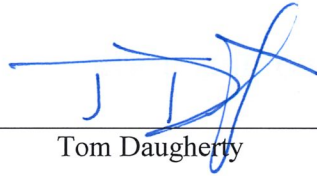


TOWN OF SILVERTHORNE

WATER SYSTEM STANDARDS

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Signed

A handwritten signature in blue ink, appearing to read 'Tom Daugherty', is written over a horizontal line. The signature is stylized and somewhat cursive.

Tom Daugherty

Public Works Director
Town of Silverthorne

OWN OF SILVERTHORNE
WATER SYSTEM STANDARDS

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TOWN OF SILVERTHORNE
WATER SYSTEM CRITERIA

I. GENERAL

These criteria are provided as general guidelines, but their use does not relieve design engineers from their responsibilities to provide safe, functional, system designs that meet the standard of care expected of a registered professional engineer in the State of Colorado.

The Town of Silverthorne has developed a master water system plan which includes source, treatment, pump stations, storage, pressure zones, and transmission and main trunk lines. The construction of on-site distribution and service lines for individual subdivisions of residential development and for commercial development shall be the responsibility of the individual developer. Once constructed the distribution lines and associated appurtenances shall be deeded to the Town for maintenance and operation.

The Developer shall be responsible for distributing water through their site in accordance with the requirements of this Section and the current fire code. Some of the maximum requirements of this Section are dependent upon specific traits of the development, particularly fire flow requirements and irrigation demand. In most instances, the Developer has the option of meeting the articulated requirements of this Section or modifying the land use plan or structure type to reduce the individual site requirements.

The Town of Silverthorne falls under the jurisdiction of Summit Fire and EMS. The Town has adopted the Uniform Fire Code, with Amendments, some of the items which are pertinent to water system design and construction are paraphrased in the sections which follow but the current Uniform Fire Code and its amendments must also be consulted for detailed information.

II. BASIC DESIGN PARAMETERS

- A. Description of System: The Town of Silverthorne's water system is comprised of several pressure zones with operating pressures ranging from 35 psi to a maximum normally allowable pressure of 125 psi at the street elevation. When designing a water distribution and firefighting water supply system, it is important to obtain actual pressure and flow measurements at the property to be developed. It is necessary to construct water distribution facilities within the proper zone in which the development falls.

The Town has a Water Master Plan which must be followed. Additional information will be provided by Town Staff upon request, including specifics of any existing system facilities in or adjacent to the subject property.

- B. Population and Water Use: Population estimates and estimates of water use for proposed developments shall be determined using the EQR (Equivalent Residential Unit) Schedule as a basis (see Town Code, Chapter 3, Article 2 Section 1). One EQR is based on an average daily the amount of domestic water used by an equivalent population of 3.5 persons at 100 gallons per day per person.

Irrigation demands will be calculated based on 0.15 gallons per day, during irrigation season, per square foot of landscaped area up to a maximum of 1000 square feet per EQR. Additional landscaping, if permitted, shall require additional EQRs.

- C. Water Rights: Each new development, which is not currently within the corporate limits of the Town of Silverthorne, will be required to provide or, subject to Town approval, pay for the needed water rights to serve the project. The Town’s portfolio of water rights is varied. The Town requires water rights which are senior to those of the Green Mountain Reservoir (1935) adjudication and ideally those senior to the Colorado River Compact (1922 adjudication). The Town’s master plans are based on a consumptive use percentage of 5% for in-house use and an appropriately calculated rate for outside irrigation.
- D. Friction Factors: Friction factor values (C using the Hazen-Williams Equations) for water system analysis and design shall be as shown in Table 4.

TABLE 4
FRICTION FACTORS

<u>Pipe Size</u>	<u>“C” Value</u>
8-inch	100
12-inch	110

- E. Fire Flow Requirements:
 1. For the base pressure zone, the basic system of supply, storage, treatment, transmission, and pumping capacity was designed to supply 3,500 gallons per minute for 3 hours. Fire flow requirements should be limited to this system capacity, at a minimum of 20 psi residual pressure, in addition to average peak daily flow rates. A required flow rate for any structure, or set of structures requiring rates over this maximum, must first be reduced through the use of sprinklers, control of building construction materials, control of space between buildings and control of the building fire loads. Fire flow requirements shall be determined by the appropriate Appendix of the currently adopted edition of the Uniform Fire Code, as adopted by the Town of Silverthorne
 2. The ability to take the fire flows out of the mains is mostly a function of hydrant spacing and hydrant type.
 - a. Hydrant type: All Town hydrants shall have one 5 ¼ inch pumper nozzle and two 2-1/2-inch nozzles. The required hydrant is further described in Section IV.A.5. of this document.

