Section 4: Water Design

Version 4.0

A. Sizing and Configuration

1. {107} The specific relay size shall be provided by the Planning Unit.
    a. For in-house water only projects the water relay requirements are available in the CIPIT (Capital Improvement Program Integrated Tracking System) pipe estimate screen of scheduled locations.
    b. For consultants designing a water only project, the water main relay requirements will be provided upon receipt of a completed water base plan.
    c. Actual final design location, configuration, and limits shall be based on the Engineer's judgment encompassing all aspects of the design process.
2. For project including sewer, water relay requirements will be provided concurrently with sewer requirements on a completed sewer base plan.
3. Consultants should see Section 6 A [77] for the base plan submittal and review procedure.

B. Proposed Water Main Design

1. Location for New Developments
    a. On City Streets with a cartway 36 feet or less – the main shall be located in the center of the street except as stated below in c.
    b. On City Streets with a cartway greater than 36 feet or with active SEPTA tracks- a dual main may be required. the use of dual mains should be approved by the Water/Sewer Engineering Supervisor.
    c. On state Highways with a cartway 36 feet or less – the main shall be located in the cartway such that the required limits of milling and paving are minimized except as stated below in d).
    d. If ordinance specifies footway lay, or if one side of street is park land or other city-owned property, a footway location shall be coordinated with Verizon, PECO, PGW, etc.
2. Location for Relay
    a. On City Streets where cartways are less than 36 feet wide, and if a dual main has not been specified, the location of the centerline of the proposed main shall be as follows, in order of decreasing desirability:
        i. Center of street (greater than 3 feet from nearest curb) – the nearer the center the better.
        ii. Footway – greater than 3 feet from the curb (Distance from proposed water main to buildings should be maximized, if within 6 feet of a building the design should be approved by the Water/Sewer Engineering Supervisor).
        iii. Gutter – within 3 feet of curb.
        iv. Footway – within 3 feet of curb.
    b. On State Highways were cartways are less than 36 feet wide and if a dual main has not been specified, the location of the centerline of the proposed main shall be as follows, in order of decreasing desirability.
        i. In the cartway of street (greater than 4 feet from nearest curb)-such that the number of lanes required to be milled are minimized. The nearer the center of the street the better.
        ii. Footway - greater than 3 feet from the curb (Distance from proposed water main to buildings should be maximized, if within 6 feet of a building the design should be approved by the Water/Sewer Engineering Supervisor).
        iii. Gutter - within 3 feet of curb.
        iv. Footway - within 3 feet of curb.
    c. Generally, the water main trench shall be located away from the curb to avoid increased installation costs as well as increased difficulty in future maintenance.
    d. Where the services on the two sides of the street are extremely unbalanced, as a row of homes opposite a school or factory, a footway location adjacent to the homes may be preferred.
    e. The closest a new 8 inch main can be installed next to an existing 6 inch main is 18 inches center to center, 24 inches is preferred.

f. Proposed water mains shall be located such that the water main is completely outside a line drawn on a 2 vertical to 1 horizontal slope from the outside trench line of the sewer (existing or proposed) and such that there exists a minimum of 3′-0″ between the respective trenches. If for whatever reason this is not feasible it shall be approved by the Water/Sewer Engineering Supervisor.

g. Where a sewer, for whatever reason, is to be abandoned and is 16″ in diameter or greater it shall be filled with flowable fill as specified in the Standard Details and Standard Specifications for Sewers.

h. Where a water main, for whatever reason, is to be abandoned and is 16″ in diameter or greater it shall be filled with flowable fill as stated in the Master Specifications.

