Chapter 19: Water Distribution

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1. Administrative Policy

A. Waterlines shall be designed and operated in accordance with all applicable Local, State and Federal codes, rules and regulations.

B. All water line in the City of Delaware are to be public and centered within a 15-ft wide (minimum) easement outside of the public right of way. Waterlines should be a minimum of 20 feet from the closest part of any structure.

C. All public waterlines require an OEPA PTI prior to construction. The PTI application can be filled out by the Consultant, however, the City must be listed as the Owner (and Applicant) of the water main, and the Utility Director must review and sign the application prior to submission to the OEPA. The City does not participate in the concurrent review process with the OEPA for PTIs. The OEPA water supply number for the City of Delaware is 2100311.

D. Private waterlines are permitted only as approved by the City and are to be constructed to the same public standards.

E. Developers are required to extend waterlines to adjacent property lines, at their own expense, in order to provide for future service area.

F. The City of Delaware requires the use of Ductile Iron Pipe (DIP), for all public water mains. Ten (10) inch in diameter waterline is not permitted. For water mains 12” in diameter and smaller, AWWA C909 polyvinyl chloride (PVC) pipe with cast iron pipe dimensions (CIOD) and Pressure Class 235 may be used as an alternative to DIP.

G. The decision of using a master meter shall be determined by the Public Works Department with agreement from the Department of Public Utilities.

H. All commercial, industrial and institutional water services must incorporate an ASSE 1013 RPP device in a hot box (regardless of access or distance from the road) Grading and installation details are required on all meter pits for services greater than 2-inches.

I. Meter pits, where approved, shall be within 100-ft of the right-of-way.

J. A minimum six-inch meter is required if fire hydrants are being served through the meter.

K. A Chart with State Plane Coordinates including blank columns for as-built information (coordinates) for all main line valves and fire hydrants must be provided in the plan set.

2. Backflow Prevention Policy

A. All new commercial/industrial/institutional sites shall incorporate an ASSE #1013 Reduced Pressure Principle Backflow Preventer after the meter as a containment backflow device on the domestic water service. This is required, regardless of degree of hazard associated with current use, with no exceptions. All ASSE #1013 containment devices must be installed downstream of the meter in a location approved by the Public Utilities Department. Additional backflow isolation devices may still be required depending on what processes are taking place in the facilities for the protection of those within the building, but the distribution system will remain protected regardless.

B. Any renovation of an existing commercial, industrial, or institutional facility shall include the installation of an ASSE #1013 device on the domestic water line after the meter as part of the renovation process, regardless of degree of hazard associated with current use. The Planning Department should notify the Public Utilities Department of all renovations as they are occurring so that the Backflow installations can be included into the backflow database.

C. No meters shall be placed inside the buildings on new construction. All meters shall be in pits or vaults outside. The water lines will be public to the curb valve or 60' from the water main and copper is required to the meter with one meter and one backflow device per building.

D. All outside hose bibs must have a hose connection vacuum breaker installed.

E. All backflow containment devices must be approved by the Public Utilities Department as to type and location of installation and installed in a horizontal position between 12" to 48" off the floor with test cocks readily accessible for testing purposes. An ASSE 1013 or 1047 device shall not be installed in a pit. All ASSE 1020 or 1021 devices used for irrigation shall not have a shut off valve after the device. If any chemicals are used in the irrigation system (i.e. antifreeze) an ASSE 1013 device is required.

F. Existing homes wanting to use well or cisterns for outside watering shall install backflow prevention devices to prevent contamination of the public main by well or cistern water.

3. General Water Line Requirements

All water lines shall be installed in accordance with the standards outline in the Great Lakes - Upper Mississippi River Board (GLUMRB) of State and Provincial Public Health and Environmental Managers, Recommended Standards for Water Works, Current Edition.

A. Air Relief Valves: At high points in water mains 12-inch diameter and larger where air can accumulate, provisions shall be made to remove the air by means of hydrants or manual air relief valves.