- b. Hydrant spacing shall meet the requirements of the appropriate Appendix of the currently adopted edition of the Uniform Fire Code, as adopted by the Town of Silverthorne. Specific hydrant locations, and orientation, shall be determined by the Town Public Works Director and the Summit Fire and EMS Fire Marshall.
- F. Pressure: The system shall be designed to be capable of supplying the required demands at the following specified pressures:
1. Minimum static pressure of 30 psi at peak hour demand at the street.
 2. Required fire flows at 20 psi residual pressure during peak day demands.
 3. Normal static pressure between 35 and 125 psi. (Pressures up to 135 psi are possible).

III. DETAILED DESIGN REQUIREMENTS

A. Water Lines:

1. Distribution and transmission system pipelines:
 - a. Shall not be smaller in size than portrayed on the Water Master Plan drawings (Contact the Town Utility Manager). The Developer shall analyze the proposed subdivision system to ensure Master Plan sizes are adequate. The minimum distribution system pipeline shall be 8-inch.
 - b. Shall be looped to provide: a system which adds to the strength of the surrounding system, adequate flexibility and, preclude dead end mains greater than 100 feet in length.
 - c. Shall be per AWWA Standards and not less than DR 14 C900 plastic pipe or Class 52 “bagged” ductile iron (DIP). See Section IV.A.1.a.
 - d. Shall be installed with tracer wire and must ***not*** be installed with conductivity connections.
 - e. Shall be installed with a minimum cover of 8 feet. The cover shall be maintained when water lines pass under culverts or drainage swales or roadside ditches. Insulation for freeze protection of pipes may be proposed in lieu of this cover. The maximum allowable depth of cover shall be 12 feet.
 - f. Shall be installed with a minimum 10-foot clear separation from any sewer main.

- g. Shall have isolation valves installed in the system and as required by the Town to facilitate isolation of sections of water main so as to provide system flexibility and reliability.
- h. Shall be insulated from freezing where construction phasing or other circumstances indicate a risk.

2. Trench Systems - Detail W3

Pipes shall be bedded so as to not provide hydraulic permeability in excess of that of the natural soils. At no time shall the bedding be allowed to transport water within the trench or interconnect water, sewer, or service line trenches and bedding. Designing for the prevention of the transport of water within the trench is the responsibility of the design engineer. The following methods are usually acceptable: impervious bedding material (i.e. compacted road base, or flow fill), properly spaced clay dams; PVC anti-seep collars. Other methods may be approved by the Town.

If non-impervious pipe bedding material is used, a system for preventing movement of water is to be installed with spacing determined by the slope of the pipe. A new trench dam is to be installed at a point where the horizontal level of the top of the bedding material at the downstream dam reaches the bottom of the trench at the upstream dam.

3. Service system lines - Detail W1:

- a. Shall be a minimum of one inch for single family residential and sized to handle computed required flows for all applications.
- b. Shall be equipped with pressure regulating valves where the static pressure may exceed 80 psi.
- c. Shall be type Pure-Core DR 9 HDPE for 1-inch size, or larger. See Section IV.A.1.b.
- d. Shall be installed with a minimum of 8 feet of cover and a maximum of 12 feet of cover. If any portion, including the goose neck, has less than the required 8 feet of cover, insulation must be provided.
- e. Shall be installed with a McDonald curb stop and box or equal approximately 1- to 3-feet from the property line, with the top at or above grade.
- f. Shall be installed with a minimum 10-foot clear separation from sewer service lines, or with a minimum one-foot vertical separation where crossing at a required minimum angle of 45 degrees.

- g. Shall be insulated where any part of the service line is less than eight feet from the below ground surface using 100 psi foam under all driveways, roadways, or parking areas, or 60 psi foam anywhere else.

