or coupling holes. Before the pipe is lowered into the trench:

(1) A bell or coupling hole shall be dug with sufficient length, width and depth to permit the joint to be made properly and

(2) The trench bottom between bell or coupling holes shall be made flat and cut true and even to grade so as to provide continuous contact of the trench bottom with the pipe.

10. Care of Surface Material for Re-use

All surface materials that, in the opinion of the District, are suitable for reuse in restoring the surface shall be kept separate from the general excavation material as directed by the District.

11. Piling of Excavated Material

All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes, or other utility controls shall be left unobstructed and accessible during construction. Gutters shall be kept clear or other satisfactory provisions made for street drainage and natural water courses shall not be obstructed.

12. Trenching by Hand or Machine

Hand methods for excavation shall be employed in locations shown on the drawings. In other locations, the applicant may use trench-digging machinery or employ hand methods.

13. Permits

All work performed in the public right-of-way shall be so performed under an encroachment permit from the controlling agency and in accordance with the rules and

regulations of such a permit. All permits shall be obtained by the Applicant or his Contractor.

F. LAYING

1. Lowering of Pipe and Accessories into Trench

Implements, tools, and facilities satisfactory to the District shall be provided and used by the Applicant for the safe and efficient execution of the work. All pipe, fittings, valves, hydrants, and accessories shall be carefully lowered into the trench with suitable equipment in a manner that will prevent damage to pipe and fittings. Spreader bars shall be used on all full length pipe over 8 inches in diameter. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. Pipe and accessories shall be inspected for defects prior to their being lowered into the trench. Any defective, damaged, or unsound material shall be repaired or replaced as directed by the District.

All foreign matter or dirt shall be removed from the interior and ends of pipe and accessories before it is lowered into position in the trench. Pipe shall be kept clean by means approved by the District during and after laying.

2. Laying of Pipe

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. If the pipe-laying crew cannot put the pipe into the trench and in place without getting earth into it, the District may require that before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size, or other suitable protection approved by the District, shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing, or other materials shall be placed in

the pipe. Pipe in the trench shall have the end covered at all times.

3. Cutting of Pipe

The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining and so as to leave a smooth end at right angles to the axis of the pipe. Field cut pipe ends shall be beveled to match the ends of full length pipe.

Flame cutting of cast iron pipe by means of an oxyacetylene torch shall not be allowed.

4. Direction of Bell Ends

Pipe shall be laid with bell ends facing in the direction of laying, unless directed otherwise by the District. Where pipe is laid on a grade of five percent (5%) or greater, the laying shall start at the bottom and shall proceed upward with the bell ends of the pipe up-grade. When planning the project the direction of laying pipe shall be determined so the laying progress is generally uphill.

5. Unsuitable Conditions for Laying Pipe

No pipe shall be laid when, in the opinion of the District, trench conditions are unsuitable.

G. BORING AND CASING

1. The casing installation and pipe through it shall be constructed according to the location and grade as shown on the plans. In any event, the minimum cover over the top of the casing shall be no less than three (3) feet. Any deviation from the plans to maintain three (3) feet of cover shall be brought to the attention of the District.

Excavation and trenching shall be the same for casing as for regular pipe and the sub-grade preparation shall also be the same.

2. The carrier pipe to be used shall be the same as used on the rest of the project. This pipe shall be mounted on plastic casing insulators specifically made for the size and class of pipe used in the project to assure that no part of the carrier pipe or appurtenant couplings rest on the casing pipe.
3. Casing insulators must be securely fastened to the pipe to prevent movement along the pipe barrel during the pulling or pushing operations. Casing insulators are to be provided for both ends of each pipe length and are to be positioned an equal distance from each joint. Maximum spacing between casing insulators shall be ten (10) feet.
4. Test for leakage shall be conducted before closing the ends of the casing.
5. The materials, methods and operations of the Contractor shall conform to these specifications, other sections of these specifications, and to the standard requirements of the local controlling entity, city, county and State of Colorado.

H. JOINING OF PIPE

1. Mechanical Joints

a. Cleaning and Assembly of Joint

The last eight (8) inches outside of the spigot and inside of the bell of mechanical joint pipe shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter from the joint, and then painted with a lubricant. The cast iron gland shall then be slipped on the spigot end of the pipe with the lip extension of the gland toward the bell. The rubber gasket shall be painted with

the lubricant and placed on the spigot end with the thick edge toward the gland. The entire section of the pipe shall be pushed forward to seat the spigot end in the bell. The gasket shall then be pressed into place within the bell. Care shall be taken to locate the gasket evenly around the pipe and into position for bolting, and that all of the bolts are inserted and the nuts screwed up tightly with the fingers. All nuts shall be tightened with a torque- limiting wrench.