B. Blocking: All tees, bends, plugs, and hydrants shall be provided with reaction blocking and tie rods, or joints designed to prevent movement. Tie rods shall be coated with two coats of bitumastic material equal to Inertol No. 49 thickness.

C. Cover: The minimum cover shall be 48 inches. Excessive bury depth is to be avoided.

D. Separation of Water Mains and Sewers: Water mains shall be laid at least 10-feet horizontally from any existing or proposed sanitary sewer, force main, or storm sewer. The distance shall be measured edge to edge.

E. Crossings: Water mains crossing sewers shall be laid to provide a minimum vertical distance of 18-inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. At crossings, one full length of water pipe should 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.

F. Pipes: All public water mains greater than 2-inches in diameter shall be ductile iron pipe or polyvinyl chloride pipe as specified herein. K-copper may be used for lines 2-inches in diameter or less. The minimum pipe size for new water mains shall be 6-inches.

G. Stream Crossings

1. Above-water crossings: The pipe shall be adequately supported and anchored, protected from vandalism, damage, and freezing, and accessible for repair or replacement.

2. Underwater crossings: A minimum cover of five feet shall be provided over the pipe. When crossing water courses which are greater than 15 feet in width, the following shall be provided; The pipe shall be of special construction, having flexible, restrained or welded watertight joints; Valves shall be provided at both ends of water crossings so that the section can be isolated for testing or repair; the valves shall be easily accessible, and not subject to flooding; Permanent taps or other provisions to allow insertion of a small meter to determine leakage and obtain water samples on each side of the valve closest to the supply source.

4. Hydrant Testing Requirements

When it is necessary to test flow an existing hydrant for the purposes of determining the capacity of the water distribution system as specific locations, the following minimum data shall be collected and provide the City when submitting such analysis.

A. Effective Point (location of hydrant GPS coordinates)

B. Test point (hydrant) elevation

C. Date of test

D. Who performed the test

E. Static Pressure, psi

F. Residual Pressure, psi

G. Flow (pitot) pressure, psi

H. Hydrant Flow, gpm

I. Fire flow corrected to a 20 psi residual pressure

J. Residual pressure corrected to a 2250 gpm flow

K. Elevation of the water storage tank at time of test

5. Modeling Process

A. A water distribution model is required for all developments served by new mainline extensions. If the development is on an existing main, at a minimum, fire service calculations are required to verify the adequacy of the existing line proposed to be tapped.

B. The water model must be signed and sealed by the Ohio Registered Professional Engineer of record.

C. Multiple analyses should be performed using the Maximum Daily Flow (MDF) without fire flows as well as the Peak Hour Flow without fire flows in order to determine pressures and flows at nodes throughout the system. Once the area of lowest pressure is identified, the fire flow should be added at multiple areas to determine the worst case scenarios under those conditions. The analysis should include pressures and demand flows throughout the system. This process shall be documented in the report summery.

D. Check that the correct elevation used for water in the tank and that the model calibrated from the flow metering point (hydrant) back to the tie-in point. Evaluate the critical point(s) of the model. This point(s) should be described and defended in the report summary and is most likely a dead end or the point furthest from the tie-in.

E. It is City of Delaware policy to promote looping and redundant sources of water in the event of a major failure in one main line.

F. Hazen-Williams coefficient should be between 120-140 (130 is typical for ductile iron). A lower coefficient must be used if minor losses are not accounted for in the model. As the system ages, the Hazen-Williams coefficient should be reduced to account for deterioration in the hydraulic capacity of the pipe.

