

**STATE OF CONNECTICUT DEPARTMENT OF PUBLIC HEALTH
DRINKING WATER SECTION**

WATER MAIN DESIGN AND CONSTRUCTION GUIDELINES

Effective Date: October 1, 2006

The following guidance is provided in the interest of facilitating the approval process for federally or state funded projects such as Drinking Water State Revolving Fund and STEAP grant projects that may include water main replacements or installations. Discretion in the application of these guidelines is allowable except as required by regulation. For routine distribution water main installations that do not require approval from the Department prior to construction, it is recommended that the following guidelines be utilized during design and construction except as required by regulation.

Sizing and Layout

(1) Section 19-13-B102(p) of the Regulations of Connecticut State Agencies (RCSA) requires transmission facilities to be sized to provide flows in excess of the maximum flows experienced in the community water system or service area. In addition, Section 19-13-B102(f)(1) of the RCSA requires that all service connections have a minimum water pressure at the main of 25 psi under normal operating conditions which in these guidelines includes normal peak demands but excludes fire flow demands. Whenever feasible, it is recommended that the minimum water pressure be 35 psi. Positive pressure (20 psi minimum recommended) should be maintained under all flow conditions, including fire flows if fire protection is provided, at all points in the distribution system. Pressure reducing devices should be installed where static pressures will exceed 100 psi. Pressure reducing devices conforming to section 604.7 of the current State of Connecticut Plumbing Code should be installed on individual service lines where static pressures entering the building are greater than 80 psi. If fire protection is to be provided, the system design should be such that fire flows, minimum fire flow pressures, hydrant spacing, etc. are in accordance with the requirements of the local fire protection regulatory authority.

(2) Water mains should be sized, whenever possible, to achieve a balance between hydraulic requirements and water quality maintenance. Excessive retention time (less than 5 to 7 days of retention time recommended) may result in low flow areas which may lead to water quality deterioration during normal operating conditions. If excess capacity is required for fire flow or future demands, flushing devices or equivalent should be installed in low flow areas and an operational plan should be implemented to routinely flush low flow areas. The use of smaller diameter parallel water mains in lieu of single larger mains should be considered whenever possible.

(3) Water mains should be looped and dead-end water mains avoided whenever possible. If dead-end mains are unavoidable, flushing devices should be installed at the termini of the dead-end water mains and an operational plan should be implemented to routinely flush the dead-end mains. If water mains will be separated by a closed valve thereby creating static conditions (as in the case of pressure zone boundaries for example), flushing devices should be installed on both sides of the closed valve.

Materials

(1) Pipes, fittings, valves, meters, fire hydrants, and other appurtenances should, at a minimum, conform to the most current applicable AWWA standards if available. In the absence of applicable

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AWWA standards, materials and products should conform to other applicable recognized industry performance standards, if available, to ensure integrity and performance during service.

(2) Water service lines should conform to sections 603 and 605 of the current State of Connecticut Plumbing Code.

(3) Materials and products should not cause the water delivered to the customers to become non-potable, produce aesthetic problems such as taste and odors, or promote bacterial growth after being placed into active service. All pipe materials and products including, but not limited to, paints, linings, coatings, adhesives, and lubricants in direct contact with potable water should be certified to NSF/ANSI Standard 61. All materials and products in contact with potable water should be compatible with the water quality characteristics.

(4) Materials should be capable of withstanding internal and external forces to which they may be subjected while in service.

(5) Metallic materials should be protected against internal and external corrosion.

(6) The use of non-metallic buried water pipe should include a tracer wire, underground utility detection tape, or equivalent means for pipe location.

(7) Non-permeable materials, including joint gaskets, should be used in areas where organic contamination is reasonably known to exist or encountered during construction.

Appurtenances

(1) Shut-off valves should be installed at intervals and locations as determined by the public water system (PWS) to minimize interruptions of service to customers during repairs or maintenance.

(2) At high points in water mains where air may accumulate and cause pipe restrictions, provisions should be made to remove the air by air release valves or equivalent means. Air release valves should be located and installed to prevent the entry of rainwater and vermin and under no circumstance should they be subject to being submerged.

(3) Blow-offs or equivalent appurtenances should be installed at low points of the water main installation, depending on flow rate and pipe profile, where sediment may accumulate.