The torque for various sizes of bolts shall be as follows:

Bolt size (inches)	Range of Torque (foot-pounds)
5/8	45 - 60
3/4	75 - 90
1	100 - 120
1 1/4	120 - 150

Nuts spaced one hundred eighty (180) degrees apart shall be tightened alternately in order to produce an equal pressure on all parts of the gland.

b. Permissible Deflection in Mechanical-Joint Pipe

Whenever it is desirable to deflect mechanical joint pipe in order to form a long-radius curve, the amount of deflection shall not exceed the maximum limits recommended by the manufacturer. The contractor shall have, at the site, the information from the manufacturer showing the maximum deflection allowable for the pipe being installed.

2. Push-On Joints

a. Cleaning and Assembly of Joint

The inside of the bell and the outside of the spigot shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter.

The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the bell socket.

A thin film of gasket lubricant shall be applied to both the inside surface of the gasket and the spigot end of the pipe.

Gasket lubricant shall be as supplied by the pipe manufacturer and approved by the District.

The spigot end of the pipe shall be entered into the bell end with care used to keep the joint from contacting the ground. The joint shall then be completed by forcing the plain end to the bottom of the socket with a forked tool or jack-type tool or other device approved by the District. Pipe that is not furnished with a depth mark shall be marked before assembly to assure that the spigot end is inserted to the full depth of the joint. Field-cut pipe lengths shall be filed or ground to resemble the spigot end of such pipe as manufactured.

b. Permissible Deflection in Push-On Joint Pipe

Whenever it is desirable to deflect push-on joint pipe, in order to form a long-radius curve, the amount of deflection shall not exceed the maximum limits recommended by the manufacturer.

The contractor shall have, at the site, the information from the manufacturer showing the maximum deflection allowable for the pipe being installed.

I. POLYETHYLENE ENCASEMENT

Polyethylene wrap shall be required on all ductile iron pipe and cast iron fittings installed, unless otherwise stated in the plans or Special Provisions.

The polyethylene wrap tubing shall be cut to provide for a minimum of one (1) foot of lap over both the adjoining pipes. The ends of the tubing shall be wrapped using three (3) circumferential turns of plastic adhesive tape.

The loose wrap on the barrel is to be pulled snugly around the barrel of the pipe and the excess folded over at the top. This fold will be held in place by means of six (6) inch strips of the plastic tape placed at intervals of three (3) feet along the pipe barrel.

Bends, reducers, and offsets shall be wrapped in the same manner as the pipe.

Valves shall be wrapped by bringing the tube wrap on the adjacent pipe over the bells of the valve and sealing with adhesive tape. The valve bodies shall then be wrapped with flat sheets passed under the valve bottom and brought up around the body to the stem and fastened with the tape.

J. TRACER WIRE

Tracer wire shall be installed with all water mains, and shall be 12 gauge or 14 gauge solid copper UF/UL insulated direct burial wire. The tracer wire shall be laid directly above the water line along its entire length. Test stations shall be installed as required by the District, but less than 1000 feet apart. Wire to the test station shall be at least eighteen (18) inches deep. All splices and connections shall be made with silicon filled waterproof connectors approved by the District.

Upon completion of the installation, the tracer wire shall be tested by District personnel. A test will pass if the wire can be traced from a test station to the adjacent station(s).

Should a section fail, the break shall be found and repaired, at no additional cost to the District.

K. SETTING OF VALVES AND FITTINGS

1. General Requirements

Valves, fittings, plugs, and caps shall be set and joined to pipe in the same manner specified for the cleaning, laying, and joining of pipe.

2. Location and Depth of Valves

Valves in water mains shall be located as shown on the plans. A valve extension is required if the distance from the top of the operating nut to the street or grade surface is greater than five (5) feet.

3. Valve Boxes and Valve Pits

a. Valve Boxes

A valve box shall be provided for every valve that does not have exposed gearing or an exposed operating mechanism or in which the gearing or operating mechanism is fully protected with a cast-iron grease case. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the wrench nut of the valve, with the box cover flush with the surface of the finished pavement or such other level as may be directed.

b. Valve Pits

A pre-cast concrete valve pit shall be provided for every valve that has exposed gearing or an exposed operating mechanism. The valve nut shall be readily accessible for operation through the opening in the manhole, which shall be set flush with the surface of the finished pavement or such other level as may be directed.