3. Utility Interference

a. Philadelphia Gas Works

i. The City has an agreement with PGW, which basically states that if the proposed sewer and/or water main places the gas main within a 2 vertical to 1 horizontal influence line, the City will reimburse PGW for up to 50% of the replacement costs. It is therefore in the Water Department's best interests to evaluate our locations for proposed water mains/sewers in context of the potential costs associated with reimbursement to PGW. See Appendix IVg [85] for the Water Department /PGW Agreement.

b. Other Utilities

i. If other utilities have constructed their facilities over our water main or have installed their facility in our proposed location after they have been informed of our plans to relocate in a specific location, then they shall be responsible for either relocating their facility or reaching an agreement with the Water Department where we will relocate our facility and the other utility will pay for any additional costs to the Water Department.

ii. Utility presence in the street is by permit of the Streets Department. A highway opening permit must be obtained through the Streets Department's Guaranteed Paving Information System (GPIS) for each location where they install a new facility. This permit, along with the highway opening permit guidelines establishes the terms and conditions under which all utilities are governed in City streets. This permit gives the City and all its Departments certain rights concerning the relocation of non-city utility's facilities, for the benefit of the City. Due to the costs involved in relocating infrastructure, much prudence and engineering judgment must be used in invoking our rights with respect to other utilities. See Appendix IVb [86] for a further explanation and reference samples of the GPIS application.

4. Limits of proposed mains in major streets (cartway 26 feet or wider).

a. Intermediate intersections shall be completely rehabilitated and set up for future relay. Exception is made for intersections with ductile iron (D.I.) or cast iron tyton joint (C.I.T.J.) pipe. (1970 vintage or newer)

b. The end intersections shall be completely rehabilitated if any of the following apply:

i. Concurrent sewer work extends into the intersection.

ii. Previous relay of adjacent streets has extended up to or into the intersection.

iii. Intersecting street water main is 100 years old or older.

c. If the end intersection is not to be rehabilitated, the tie-in shall be as follows:

i. If the intersecting main is greater than 6 inches. In general, the limit shall be at the intersecting main.

ii. If the intersecting main is 6 inches, attempt to tie into the existing leg without entering the intersection (i.e. at curbline) or if due to the geometry it is necessary to enter the intersection, still attempt to tie into the existing leg.

5. Limits of proposed mains in secondary streets (cartway less than 26 foot wide).

a. Intermediate streets shall be rehabilitated. Exception shall be made for intersections with D.I. or C.I.T.J. pipe (1970 vintage or newer).

b. End intersections are not to be rehabilitated unless required:

i. For concurrent sewer construction.

ii. To finish off intersection from previous relay.

iii. By geometry.

c. If the end intersection is not to be rehabilitated, follow the instructions under 4c above.

6. Relay size

a. Except as otherwise specified, minimum relay is 8 inch.

b. On a dual main relay, one main shall be 6 inches if no fire hydrants are connected, except Center City (Delaware River to Schuylkill River and Vine Street to South Street) locations which shall be 8 inches minimum.

c. In cul-de-sacs the water main loop beyond the hydrant tee shall be relayed with a 6 inch main.

7. Pipe Material

a. All mains shall be ductile iron pipe with push-on joints unless otherwise specified by the Water Department.

b. The class of ductile iron pipe shall be 56 for sizes 6”, 8”, 10” and 12”. Class 54 shall be used for sizes 3”, 4”, 16” through 48”.

8. Valves

a. Size – All water mains shall have valves of the same size as the main unless otherwise noted except 3” mains or service connections shall have 4” valves.

b. Type – All valves, 12” and smaller, other than tapping valves are Water Department Standard resilient seat mechanical joint gate valves furnished with retainer glands. Valves 16” and greater shall be gate valves or butterfly valves as directed by the Water/Sewer Engineering Supervisor on a case by case basis.

c. Line Valve Location:

i. When the main is in the cartway 8 feet or further from the nearest curb, the valve shall be located on the house line. This makes it easy to find when it is snow covered.

ii. When the main is in the cartway less than 8 feet from the nearest curb, the valve shall be located on the curb line so that cars won’t park over it.

iii. When the main is in the footway the valve shall be located on the house line unless conditions make it necessary to be placed closer to the curb line.

d. Fire Hydrant and Service Connection Valve Locations:

i. Domestic and fire service connection valves shall be located as close to the main as possible.

ii. Fire hydrant valves shall be connected directly to a hydrant anchoring tee if possible.

e. Appurtenances:

i. All valves shall be supplied with Water Department 7 inch plastic or cast iron valve boxes.