B. Fire Hydrants – Detail W4:

1. Shall be as described in Section IV.A.5.
2. Shall not be closer than 30 feet measured distance to the closest structure without the approval of the Town.
3. Shall be accessible from roads meeting the criteria of the roads section of this document.
4. Shall be installed on a lateral line of at least 6-inch pipe no longer than 150 feet in length. The lateral shall have a hydrant isolation valve located 3 to 6 feet from the fire hydrant and shall have tracer wire installed in accordance with Section IV.A.4, and Detail No. W11.
5. Shall be installed with the grade ring located at or near the elevation (\pm 2 inches) of the surface of the roadway, sidewalk, or bike path on which it fronts.
6. Shall be installed in a location or manner such that a clear operating platform free of obstructions or obstacles exists within a five (5) foot radius of the operating nut.
7. Shall be installed in a location or manner such that the path a fireman would be required to take from the logical pumper location to the fire hydrant is not impaired by any obstruction or obstacle including landscape berms or drainage swales having a vertical deviation of more than 18-inches from the traffic flange elevation.
8. As determined by the Public Works Director: where exposed to potential damage fire hydrants shall be protected by appropriate crash bollards located so as not to block any of the outlets.

C. Miscellaneous Provisions:

The Developer is responsible for the design, construction and inspection of water lines needed to provide the required demands for domestic use and fire flows for the property. The Town does not permit separate water lines from the water main to any required building fire system. If per Town Water Master Plan requires a pipeline of a size larger than that needed to provide the needs of the development, the Town will be responsible for the additional cost of pipe material required to

have the necessary size pipeline installed, however, no line less than 12-inches in diameter shall be considered as oversized.

1. Water Meters – Details W2A and W2B.

- a. Water meters are required for all services provided to Town customers. Permanently installed meters must be sized by the design engineer and paid for at the time of building permit issuance and will then be provided by the Town when the property has a heated and protected location for the meter. Each meter will be connected to a transponder which shall be installed by the Town when a final inspection is called for by the developer.
- b. The meter shall be installed by the developer inside each building in a heated, protected, safe location, accessible by walking. It shall be installed subject to the approval of the Town and so that the meter has a minimum of 12-inches of clearance above and below, right and left and a minimum working space clearance of 3 feet on the side from which maintenance will occur. It shall be protected from freezing. Meters shall not be installed on the fire sprinkler system of any building. Please allow a minimum of 4 weeks lead time for meters.
- c. Backflow Prevention Device. All connections to the Town water system are required to have backflow prevention devices installed downstream of the water meter. Single family residential buildings shall have at least a double check valve assembly similar to or equal to a Watts Regulator No. 7. Multi-family, transient residential, and commercial buildings will require a higher degree of backflow protection depending on the level of potential hazard. All Fire Sprinkler and Irrigation systems must have a currently certified, testable, reduced pressure backflow prevention device.

4. Thrust restraint – Detail W7.

- a. At least two of the following three types of thrust restraints must be employed; thrust blocking, stainless steel rodding, and restrained joints. Thrust blocks are to be sized for the fitting to be restrained at test pressure while taking into consideration the soil bearing pressures. The thrust block shall be mixed concrete, poured against firm, undisturbed soil. If sufficient undisturbed bearing area cannot be obtained for thrust blocks, oversized blocks, restrained joints in adequate lengths, or a combination of the two may be acceptable, subject to Public Works Director approval. Thrust blocks shall be poured with a bond breaker in such a manner to leave bolts on fittings accessible for repairs.

5. Fire Sprinkler Systems. Fire sprinkler systems shall be equipped with flow detection equipment and shall have anti-tampering devices attached to valves.

The location of sprinkler system equipment shall be approved by the Fire Marshall (See adopted Uniform Fire Code). A single service line to the building is required, with the domestic service tapped to the fire line inside the building.

6. Distribution system appurtenances.

- a. Air Release Valves (ARVs) are required at all high points of pipelines that have the potential to trap air and affect flow. Hydrants are not an approved equal to ARVs.
- b. Blow-offs must be installed at the end of all temporary dead-end lines. These must be sized to provide required flushing velocities per AWWA standards. See Detail W10.
- c. Main line pressure reducing valves (PRVs) may be required to meet the pressure zone requirements in the Town of Silverthorne.