Pits shall be so constructed as to permit minor valve repairs and afford protection to the valve and pipe from impact where they pass through the pit walls.

L. SETTING OF HYDRANTS

1. Location

Hydrants shall be located as shown on the drawings or as directed so as to provide complete accessibility and minimize the possibility of damage from vehicles or injury to pedestrians.

When placed behind the curb, the hydrant barrel shall be set so that no portion of the hose nozzle cap will be less than twenty-four (24) inches nor more than thirty (30) inches from the gutter face of the curb or sidewalk.

When set in the lawn space between the curb and the sidewalk, or between the sidewalk and the property line, no portion of the hydrant or nozzle cap shall be within six (6) inches of the sidewalk.

2. Position

All hydrants shall stand plumb and shall have their two hose nozzles parallel with the curb, except that hydrants having two hose nozzles ninety (90) degrees apart shall be set with each nozzle facing the curb at an angle of forty five (45) degrees. Hydrants shall be set to the established grade, with the safety flange approximately four (4) inches above the ground, as shown or as directed by the District. No more than one extension is allowed on any hydrant.

Bollards may be required by the fire authority.

3. Connection to Main

Each hydrant shall be connected to the main with a six (6) inch branch controlled by an independent six (6) inch gate valve, at the main line, unless otherwise specified.

4. Hydrant Drainage in Pervious Soil

Wherever a hydrant is set in soil that is pervious, drainage shall be provided at the base of the hydrant by placing coarse gravel or crushed stone, from the bottom of the trench to at least six (6) inches above the waste opening in the hydrant and to a distance of one (1) foot around the elbow. No drainage system shall be connected to a sewer.

5. Hydrant Drainage in Impervious Soil

Wherever a hydrant is set in clay or other impervious soil, a drainage pit two (2) feet in diameter and three (3) feet deep shall be excavated below each hydrant and filled compactly with coarse gravel or crushed stone, under and around the elbow of the hydrant and to a level of six (6) inches above the waste opening. No drainage pit shall be connected to a sewer.

6. Anchorage for Hydrants

The bowl of each hydrant shall be well braced against unexcavated earth at the end of the trench with concrete backing, and it shall be restrained with mega-lugs or as directed by the District.

M. THRUST BLOCKS

All plugs, caps, tees, and bends, unless otherwise specified, shall be provided with a concrete thrust block and mega-lugs.

Thrust blocks shall be placed between solid ground and the fitting to be anchored. The area of bearing on the pipe and on the ground in each instance shall be in accordance with the detail drawing or as directed by the District. If, in the opinion of the District, the soil bearing capacity is not sufficient to provide adequate restraint based on minimum bearing areas shown on the detail drawing, then the minimum bearing area shall be increased to a size that will ensure adequate restraint. In every instance, the kick-block shall bear against undisturbed earth. The thrust blocks shall be so placed that the pipe and fitting joints will be accessible for repair. A bond breaker shall be placed between the pipe and the thrust block to facilitate future removal.

A metal harness of tie rods, or clamps of adequate strength to prevent movement, may be used instead of concrete backing, when approved in writing by the District. Steel rods or clamps shall be galvanized, stainless steel or otherwise rust-proofed, or shall be painted as shown or directed by the District.

N. JOINT RESTRAINT

All valves, tees, bends and caps shall have mechanical joint restraints in addition to any required concrete thrust blocks.

The joint restraints shall be EBBA Iron Mega-lug Series 1100 or Series 2000PV, or equal specifically approved by the District. Any pipe joints located less than a full pipe

length away from the fitting or valve requiring restraint shall likewise be restrained.

O. PLACING CONCRETE

Prior to placing the concrete, the Contractor shall remove all shavings, pieces of wood or other debris and shall thoroughly wet the areas in which concrete is to be placed.

After completion of the mixing, the concrete shall be rapidly conveyed to the forms and shall be deposited in such a manner as to prevent separation of the ingredients. The concrete shall be distributed as evenly as possible and shall be compacted by spading to insure obtaining a solid homogeneous mass without honeycombs and that all voids and pockets are filled. Concrete shall be placed against undisturbed earth for restraint support.

Concrete for thrust blocks shall have a minimum twenty eight (28) day compressive strength of three thousand (3000) psi. Sackcrete shall not be used.