(4) Chambers, pits, or manholes containing distribution system appurtenances should be located, to the extent feasible, to prevent flooding or adequately drained to keep the structure dry. If gravity drainage is not practical and a sump pump or other mechanical means are employed to drain the water to a storm sewer or other drainage system, a check valve should be installed on the pump discharge line and the discharge should be located above the normal flow elevation in the receiving chamber or pipe. In no instance should a drain be connected directly to any sanitary or combined sewer.

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- (5) Flushing devices should be installed at intervals and locations as determined by the PWS to allow for adequate flushing of the entire water main.
- (6) The drain ports for dry-barrel fire hydrants should be provided with a gravel pocket or equivalent for drainage and should not be connected to any sewer. Hydrant drains should be located at least 10 feet from sanitary sewer force mains and any part of a subsurface sewage disposal system. Hydrant drains should be located a minimum of 18 inches from gravity sanitary and storm sewers (10 feet recommended whenever possible). If the water table in the area is known to be high, the drain ports should be plugged watertight and an operational plan should be implemented to pump the hydrant barrels dry during freezing weather.
- (7) Fire hydrants should not be installed on water mains that are not sized for fire protection and should not be connected to a PWS which does not have adequate flows/capacity to meet fire flows.
- (8) Flushing devices should not be directly connected to any sewer.
- (9) Flushing devices should be capable of providing a minimum flushing velocity of 2.5 feet per second.
- (10) Appurtenances should be installed in accordance with the most current applicable AWWA standards/manuals if available. If manufacturer's instructions are more stringent than AWWA standards, appurtenances should be installed in accordance with manufacturer's instructions. In the absence of applicable AWWA standards, appurtenances should be installed in accordance with the more stringent of manufacturer's instructions or other applicable recognized industry standards if available. At a minimum, appurtenances should be firmly supported to prevent excessive settlement.

Service Connections

- (1) Domestic service pipes should have a minimum diameter of $\frac{3}{4}$ inch.
- (2) Domestic service pipes should be sufficiently flexible to prevent fracture from expansion, contraction, and differential settlement.
- (3) Domestic service pipes should be connected to a single-service corporation stop at the water main and should be installed with a shut-off valve and curb box.
- (4) Domestic service connections should be individually metered.
- (5) Means should be provided to flush dedicated fire service lines to remove stagnant water.

Installation

- (1) Installation of water pipe should be in accordance with the most current applicable AWWA standards/manuals if available. If manufacturer's instructions are more stringent than AWWA

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standards, water pipe should be installed in accordance with manufacturer's instructions. In the absence of applicable AWWA standards, water pipe should be installed in accordance with the more stringent of manufacturer's instructions or other applicable recognized industry standards if available. At a minimum, continuous uniform and stable support, free of unsuitable materials, should be provided such that the water pipe is fully and firmly supported along its entire length. Proper embedment and backfill, free of unsuitable materials, should be provided and sufficiently compacted to ensure that the water pipe is adequately supported, stabilized, and protected. Special care should be taken when making pipe joints to ensure water tightness.

(2) All materials should be kept as clean as possible during construction. The use of plugs or equivalent on the open ends of the pipe is recommended to prevent contamination of pipe at the job site. Joints should be cleaned of any grit and other foreign material which may promote leakage.

(3) All buried water pipe should be placed at such a depth below finished ground level, four feet minimum, that will prevent freezing during the coldest weather experienced. Service connections that will not be used during freezing weather and will be drained during such time may be exempt from this recommendation. In special situations, excluding ledge, where it may not be feasible to bury the water pipe below the frost line, the use of adequate insulation or equal may be permissible to prevent freezing of the water pipe. Consideration should also be made for insulating water pipe that is installed four feet or greater below finished ground level but passes above or below a structure that may be a cold air source such as a culvert.

(4) Thrust blocks and/or restrained joints should be used on all tees, bends, caps, plugs, reducers, valves, hydrants, etc. to prevent joint separation. If a combined thrust block/restrained joint system is used, either the thrust block or restrained joint system should be designed to provide full thrust restraint independent of the other system.

(5) The water main should be adequately protected by the use of flexible joints, preferably ball and socket joints, or equivalent in critical areas of water main stress such as piping through rigid walls or structures and/or where differential settlement may occur.