G. Pressures and Flow Requirements

1. Minimum residual pressure: 20 psi
2. Minimum Static Pressure: 35 psi
3. Average Daily Flow (ADF)
4. Single Family 400 gpd
5. Multi-Family 300 gpd
6. Retail 0.2 gpd per 1.0 sq ft of floor space
7. Demand can be calculated flows based on AWWA design standards or historical data for commercial and industrial users. Additionally, the values in Table 12 for estimating the demand of various facilities in the water model.
8. Maximum Daily Flow (MDF) is 2.0 times the Average Daily Flow (ADF)
9. Peak Hour Demand Factor is 3.0.
10. Meet Fire Flows Requirements in this guide and the current edition of the Ohio Fire Code whichever is greater.

H. Water Tap Sizing: It is the responsibility of the engineer to determine the appropriate service tap size and metering arrangement to meet both the domestic and fire suppression needs of each development. Table 19-1 lists typical sizes for various developments.

Table 19-1: Tap Sizes for Building Type

Residential Building Service Tap Size

Number of Units	Minimum Service Size
Single Family	3/4-Inch
Two (2) Family Units	1-Inch
Three (3) through Six (6) Family Units	1 1/2-Inch
Seven (7) through Twelve (12) Family Units	2-Inch

* This chart is based on the City of Columbus Water Service Manual. (2004 ed.)

Table 19-2: Water Usage for Planning

WATER USAGE SUGGESTED GUIDE *		
PLACE	Gallons/Day	**OCCUPANCY**
Apartments / Condominiums	300	per unit
Assembly Halls	2	per seat
Bowling Alleys (no food service)	75	per lane
Churches (small)	3 - 5	per sanctuary seat
Churches (large with kitchen)	5 – 7	per sanctuary seat
Country Clubs	50	per member
Dance Halls	2	per person
Drive-in Theaters	5	per car space
Factories (no showers)	25	per employee
Factories (with showers)	35	per employee
Food Service Operations		
Ordinary Restaurant (no 24 hour)	35	per seat
24 – Hour Restaurant	50	per seat
Banquet Rooms	5	per seat
Restaurant along Freeway	100	per seat
Tavern (very little food service)	35	per seat
Curb service (drive-in)	50	per car space
Vending Machine Restaurants	100	per seat
Homes in Subdivisions	400	dwelling
Hospitals (no resident personnel)	300	per bed
Institutions (residents)	100	per person
Laundries (coin operated)	400	per standard size machine
Mobile Home Parks	300	per mobile home space
Motels	100	per unit
Nursing and Rest Homes	150	per patient
Nursing and Rest Homes	100	per resident employee
Nursing and Rest Homes	50	per non-resident employee
Office Buildings	20	per employee
Recreational Vehicle Parks and Camps	125	per trailer or tent space
Retail Store	20	per employee
Schools		
Elementary	15	per pupil
High School and Junior High	20	per pupil
Service Stations	1000	first bay or pump island
	500	additional bay or pump island
Shopping Centers (no food service or laundries)	0.2	per 1-sq. ft. of floor space
Swimming Pools (average)	3 – 5	per swimmer
With Hot Water Showers	5 – 7	per swimmer
Travel Trailer Parks and Camps	125	per trailer or tent space
Vacation Cottages	50	per person
Youth and Recreation Camps	50	per person

*From the Ohio EPA publication Guidelines for Design of Small Public Water Systems, 1991.

6. City of Delaware Elevated Water Storage Tanks Data

A. Cheshire Road (Southeast Highlands) Elevated Water Tank (Fluted)

1. Storage available:	2 MG
2. Overflow Elevation:	1100.0-ft
3. Minimum Water Elevation (bottom of the bowl):	1060.0-ft
4. Typical Operating Elevation:	1090.0-1094.0-ft
5. Diameter of Bowl:	100.0-ft
6. Existing Ground Elevation:	941.0-ft
7. Outlet Pipe (Ductile Iron):	16.0-in