9. Fire Hydrants

a. Type – all fire hydrants shall be Water Department Standard with mechanical joint inlets furnished with retainer gland.

b. All existing hydrants that are affected by the proposed water main relay, regardless of type or age, shall be replaced with hydrants with center compression locks.

c. Maximum spacing between hydrants:

i. Residential areas – 600 feet measured along the curb line.

ii. Commercial/Industrial areas – 500 feet measured along the curb line.

iii. The placement of hydrants in the middle of the block shall be avoided, unless the maximum spacing requirements cannot be met.

iv. The existence of high pressure fire service hydrants shall not affect the above spacing.

d. Color Coding

i. All hydrants shall be color coded by having their bonnets painted in accordance with the following, based on water main size:

- (6″-8″)Orange
- (10″-12″) Green
- (16″- Larger) Red

e. Location:

i. All hydrants except those used for blow-off and/or for dewatering purposes shall be 18 inches from curb, located near intersections and connected to the main near but behind the line valve (away from the intersection). This will prevent a hydrant from being out of service if the intersection is shut down.

ii. Where possible, hydrants shall face streets at least 26 feet wide.

iii. Where possible, hydrants shall face the wider street at a particular intersection.

iv. If there are multiple acceptable locations for a fire hydrant at an intersection based on the above criteria, then consideration should be given to:

- Choosing a location which due to the existing traffic patterns will minimize the risk of an automobile knocking the hydrant down in the future.
- Choosing a location which based on the parking patterns on the intersecting streets will maximize parking spaces in that immediate area.

v. On water relay, as well as new construction, the placement of hydrants in the middle of the block shall be avoided, provided all other requirements are met.

vi. All water mains with dead ends shall have a fire hydrant placed at the end of the line for flushing purposes. Consideration shall be made for the disposal of flushed water.

f. Hydrant Anchoring Tee:

i. Whenever possible a hydrant anchoring tee rather than a mechanical joint tee should be used for the hydrant leg.

g. Valving:

i. All fire hydrant legs shall have a 6 inch valve located as close to the main as possible. The hydrant valve, wherever possible shall be placed onto a hydrant anchoring tee.

h. Water mains in relation to fire hydrants:

i. Fire hydrants used for fire protection shall not be connected to mains less than 8 inches in diameter.

ii. For water mains laid in the footway, a minimum distance of 5 feet from the curb for 8 inch mains is required for a straight hydrant connection (5′-3″ for 12 inch mains).

iii. For water mains laid in the cartway, a minimum distance of 3 feet from the curb is required for a straight hydrant connection.

i. {102} Fire Department review of fire hydrant locations:

i. Any Contract which contains water main relay work shall be sent to the Fire Department for review, see Section 6 D.4.a [116]. A print shall be made and marked up showing which hydrants are being added and which hydrants are being removed. All hydrants to be removed and not replaced at that location shall be circled in red. All hydrants to remain shall be circled in orange. All new hydrants in new locations shall be circled in blue. All direct removal and replacements of hydrants shall be circled in brown, as shown on the Legend for Fire Department Review of Fire Hydrant Elimination in Appendix IVa [87]. All drawings shall have a legend denoting the system of marking used attached to the print.

10. Water Main Depth

a. Cover

i. Mains 12 inches and under are normally installed at 4 foot cover.

ii. Mains 16 inches and over, minimum cover shall be as defined in the Water Main Standard Details. Contact the Water/Sewer Engineering Supervisor for specific direction.

iii. Less than 4′-0″ cover shall only be used when absolutely necessary. Contact the Water/Sewer Engineering Supervisor prior to using a cover less than 3’- 6”.

b. Crossing Sewer

i. The vertical distance between water main and sanitary sewer shall be a minimum of 18 inches.

c. Crossing Transmission Water Mains (16” and Greater)

i. For locations where a transmission main crossing is required a section detail will be provided showing the location of the existing main and proposed crossing with the vertical clearance noted.

ii. If the depth of the existing transmission main is not accurately recorded a test pit can be performed during design to confirm the depth of the main.

iii. The required vertical clearance when crossing an existing transmission water main is 18 inches wall to wall, 24 inches is preferred.

iv. When crossing underneath of the existing transmission main a means and methods for performing the crossing in a nondestructive manner will be submitted for approval by the Water/Sewer Engineering Supervisor.

v. When the required vertical clearance cannot be maintained 2 pipe lengths of the transmission water main should be replaced at the location of the crossing. The addition of transmission main design work will be completed with the approval of the Water/Sewer engineering Supervisor.