No concrete shall be poured when the temperature is below forty (40) degrees F except with the approval of the District. Such approval will be based on a favorable weather forecast or on adequate provisions by the Contractor for cold weather protection and heating. The Contractor shall be responsible for damaged concrete resulting from unfavorable weather conditions.

P. DISINFECTING AND TESTING MAINS

1. General

The Contractor shall disinfect and test all mains at no additional compensation regardless of existing conditions. The Contractor will not be paid extra for corporation stops, taps, service pipe, bulkheads or any other fittings and appurtenances used to relieve air, fill, drain, pressure test or flush any water main installed under these specifications.

2. Disinfection

Upon completion of the new and/or repaired water mains, or any usable portion thereof, and prior to placing the system or part thereof in operation, all new mains, valves, hydrants, etc. shall be thoroughly flushed and disinfected, using a hypochlorite, meeting AWWA B300, and water mixture applied in amounts sufficient to produce a dosage of fifty (50) mg/liter, and in accordance with AWWA Standard C-651, latest revision. Extreme care must be taken when handling hypochlorite as they may be dangerous to health.

Flushing shall be done with a flushing velocity of at least two and one-half (2½) feet per second. The Contractor shall provide all fittings required to flush the line. Flushing shall be done prior to disinfection unless the tablet method of disinfection is used.

Disinfection shall be accomplished as described below. The chlorinating material shall be either calcium hypochlorite (70% available chlorine by weight) or sodium hypochlorite (in 5¼% - 15% available chlorine). A table is shown to aid in determining the amount of hypochlorite disinfectant required.

The following information is a minimum guide only and the actual amounts needed will be determined by the condition of the pipe after it was placed.

CHLORINE REQUIRED TO PRODUCE 50 MG/L CONCENTRATION IN 100 FEET OF PIPE BY DIAMETER

100 percent Pipe Size (in.)	Chlorine (lb.)	1 percent Chlorine Solutions (gal.)
4	0.027	0.33
6	0.061	0.73
8	0.108	1.30
10	0.170	2.04

12

0.240

2.88

The Contractor may elect to use the tablet method of disinfection. If the tablet method is to be used, the Contractor must exercise extra care to prevent trench water or foreign material from entering the main during installation. In order to obtain fifty (50) mg/liter dosage, the minimum number of 5-gram hypochlorite tablets (3-3/4 grams available chlorine per tablet) shall be as shown in the following table.

Pipe Diameter (inches)	Number of Tablets per Joint (20 ft. joints)
4	1
6	2
8	3
10	5
12	7

The hypochlorite tablets shall be fastened to the top of each joint of the pipe using Permatex No. 1. The Contractor shall ensure that the tablets are located in the top of the pipe after the joint has been installed.

After a contact period of not less than twenty four (24) hours, the treated water in the lines shall contain not less than twenty five (25) mg/liter chlorine throughout the length of the line.

All valves in lines being disinfected shall be opened and closed several times during the contact period, unless they are being left closed for the pressure test, or to assure the highly chlorinated water doesn't affect existing lines. During the flushing and disinfection of the new mains, the Contractor shall make sure that none of the disinfecting solution enters any existing main.

3. Flushing Main

The entire line shall be flushed after the specified contact period and such flushing continued until the

residual chlorine content is not greater than 1.0 part per million.

The entire line, including hydrant leads, branch lines, and dead end mains shall be flushed. The discharge of flushed water shall be accomplished in such a manner that no erosion will occur and highly chlorinated water will not damage streets, fish, animals, plants, or other property. When necessary, federal, state or local regulatory agencies should be contacted to determine special provisions for disposal of the heavily chlorinated water. If this cannot be accomplished, de-chlorination procedures may be required by the District prior to flushing.

Chlorine residual of the water to be discharged will be neutralized by treating with one of the following chemicals:

Pounds of chemical required to neutralize various chlorine concentrations in 100,000 gallons of water:

Residual Chlorine Conc. Mg/l	Sulfur Dioxide SO ₂	Sodium Bisulfate NaHSO ₃	Sodium Sulfite Na ₂ SO ₃	Sodium Thiosulfate Na ₂ S ₂ O ₂ 5H ₂ O
1	0.8	1.2	1.4	1.2
2	1.7	2.5	2.9	2.4
10	8.3	12.5	14.6	12.0
50	41.7	62.6	73.0	60.0

Procedures for discharge will be subject to the review of the District's authorized representative. Any damage caused by flushing shall be repaired by the Contractor to the original condition.