B. Sunbury Road (East Side) Elevated Water Tank (Fluted)

1. Storage available:	1 MG
2. Overflow Elevation:	1100.0-ft
3. Minimum Water Elevation (bottom of the Bowl):	1060.0-ft
4. Typical Operating Elevation:	1085.0 – 1100.0-ft
5. Diameter of Bowl:	100.0-ft
6. Existing Ground Elevation:	933.0-ft
7. Outlet Pipe (Ductile Iron):	16.0-in

C. London Road (West Side) Elevated Water Tank (Fluted)

1. Storage available:	1 MG
2. Overflow Elevation:	1100.0-ft
3. Minimum Water Elevation (bottom of the Bowl):	1160.0-ft
4. Typical Operating Elevation:	1085.0 – 1100.0-ft
5. Diameter of Bowl:	100-ft
6. Existing Ground Elevation:	940.0-ft
7. Outlet Pipe (Ductile Iron):	16-in

Note: All elevations are based on NAVD 88

7. Fire Suppression

A. All plans shall be reviewed by the Fire Chief or his representative for the purpose of insuring compliance with applicable Local, State and federal Fire Codes, Rules and Regulations for hydrant spacing, area fire flows, and fire vehicle access. Plans will be drafted with sufficient detail to allow the reviewer to determine code compliance. Approved plans shall be on file prior to the start of construction. Plans that are altered or revised after initial approval shall be resubmitted for review and approval.

B. On commercial buildings if a post indicating valve is installed it must be monitored by the Fire Alarm Control Panel. NFPA 13 requires that on each source of water supply a post indicating valve be installed. The key is the valve must be listed and it must be a listed indicting valve. The sprinkler supply and hydrant water pass through a meter pit with a backflow preventer with two Outside Screw and Yoke Valves. If these two valves are indicating valves then the code is satisfied. These two valves will have to be monitored by the Fire Alarm Control Panel.

8. Fire Hydrants - General Requirements

A. All fire hydrants are to be installed a minimum of 40-ft away from any building and outside the "collapse zone" whichever is greater.

B. Fire hydrants shall be located in the center of the frontage of any proposed lot.

C. A fire hydrant is required within 50-feet of any roadway intersection.

D. Fire Hydrants adjacent to roadways are to be located 2-ft off the back of curb or 8-ft off edge of pavement for uncurbed roads. Hydrants should not be located in the flowline of any drainage ditch.

E. All fire hydrants shall be first line hydrants and shall conform to the requirements of the latest City specifications adopted by the American Water Works Association. The hydrants shall be manufactured by the Mueller Company (Safety Flange Model) or the M & H Valve and Fittings Company (Traffic Model). Hydrants shall have a main valve opening at least five inches in diameter; two, two and one-half (2-1/2) inch hose nozzles and a four and one-half inch pumper nozzle with bronze National Standard male threads. Public fire hydrants are to be painted with 2 coats of Federal Safety yellow, Sherwin Williams B54Y37 per COD 1507.08(A)(1). Private fire hydrants are to be painted Federal Safety Red and White caps and bonnets per COD 1507.14(B) (4). Hydrants that are part of an industrial looped system (served by a pumping station) shall be painted all Federal Safety Red. All hydrants are to be fitted with a 5-inch Stortz fitting with a quick connect coupling. All hydrants shall be installed with watch valves mechanically connected directly to the hydrant and adjusted to finished grade

F. The location of fire hydrants on both public and private property shall be approved by the Fire Chief before a building permit is issued. Any deviation from the approved location of any new fire hydrant shall be approved by the Fire Chief or his authorized representative.

G. The minimum size water line to serve a hydrant shall be six (6) inches. An eight (8) inch water main is required if the line is dead-ended and exceeds 600 feet in length, the line serves more than two hydrants, or serves one hydrant and a standpipe system.

H. The finished grade for fire hydrants shall not be less than eighteen inches from the center of the four and one-half outlet. The Hydrant Flange elevation is to be 2-inches above finished grade

I. The direction the outlets face shall be approved by the Fire Chief or his authorized representative. In General the largest outlet shall face the adjacent street or driveway.