(6) Separating Distances from Sources of Pollution:

(A) Parallel installations: water mains should be laid at least 10 feet horizontally, measured edge to edge, from any existing or proposed sewer (sanitary, building/house, and storm) whenever possible. If the 10-foot horizontal separating distance cannot be physically achieved, the water main may be installed closer provided that is located in a separate trench or on an undisturbed shelf and at least 12 inches horizontally (18 inches recommended), measured edge to edge, and 18 inches above the top of the sewer, measured from crown to invert. There should be no reduction in the 10-foot horizontal separating distance for a sanitary sewer force main. No water main should come in contact with any part of a sewer manhole.

(B) Crossings: at sewer crossings, a minimum vertical clearance of 18 inches, measured from crown to invert, should be maintained between the water main and sewer with the preferred location

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of the water main above the sewer whenever possible. The water main should be centered at the sewer crossing such that the water main joints are spaced as far as possible from the sewer. If the water main will cross above the sewer and will be centered above the sewer such that the water main joints are spaced as far as possible from the sewer, the vertical separation distance may be reduced to 12 inches. There should be no reduction in the vertical separation distance of 18 inches for sanitary sewer force main crossings. If the water main will cross under a sewer, special consideration should be given to the structural support of the sewer to prevent settling or deflection of the sewer which may damage the water main.

(C) If the separating distance requirements stated in Sections (A) and (B) above cannot be achieved, the design engineer should evaluate alternatives so that the water main will be protected from potential contamination. The following alternatives may be considered acceptable:

(i) The sewer in conflict should be made of materials and have watertight joints equivalent to water main pipe, constructed in accordance with water main standards of construction, and pressure tested to ensure water tightness.

(ii) The use of pipe joint repair clamps or equivalent on the water main to ensure watertight pipe joints in addition to sufficient pipe wall thickness.

Additional alternatives not listed above may also be acceptable if adequately supported and documented.

(D) There should be a minimum separating distance of 10 feet between water mains/service lines and any part of a subsurface sewage disposal system.

(E) Separation of water service lines and building sewers should be in accordance with section 603.2 of the current State of Connecticut Plumbing Code.

(7) Bridge/Surface Water Crossings:

(A) For bridge crossings the water pipe should be adequately supported, protected from damage, and insulated to protect the pipe from freezing. Expansion or flexible joints should be installed as necessary. Shut-off valves should be installed on both sides of the bridge crossing.

(B) For underwater crossings shut-off valves should be installed on both sides of the crossing.

Cross Connections

(1) Section 19-13-B37 of the RCSA requires that no physical connection be made between the distribution system of a PWS and any customer with a private well or existing PWS well unless such well is physically disconnected from the customer's plumbing. In addition, if the well is known to be contaminated, the customer shall also install a reduced pressure principle backflow prevention device (RPD) on the service line from the PWS.

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Hydrostatic Testing and Disinfection

(1) After construction is completed all new water pipe and appurtenances should be subjected to hydrostatic pressure and leakage testing to ensure water tightness and integrity of construction in accordance with the most current applicable AWWA standards/manuals if available. If manufacturer's instructions are more stringent than AWWA standards, water pipe should be hydrostatic tested in accordance with manufacturer's instructions. In the absence of applicable AWWA standards, water pipe should be hydrostatic tested in accordance with the more stringent of manufacturer's instructions or other applicable recognized industry standards if available.

(2) Section 19-13-B47 of the RCSA requires that after construction is completed all new water pipe and appurtenances be disinfected and flushed. Disinfection should be done in accordance with the most current version of AWWA Standard C651. Chemicals used in the disinfection process should be certified to NSF/ANSI Standard 60.

(3) After disinfection and flushing but prior to placing the water main into active service, water sample(s) representative of the new construction should be collected in accordance with the most current version of AWWA Standard C651. Samples should be analyzed, at a minimum, for total coliform bacteria, HPC, total and free chlorine residual, and physical parameters. Test results, with the exception of chlorine, should meet the water quality standards shown in Table 1 prior to placing the water main into active service.

Table 1 – Water Quality Standards

Parameter	Standard
Total Coliform Bacteria	0 or absent
HPC	< 100 organisms/mL
Color	< 15 CU
Turbidity	< 5 NTU
Odor	< 2
PH	range 6.4 – 10