7. Easements

Where a water line or fire hydrant which will become the property of the Town and crosses, or is located on, private property, an exclusive easement for access, maintenance, operation, repair or replacement including upsizing, of the item or system must be provided. The easement shall meet the following requirements:

- a. The exclusive easement shall be 25 feet in width; generally, 12-1/2 feet on both sides of the center line of the pipe for the full length of the pipe on the subject property. If water and sewer lines are to be within the exclusive easement then it shall be 35 feet in width, with a 10-foot clear separation between the outsides of the pipes.
- b. The easement for a fire hydrant lateral line shall be as in item a. above and shall also extend 12 ½ feet to the rear of the fixture.
- c. An appropriate deed or dedication will be required to be conveyed to the Town prior to final acceptance of the line(s) and/or hydrant(s).
- d. The easement deed shall stipulate that the Town is not responsible for replacement or repair of any surface improvements installed within the easement and over the line.
- e. The easement shall be labeled for its use i.e., EXCLUSIVE 25FT WATER for water facilities, EXCLUSIVE 25FT SEWER for sewer facilities or EXCLUSIVE 35FT WATER/SEWER for both water and sewer, and DRAINAGE for drainage facilities. Water and sewer easements shall ***not*** be labeled as utility easements.

- f. Any below grade improvements within exclusive easements are subject to the approval of the Town, and if approved written permission from the Town for the placement of these improvements is required.
8. Placement of utilities within right-of-way or easements – Detail W14
The Town has a typical cross-section of utility placements within a street right-of-way. This layout shall be used and included in the plans and specifications for the project. Utilities other than water and sewer may be in their own easements adjacent to water and sewer easements but may only be within easements designated for Water, Sewer, with written permission from the TOS Public Works Director. Generally, other utilities may only cross at a 45degree or greater angle to the water or sewer easement.
9. Sewer main and sewer service lines that cross water mains shall have at minimum a 20-foot length of pipe centered on the point at which it crosses the water main or service line (see Detail W15).
10. Landscaping, revegetation, surface restoration, and erosion control:
- a. Wherever a water line is installed in an open area (area other than a surfaced path or roadway), the surface shall be restored to its natural condition.
 - c. Areas that are at a high risk for erosion require additional measures such as riprap, planting of low shrubs, and the use of erosion control netting to promote slope stability.

IV. SPECIFICATIONS

- A. Material: All material shall be new and the best available. It shall be specified according to the latest revision of the standards of the American Water Works Association (AWWA), the American National Standards Institute (ANSI), and the American Society of Testing and Materials (ASTM). The following are the minimum requirements.
1. Pipe.
 - a. All metal distribution pipelines and fittings shall be bagged. Either concrete lined AWWA Class 52 ductile iron (DIP), or DR 14 C900 plastic may be used. All sizes shall be “push-on” joint type with rubber gaskets.
 - b. For residential service lines the pipe shall be 1” Pure-Core or equal DR 9 HDPE or larger. If a pipe larger than 2 inch is required, the pipe shall at least 4” and be bagged, concrete lined, AWWA Class 52 ductile iron (DIP), or DR 14 C900 plastic.
 2. Fittings.
 - a. Distribution system fittings shall be bagged cast iron, Class 250, cement lined, with mechanical joints.
 - b. Service line fittings shall be appropriate for the material used, any buried metal is to be bagged, and must be rated for static operating pressures of at least 150 psi. Copper pipe and flared fittings are not permitted.
 3. Valves.
 - a. All system section valves, service line valves in ductile-iron pipelines, and fire hydrant lateral valves, shall be AWWA approved gate valves. Each valve shall conform to standards for buried service for a working pressure of at least 250 psi and be iron body, bronze-mounted, double disc, parallel seated, resilient seat wedge-type gate valves, and shall open left (counterclockwise); have a non-rising stem; a 2-inch operating nut; and mechanical joint connections.
 - b. Service line valves. Corporation and Curb stops shall be Mueller or an approved equal for the required size and be of the Compression fitting type.
 4. Pipeline Conductivity. Conductivity of the pipeline shall ***not*** be provided. Tracer wire ***is*** required per Detail W11.
 5. Fire Hydrants – Detail W4. All fire hydrants shall be Waterous “Pacer” WB-67 DDP, Mueller A-403 Centurion, or equal meeting the following requirements:

Valve	5-1/4 inch
Inlet	6 inches for mechanical joint
Depth of Bury	9' 6"
Operating Nut	Standard Pentagon
Open	Left (CCW)
Outlets	Two 2-1/2 inch and one 5 1/4 inch pumper nozzle
Threads	NHT National Hose Thread
Color	Red, blue caps must be provided if static pressure is in excess of 135 psi
Thrust Restraint	Bottom thrust block and 2each 3/4" stainless steel tie rods from main tee to hydrant bottom or as approved by the Town.
Elevation of nozzle	42 1/2" operating nut above finished ground surface at bury line.

6. Valve boxes – Detail W5.
 - a. Main line valve boxes shall be cast iron, have a diameter of 5-1/4 inches, and be 1/4-inch minimum thickness. They shall be an extension type with screw-on, have a Denver style flared base to fit over the matching sized valve, and have a cover labeled "WATER." Shall be a Tyler 6850 three piece or approved equal.
 - b. Curb stop boxes shall be "McDonald" or Equal, any extensions must be welded.

7. Thrust restraint – Details W7 and W9.
 - a. Thrust blocks shall be made of concrete with a mix no leaner than 1-part cement to 2-1/2 parts sand to 5 parts aggregate to 1/2 parts water, and have a 28-day strength of not less than 3000 psi. The bond breaker shall be polyethylene sheeting.
 - b. Tie rods – Detail W8, shall be stainless steel with a minimum tensile strength of 60,000 psi. All joint harnesses, clamps, rods, bolts, washers, nuts and other metal parts shall also be Stainless steel.

8. Polyethylene bagging/sheeting/sheathing shall meet ASTM Standards with a minimum thickness of 8 mils. For pipe or tie rod protection, it must be tubular with provisions for making watertight connections and joints. Tears shall be avoided but must be made watertight. All buried metals must be bagged.

10. Insulation – Detail W3

Where approved and required, insulation shall be rigid extruded polystyrene foam boards measuring at least 2 feet wide by 8 feet long by 2 inches thick with a high-density skin. The boards shall be placed minimum 3-inches (6-inches preferred) above the pipe on a compacted backfill bed. They shall be placed per Detail W3, to form a minimum width of 48 inches or full trench width, whichever is less and jointed with adhesive tape. Insulation shall be 100 psi rated under driven surfaces and at least 60 psi rated for any other installation

B. Installation:

1. Installation of all water lines, valves, fittings, and other appurtenances which will become the property of the Town or connect to a Town system where service will be required to be provided, shall be performed in a high-quality manner. The work shall be conducted with such forces of workers possessing the necessary knowledge, ability, skill and experience to complete their portions of the project in a first class and acceptable condition in a reasonable amount of time. Town reserves the right to reject any work that is not completed according to Town standards and/or in a high-quality manner.
2. Safety. In accordance with generally accepted construction practices and the requirements of State and Federal safety regulations, the Contractor will be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of work. This requirement will apply continuously and not be limited to normal working hours. The duty of the Engineer's inspector to conduct construction observation of the Contractor's performance is not intended to include review of the adequacy of the Contractor's and Subcontractor's safety measures, in, on, or near the construction site. The Contractor must provide the Inspector with safe access to the job site. Unsafe work areas will not be inspected; uninspected work will not be accepted.

The Contractor shall at all times take necessary precautions to insure the protection of the public. The Contractor shall furnish, erect, and maintain, at his own expense, all necessary barricades, suitable and sufficient warning lights, construction signs, provide a sufficient number of watchmen, and take all necessary precautions for the protection of the work and safety of the public through or around their construction operations.

3. Trenching and Backfill Detail W3. All trenching and backfill operations shall conform to applicable OSHA standards and the requirements set forth in the Town of Silverthorne, Excavation Permit Process and Standards, Section 2.
4. Construction details must be included in the construction plans to ensure a complete understanding of construction procedures which are compatible and acceptable to the Town's system and standards of performance. All supplied details shall be subject to review and require the approval of the Town.
5. Example Detail Nos. W1 through W15 provided in the appendix to this text are intended solely for informational purposes to portray the types of installation methods which may be compatible with Town systems and to illustrate basic standards of construction expected on Town facilities. These details do not relieve the Design Engineer from their responsibilities to provide safe, functional, system design that meets the standard of care expected of a registered professional engineer in the State of Colorado.