4. Bacteriological Testing

After disinfection, flushing, and hydrostatic testing, the water in the new main shall be tested for

bacteriological quality. The Contractor shall contact the District to sample the water line for Bacteriological quality. The Contractor shall assist the District in obtaining any samples from any readily available source including exposed corporation stop, fire hydrant, or other source. If the samples are unsatisfactory, the mains must be re-disinfected and the whole procedure repeated until satisfactory. The cost of all bacteriological testing shall be the responsibility of the contractor. The District shall issue a letter of acceptance of the tests as satisfactory.

5. Pressure Test and Leakage Test

After the pipe has been laid, including fittings, valves, corporation stops, and hydrants, and the line has been backfilled in accordance with the Standard Specifications, each valved section, unless otherwise directed by the District, shall be subjected to hydrostatic pressure of not less than two hundred (200) pounds per square inch or one and one-half ($1\frac{1}{2}$) times the maximum working pressure, whichever is greater.

The maximum working pressure, if greater than one hundred (100) psi, will be given in the special conditions. In no case will the maximum working pressure be less than the actual line pressure in the water mains adjacent to the new lines at any given time. Butterfly valves or resilient seat gate valves may not be pressure tested against if the difference between the test pressure and the pressure on the back side of the valve is greater than one hundred fifty (150) psi or two hundred (200) psi respectively. In such cases the valve must be left in a full open position during the test and a suitable plug and bulkhead shall be used to seal off the section of the pipe to be tested. The pressure test shall last two hours.

Water added to maintain the pressure shall not exceed the allowable leakage from the following formula during the two hour test period.

$$L = \frac{ND - P}{7400}$$

- L = Allowable leakage in gallons per hour.
N = Total number of joints in the length of pipe tested.
D = Nominal diameter of the pipe in inches.
P = Average test pressure during the leakage test in psi.

Each valved or bulk headed section of pipe shall be slowly filled with water and the specified test pressure, measured at the lowest point of elevation, shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, gauges, and all necessary apparatus shall be furnished by the Contractor. Gauges and measuring devices must meet with the acceptance of the District and the necessary pipe taps made as required. Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at points of highest elevations and afterward tightly plugged with brass plugs.

Any visible leak shall be eliminated by the Contractor before the line is accepted. Any cracked or defective pipe, fittings, valves, or hydrants discovered in the pressure test shall be removed and replaced by the Contractor with sound material in the manner provided. The test shall be repeated until the water main passes the pressure and leakage test and is accepted by the District. An authorized District representative must witness the pressure test. The District will issue a letter of acceptance of the tests as satisfactory.

Q. BACKFILLING

1. General Requirements

Unless otherwise specified for hydrostatic test purposes, all trenches and excavations shall be backfilled immediately after the pipe is laid therein, but not before the pipe has been inspected by the District.

2. Backfill Material

All backfill material shall be free from cinders, ashes, refuse, vegetable or organic material, boulders, rocks, or stones, frozen material or other material that in the opinion of the District is unsuitable. From one (1) foot above the top of the pipe to the final grade, however, material containing stones up to eight (8) inches in their greatest dimensions may be used, unless otherwise specified.

3. Use of Excavated Material as Backfill

When the type of backfill material is not indicated on the drawings or specified, the Applicant may backfill with the excavated material, provided that such material consists of loam, clay, sand, gravel, or other materials that, in the opinion of the District, are suitable for backfilling. If excavated material is indicated on the drawings or specified for backfill, and there is a deficiency due to a rejection of part thereof, the Applicant shall furnish the required amount of sand, gravel, or other approved material.

4. Sand or Gravel Backfill

If sand or gravel backfill is not indicated on the drawings or specified, and in the opinion of the District should be used in any part of the work, the Contractor shall furnish and backfill with sand or gravel as directed.

5. Limestone Screenings Backfill

When muck, ash, refuse, cinders, or acid soil is encountered in the excavation, the Contractor shall completely encase the pipe, fittings, and appurtenances in limestone screenings one (1) foot thick and complete the backfilling of the trench as shown or directed by the District. The limestone screenings shall be placed in layers three (3) inches thick and compacted by tamping to the bottom of the trench at sub grade as required in these Specifications.