11. Gas Mains

a. The proposed water main trench shall be completely outside a line drawn on a 2 vertical to 1 horizontal slope from the outside edge of the gas main trench, unless this is not feasible.

b. 12″ vertical clearance is required between the pipes.

c. If these guidelines are violated, PGW will replace their gas main in the affected area. This work shall fall under the PGW agreement. See Appendix IVg [88].

12. Existing Water Main

a. The existing water main that is to be abandoned at the completion of the relay shall remain in service during the work, except intersections beyond the line valves. In cases of possible conflict, bends or offsets shall be used to bend around the existing water main.

b. If the existing water main to be abandoned is 16″ or greater it should be filled with flowable fill.

13. Railroads

a. Prior to designing the railroad crossing the designer shall establish the present status of the tracks (i.e. active, inactive, primary, secondary or abandoned). This parameter shall affect the method of design of the crossing.

b. Pipelines crossing active tracks may require a casing pipe. When a casing pipe is required it shall be installed at 5′-6″ cover and shall be provided with casing insulators. Casing pipe installed by jacking and boring will be steel and by open cut, ductile iron. Casing pipe shall be sized as follows:

Water Main Size	Casing Pipe
8″	16″
12″	20″
16″	24″

c. For more information consult the Pipeline Occupancy Specifications on the web site of the specific railroad (Conrail, Amtrak, CSX, Norfolk Southern, SEPTA). For further information Railroad contacts are listed in Section 6.

d. Contract drawings shall contain a section and profile of the water main and casing pipe at the railroad crossing showing the casing pipe details.

e. Consultants shall submit their design directly to the railroads. See Sect. 6 D.9. [101]

14. Service Connections

a. A service list of all properties to be reconnected shall be attained from the PWD Intranet for In-House projects. Consultants shall request the service list from the Design Branch front office staff.

i. The request shall include the hundred-block of each street and shall be sent to **Annamarie.Meyers@phila.gov**.

ii. This service list shall be included at the end of the Contract Specifications.

iii. All services other than those with D (discontinuance) permits and those to empty lots shall be replaced.

b. Supply lines which have current accounts shall be replaced and reconnected.

c. Supply lines for unoccupied Non-Billed Accounts (NB-9 accounts), shall be replaced including a new curb stop. The new curb stop shall not be reconnected to the existing service pipe. The new curb stop shall be left in the “off’ position and the house side of the curb stop shall be capped or plugged.

d. The supply line to an NB-9 property which is found to be occupied shall be replaced. The new curb stop shall be reconnected to the existing service piping. Customer Service shall be notified whenever this condition is observed.

e. No lot, unless it is a current account, shall receive a new supply line.

f. Depth of proposed service piping:

i. All service piping shall be placed at 4′ cover including the proposed curb stop.

ii. If the existing curb stop is at a different elevation than the proposed curb stop, the proposed curb stop shall be placed at 4′ cover and the necessary adjustment shall be made on the distributing pipe between the proposed curb stop and the house.

g. Ferrule type services (2-1/2 inches and smaller) shall be replaced with type K copper unless polyethylene is specified by the corrosion control consultant. Such services shall be installed with one continuous length of copper service pipe between the ferrule at the main and the curb stop.

h. Ferrule type services are replaced on an equal size basis except the minimum is 3/4 inch and 1- 1/4 inch is replaced by 1-1/2 inch

i. Ferule type services shall be replaced from the main up to and including the curb stop.

   i. Main in Footway – curb stops for adjacent properties shall be on the house side of the main within 4 feet of the main. When polyethylene is used there may be exceptions. Please verify current policy.