C. Observation and Testing: All facilities being constructed by the Developer, which will become the property of the Town, or which will connect to a Town system where service will be required to be provided, may be subject to continuous inspection and testing by the Town, and/or the Lake Dillon Fire Protection District (for fire protection items and systems).

1. Construction checking.

- a. The developer will provide full time construction inspection by a qualified inspector as determined by the Town Engineer.
- b. During construction, the Town will make periodic observations (sometimes commonly referred to as “inspections”). The purpose of these observations and construction checking is to determine the progress of the work and to see if the work is being performed generally in accordance with plans and specifications. The Town will in no way be responsible for how the work is performed, safety in, on, or about the job site, methods of performance, or timeliness in the performance of the work.

c. Inspection of Work.

(1) Inspectors shall inspect materials used, and observe the work done. Inspections may extend to all or any part of the work and to the preparation or manufacture of the materials to be used. The inspectors will not be authorized to alter the provisions of specifications, or to delay the fulfillment of the construction by failure to inspect materials and work with reasonable promptness. An Inspector cannot issue instructions contrary to the approved drawings and specifications or act as Foreman for any Contractor or Sub-contractor. The Inspector will have authority to reject defective material and to suspend any work that is being done improperly subject to the final decision of the Town.

(2) If sub-standard material, not conforming to the requirements of the approved drawings and specifications, has been delivered to the project, or has been incorporated in the work, or if work shall have been performed of inferior quality, then such material or work shall be considered as unacceptable, and shall be removed and replaced with materials conforming with the approved plans and specifications as directed by the inspector or Town at the Developers expense, prior to acceptance of the facilities and before any services will be provided. All materials shall be subject to examination and testing by the Town at any time during manufacture. The Town reserves the right to reject defective materials during manufacture or before they have been incorporated into the work.

- (3) Some specific items and work, as listed below, and others as may be required by the approved specifications, are required to be tested or checked. The Developer or his Contractor shall give the inspector and the Community Development Department not less than two business days' notice of readiness for inspection. If the inspection is by an authority other than the Town, of the date and time fixed for such inspection. If any work should be covered up without the consent of the Inspector it must, if required by the Inspector or the Town, be uncovered for examination at the Developer's expense.

A list of specific items requiring continuous observation follows:

- (a) Pipeline installation, bedding, and backfill.
- (b) Fire hydrant installation from main line tee to grading of ground at grade ring.
- (c) Thrust blocks. (forming and rebar placement, if applicable, shall be approved by the Inspector prior to pouring concrete.)
- (d) All valve boxes, main line, hydrant laterals, and service curb stop boxes form placement over valve to surface grading and concrete collar installation.
- (e) All service line connections to main lines
- (f) Testing of residual chlorine content, and/or sample collection for bacteriological testing note that this must be observed by the Town.
- (g) Main line flushing after to high chlorine test: Note that no flushing of waterlines into manholes can be done unless written permission from the Town is obtained and in hand, and any special instructions and/or limitations are being followed.
- (h) Final pressure and leakage tests
- (i) All connections to existing Town systems. Note that a minimum of two business days' notice must be provided to the Town.

- (ii) Adjustments of fire hydrant traffic flanges, if approved. (This includes any disassembly of fire hydrants on site once material has been provided by the equipment supplier).
- (m) Water meter installation
- (n) Blow-off installation
- (o) PRV system installations
- (p) Fire hydrant operation and flow rate test

2. Testing

- a. Throughout the progress of the work, several tests are required to be performed to ensure system integrity, to demonstrate system operation, and to ensure system compatibility prior to placing it into service with the existing Town system. The Town must be given at least two business days of notice prior to testing.
- b. The following is a description of the actions or tests to be performed along with some specific requirements.
 - (1) Pipeline Flushing – in conformance with the then current AWWA Standard. The Contractor shall flush the pipelines as the work progresses by means in accordance with good practice to ensure that sand, rocks, or other foreign material are not left in any of the pipelines. The flushing shall be made through an open pipe end; otherwise, use of a fire hydrant may be acceptable, but only on special approval of the Town. When flushing, care must be taken to prevent damage to property or roadways or erosion of surrounding soils. The Contractor is responsible for repairing any damage.
 - (2) Pressure Test. After each section of the pipeline has been laid the pipe shall be slowly filled with water and tested according to then current AWWA Standard. All pipes shall be tested at a pressure of at least 1.5 x the working pressure at the point of testing. Test pressures shall be not less than 1.25 x the working pressure at the highest point along the test section. To the extent possible, each segment shall be tested separately.