Above these elevations, the limestone screenings shall be placed in layers three (3) inches thick and compacted by tamping under the pipe, fittings, and appurtenances to the centerline. From the centerline to one (1) foot above the pipe, fittings, and appurtenances, the limestone screenings shall be placed as specified in these Specifications.

6. Backfilling Under Pipe

All trenches shall be backfilled by hand, from the bottom of the trench to the centerline of the pipe, with native materials approved by the District, sand, or other approved material placed in layers of three (3) inches and compacted by tamping. Backfilling material shall be deposited in the trench for its full width on each side of the pipe, fittings, and appurtenances simultaneously.

7. Backfilling Over Pipe

From the centerline of the pipe, fittings, and appurtenances, to a depth of one (1) foot above the top of the pipe, the trench shall be backfilled by hand or by approved mechanical methods. The applicant shall use special care in placing this portion of the backfill so as to avoid injuring or moving the pipe.

The backfill material from the centerline of the pipe to one (1) foot above the pipe shall consist of native material removed from the trench and approved by the District for this purpose, or other material approved by

the District, that shall be placed in six (6) inch layers and compacted by tamping.

8. Caution Ribbon

All lines shall be laid with a plastic identification ribbon stating "Caution: Buried Water Line" or equivalent. The identification ribbon shall be between six (6) and eighteen (18) inches from the surface of the ground and directly above the pipe.

9. Backfilling to Grade

a. Backfilling of Existing Streets and Permanent Structures

Where the excavation is made through permanent pavements, gravel based streets and alleys, curbs, driveways, or sidewalks; or where structures are undercut by the excavation, the entire backfill to the sub grade of the structures shall be made with gravel or flow-filled or as required by the local transportation authority. Walks and driveways consisting of broken stone, gravel, slag, or cinders shall not be considered as being of a permanent construction.

The backfill material from six (6) inches above the pipe to the street grade shall be placed in six (6) inch layers and compacted to 95% Proctor by tamping.

b. Backfilling in Streets or Alleys to be constructed at a later date

Backfill shall be as directed in "Backfilling of Existing Streets and Permanent Structures"

c. Backfilling Where Settlement is Unimportant

Where shown on the drawings or specified by the District, the contractor may backfill the trench from one (1) foot above the pipe to the top of the trench with the excavated material, and the backfill shall be wheel rolled and neatly rounded over the trench to a sufficient height to allow for settlement to grade after consolidation.

10. Backfilling in Freezing Weather

Backfilling shall not be done in freezing weather except with permission of the District. If allowed, it shall not be made with frozen material. No fill shall be placed where the material already in the trench is frozen.

11. Backfill Sand

All sand used for backfill outside the bedding and pipe zone shall be a natural bank sand, graded from fine to coarse, not lumpy or frozen, and free from slag, cinders, ashes, rubbish, or other material that, in the opinion of the District, is objectionable or deleterious. It shall not contain a total of more than ten (10) percent by weight of loam and clay, and all material must be capable of passing through a three-quarter (3/4) inch sieve. Not more than five (5) percent shall remain on a No. 4 sieve.

12. Backfill Gravel

Gravel used for backfill shall be as directed by the governing Transportation Authority, or if not so specified, shall be Base Course conforming to the following specifications:

Percentage by Weight

Standard Size of Sieve	Passing Sieve
3/4 inch	100%
No. 4	0 - 60%
No. 10	25 - 50%
No. 200	5 - 12%
Liquid Limit	25 Maximum
Plastic Limit	6 Maximum

13. Backfill Limestone Screenings

Screenings shall consist of the products obtained from crushing sound limestone or dolomite ledge rock and shall be free from shale, dust, excessive amounts of clay, and other undesirable materials. All materials shall pass a one-half (1/2) inch sieve and no more than twenty five (25) percent shall pass a No. 100 sieve.

R. CLEANUP

Periodic cleanup work should be ongoing during the construction period. Fences, posts, wires etc. should be repaired as the project progresses. Any fence, driveway or U.S. mailbox, etc., damaged must be repaired before the completion of the same work day during which they were damaged. Where livestock is present at the work site the contractor shall arrange control of the livestock with the livestock owner and be responsible for control of the livestock during construction.

All surplus water main materials furnished by the Contractor and all tools and temporary structures shall be removed from the site by the Contractor. All dirt, rubbish, and excess earth from the excavation shall be hauled to a dump provided by the Contractor and the construction site left clean to the satisfaction of the District. All surplus water main materials furnished by the District shall be removed and delivered by the Contractor to a location designated by the District.