   ii. Main in cartway or opposite footway – curb stop shall be 18 inches from the curb line in the footway.

j. Valve type services (3 inches and larger) shall be replaced with ductile iron pipe except where an isolation joint is required by the corrosion control plan.

k. Valves for valve type services are placed as close as possible to the water main.

l. Valve type services are replaced size for size except that 3 inch services are replaced with a 4 inch tee branch and a 4 inch valve followed by a 4 x 3 reducer.

m. Valve type services for mains in the cartway and opposite footway shall be replaced to the curb. For mains in the footway, valves for adjacent properties shall be on the property side of the main and the connection of the new pipe to the existing service shall be as close as possible to the new valve.

15. Fittings

a. All fittings 12 inch and under shall be 350 psi compact ductile iron mechanical joint.

b. All fittings 16 inch and over shall be ductile iron mechanical joint (350 psi 24 inch and under).

c. The openings on all fittings shall be mechanical joint bells.

d. Vertical Offsets

   i. Vertical offsets 1'-0" or less shall be done by pipe deflection where possible.

   ii. Where bends are required for vertical offsets bends (1/32 and 1/16) are preferred as they reduce the size of necessary thrust blocks.

e. Horizontal bends except as otherwise necessary shall be 1/8 (45°) bends.

f. Where possible, a pair of rotated bends is preferable to separate horizontal and vertical bends. For example when rotating a 1/8 bend halfway, it appears as a 1/16 bend in plan and a 1/16 bend if there were a profile view. More Information is included in the America Ductile Iron Pipe handbook on page 17-26.

g. All thrust fittings, bends, branch of tees, offsets, caps and plugs, and sleeves shall be provided with ductile iron retainer glands. In addition, when the distance of any existing fitting to a thrust fitting is less than 10 feet, it shall also have miscellaneous iron and steel harnessing as detailed in the Standard Details for Water Mains.

h. When a push-on joint is within 10 feet of a thrust fitting, fire hydrant, valve or sleeve, the push-on joint shall be harnessed with miscellaneous iron and steel as detailed in the Standard Details for Water Mains.

i. All thrust fittings and fire hydrants shall receive concrete thrust blocks

C. Quantities for Water

1. Bill(s) of Materials shall be provided on each drawing indicating all fire hydrants, valves and valve boxes and fittings shown on that sheet.
    a. The order of the Bill of Materials shall be as follows:
        i. Fire Hydrants
        ii. Valves (descending size)
        iii. Crosses
        iv. Tees
        v. Bends
        vi. Offsets
        vii. Reducers
        viii. Sleeves
        ix. Caps
        x. Plugs
    b. The Engineer shall calculate the tonnage of ductile iron fittings to be used on each project to be incorporated into the specifications. See Appendix VII [76] for a list of weights for ductile iron fittings.
2. Pipe Totals
    a. The total of each pipe size (rounded to next highest 5 feet) shall be shown on each sheet under the heading Pipe Totals (This Sheet). On multi-sheet contracts, the total for all sheets shall be separately shown on Sheet 1 as follows:
        i. “Pipe Totals (This Sheet)”
        ii. “Pipe Totals (All Sheets)”
3. Services
    a. The length of service pipe for ferrule type services for mains in the cartway or opposite footway shall be the distance from the main to the curb plus 5.5 feet. This allows for both the 4’ expansion loop and the 18 inch distance from the curb to the curb box.
    b. For mains in the adjacent footway a total service pipe length of 7 feet shall be used.
    c. When polyethylene service pipe is used there may be exceptions. Please verify current policy.
4. Excavation
    a. Quantities shall be computed in accordance with the current edition of the Water Main Standard Details & Corrosion Control Specifications, except as necessary to increase quantities for deeper installations or prior roadway stripping by others.