Each section of the pipeline being tested shall be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Town.

The Contractor shall furnish all necessary labor and equipment to perform the test.

Before applying the specified test pressure, all air must be expelled from the pipe.

All exposed pipes, fittings, valves, hydrants and joints will be carefully examined during the test. Any cracked or damaged pipe or appurtenances found during the test shall be removed and replaced by the Contractor with sound material. The test shall be repeated until the results are satisfactory to the inspector.

- (3) Leakage Test. A leakage test shall be conducted after the pressure test has been completed, unless the pressure test indicates that there are no leaks. The Contractor shall furnish the pump, pipe, connections, meters, and all other necessary apparatus, and shall furnish the necessary assistance to conduct the test. The duration of each leakage test shall be two hours and, during the test, the main shall be subjected to a hydrostatic pressure of 1.5 x the working pressure at the point of testing. No pipeline installation will be acceptable until the leakage is less than the amount computed by the following formula: $L=SD(P)^{0.5}/133,200$

L = Allowable leakage in gallons (for two-hour test)

S = Total length of pipe (feet)

D = Nominal diameter of pipe (inches)

P = Average test pressure during the test (psi)

Should any test of pipe disclose leakage greater than that specified above, the Contractor shall, at his own expense, locate and repair the points of leakage until the leakage is within the specified allowance.

The pipe may be subjected to hydrostatic pressure and inspected and tested for leakage at any convenient time after the trench has been partially backfilled, except at the joints, or backfilled as permitted by the Town. Where any section is provided with concrete thrust blocks, the pressure test shall not be made until at least two days have elapsed after the concrete was installed.

- (4) Disinfecting. All newly installed water pipelines shall be disinfected per an approved method which fills the pipe with a chlorinated solution. This solution shall be left in the pipelines for not less than 24 hours, and after that length of time, the chlorine residual of the solution, at any place in the system, shall not be less

than 25 ppm, or the pipeline must be rechlorinated and the disinfection process repeated.

Following a successful disinfection process, the line must be flushed until the chlorine residual is at or below 1.00 ppm, or equal to 110 percent of system residual, whichever is higher. A sample must then be collected for bacteriological testing by a State approved laboratory.

Disposal of chlorinated water must be in conformance with then current CDPHE Low Risk Discharge Guidance or other method approved in writing by the Town.

- (5) Fire Hydrant Operation and Flow. The Town and/or Fire Marshall shall conduct an operational test of each newly installed fire hydrant. No hydrant will be accepted if it cannot be cycled through two complete open and shut operations without malfunction or if it shows any leakage during the test process. The water system will not be accepted if the testing indicates that the required fire flows for the project cannot be achieved through the installed hydrants.

3 As built and Acceptance Requirements

- a. Following completion of the project the Developer shall request, in writing to the Town Community Development Department, acceptance of the installed Public Improvements by the Town. Concurrently the Developer shall provide to Town sealed as-built drawings of the constructed system indicating the location and depth of all system components, and a sealed letter report from the design engineer stating that the improvements were constructed in conformance with the approved plans and specifications. The date of final acceptance shall be the date the Town issues a certificate of completion and acceptance, adding specific facilities to the Town's system.
- b. Following final acceptance by the Town and placement of the public improvements into service, the Developer shall be responsible for the satisfactory operation all public improvements for a period of two (2) years, or such other period as may be provided by contract or law, and; for the satisfactory repair or replacement of any work, material or equipment which becomes defective during this period, providing any failure results directly or indirectly from faulty workmanship or negligence by the Developer or any Contractors or Sub-contractors performing such work, or from faulty manufacturing or from faulty erection or improper handling of materials or equipment furnished or installed by the Developer or any Contractor or Sub-contractor under their direction or cognizance.