5. Paving

a. Repaving quantities in asphalt surfaced streets shall be calculated using the current Water Main Standard Details & Corrosion Control Specifications.

b. Repaving quantities in concrete surfaced streets, concrete driveways and footways shall be based on replacement to the existing joints or a saw cut depending on the wording of the specifications and the paving requirements.

c. Brick and slate footways are replaced in kind.

d. Binder quantities, when not specified by Streets Department, shall be based on a 1.5 inch minimum thickness weighing 100 pounds per square yard per inch thick, and specified in tons.

e. Backfill in State Highways shall be (2A) from 6 inches above the main to the surface bottom of the concrete base. (2A) is specified in tons (use 100 pound/cubic foot).

f. Concrete base in State Highways shall be 10 inches thick high-early strength concrete.

g. Concrete base in City Streets shall be 8 inches thick.

h. Repaving quantities in City and State Highways are specified separately.

i. Whenever a curb requires removal, the footway will require replacement to at least the first joint and the cartway shall be reconstructed for at least 2 feet from curb.

j. When the proposed main is located in a City Street or State Highway and the outside of the trench is within 3 feet or less from curb, the repaving (including the base concrete) shall extend from cutback line on one side, to the curb on the other. In addition, the curb and one block of footway shall be replaced.

k. When the proposed water main is located in an intersection of a State Highway and a City Street, the State Highway paving requirements shall extend up to the projected curb lines of the State Highway where the City Street paving requirements shall begin. Such shall be noted in the specifications. The paving quantities shall reflect this.

l. When the proposed main is located in the cartway of a State Highway the road surface will be required to be milled and repaved. The extent of milling will be for any travel, bike, or parking lanes directly affected by the standard trench restoration.

m. When the proposed main is located in a State Highway so that the outside of the trench is within 4 feet or less from curb, the repaving shall extend from cutback on one side, to the curb on the other. In addition the curb and one block of footway shall be evaluated for potential replacement.

n. When 50% or more of the cartway base is disturbed, full width/depth roadway reconstruction will be required. This requires replacement of all cartway and sidewalks and will need roadway grading plans approved by the District Surveyor.

o. Slivers of base concrete left between trenches should not be less than 3'. If less than 3' of base concrete is left between trenches, the sliver should be removed. The removal of the sliver will count towards the 50% disturbance rule above.

p. If the Streets Department paving requirements request additional paving to be added to the contract and will be paid for by the Streets Department, those quantities should be separated and placed in the proposal of the specifications as a separate section of P-items and an X should be added to the suffix of the work number. In addition, the front office staff of the Design Branch shall be notified at 215-685-6280, in order to update the log book and the computer database.

q. Where full width street restoration is required, a full width 6” stone sub-base shall be required. This will be a separate payment item.

6. Curb

a. When the proposed main is located so that the outside of the trench is within 3 feet of the curb on City Streets and State Highways, the curb and footway to the first joint shall be replaced.

b. Full width street reconstruction usually requires curb replacement which in turn requires the replacement of at least one paving block of footway.

7. Quantity Tabulation

a. See Appendix III for Water Quantity Sheet[89]. Direct link to the Water Quantity Sheet working file.

8. Green Stormwater Infrastructure

a. Trenching installed parallel to footings and walls shall not extend into the bearing plane of a footing or wall. The upper boundary of the bearing plane is a line that extends downward, at an angle of 45 degrees (0.79 rad) from horizontal, from the outside bottom edge of the footing or wall.

Change Log

Version	Type	Change
4.0	Format	Updated the duplicate of 4.B.11. (Service Connections) to the correct number, 4.B.14. Service Connections.
4.0	Format	Indented ‘4.B.11.e. Railroads’ to the left to make it ‘4.B.13. Railroads’.
4.0	Format	Idented ‘4.B.11.d. Existing Water Main’ to the left to make it ‘4.B.12. Existing Water Main’.
4.0	Addition	Content added to section B. Proposed Water Main Design subsection 1. detailing the preferred pipe configuration for water mains installed in city streets wider than 36′.
4.0	Addition	Content added to Section B. Proposed Water Main Design subsection 1. and 2. detailing the preferred placement of mains on state highways.
4.0	Addition	Content added to section B Proposed Water Main Design subsection 10. detailing the requirements when crossing an existing transmission water main.
4.0	Format	Manual converted from PDF to web content.