J. Upon completion of new water main and fire hydrant installations, the Fire Department shall be notified and the contractor will demonstrate to the Fire Chief, or his authorized representative, that all main valves and fire hydrant valves are open. If it becomes necessary for the contractor to close any main or hydrant valves after he has demonstrated to the Fire Chief, or his authorized representative, that they are open, he shall notify the Fire Department so that the above procedure may be repeated, insuring that all fire hydrants and mains are placed back in service.

9. Fire Hydrant Spacing

A. Where a condition exists in a development area with more than one Ohio Building Code Use Group, the greater requirements shall apply.

B. The maximum hydrant spacing shall be 300 feet, with one hydrant provided within 150 feet from the terminus of any dead end street for Industrial Development-Use Groups F and H; Commercial Development-Use Groups R-1, A, B, E, I, M, and S; Multi-family Development-Use Groups R-2, R-3, and Multi-single Family:

C. The maximum distance between adjacent fire hydrants is 400 feet, with one fire hydrant provided within 200 feet of the terminus of dead-end streets for Single-Family Development use Group R-4.

D. The distance from fire hydrants to buildings, or parts thereof, shall be the unobstructed distance as measured by hose laid from fire apparatus within a paved surface.

E. A minimum of two public fire hydrants must be within 500 feet of every building or part thereof. If the spacing requirements cannot be accomplished, on-site fire hydrants shall be provided and the following spacing requirements shall prevail: A minimum of one fire hydrant shall be within 300 feet of every building or part thereof, with a minimum of one additional hydrant within 500 feet of every building or part thereof.

F. Fire hydrants shall be located and/or protected from possible mechanical damage. The means of protection shall be arranged in such a manner which will not interfere with the connection to, operation of, and the maintenance of hydrants. Bollards used to protect hydrants shall be at least three feet from the hydrant on all sides. Fire hydrants shall be located so as not to be obstructed by parking spaces, dumpsters, signs, mailboxes, utility poles, bushes, and any other structures and materials.

G. Fire hydrants shall be located on all public streets and required fire apparatus access roads.

H. Existing fire hydrants on public streets are allowed to be considered as available for new development. Existing hydrants on adjacent properties shall not be considered available unless fire apparatus access roads extended between the properties and easements are established to prevent obstructions of such roads.

I. Where new water mains are extended along streets where hydrants are not needed for protection of structures or similar fire problems, fire hydrants shall be provided at spacing not to exceed 1,000-feet. A hydrant shall be provided within 50-feet of all street intersections, public and private.

10. Fire-Flow Requirements

A. Per City of Delaware Ordinance 07-85, the procedure for determining fire-flow requirements for commercial and residential buildings shall be in compliance with the most current addition of the State of Ohio Fire Code. Should a more current ordinance be established that will be the required basis of design and practice.

B. The minimum acceptable residual pressure available for firefighting is 20 psi.

C. One- and Two-Family Dwellings: The minimum fire-flow for one- and two-family dwellings having an area less than 3,600 square feet is 1,000 gpm. The fire-flow and duration for dwellings with an area greater than 3,600 square feet is specified in the Fire Flow Table. A reduction of 50% is allowed when the dwelling is equipped with an approved automatic sprinkler system, as approved by the Fire Chief.

D. Buildings other than one- and two-family dwellings: For buildings other than one- and two-family dwellings the fire-flow and duration time is specified in the Fire Flow Table. A reduction of 75% is allowed when the dwelling is equipped with an approved automatic sprinkler system, as approved by the fire chief. The resulting fire-flow shall not be less than 1,500 gpm for the duration specified in the Fire Flow Table.

E. The floor area, measured in square footage, is to be used to determine the required fire flow. The calculation area shall be the total floor area of all floor levels within the exterior walls and horizontal projection of the roof of a building. Area separated by firewalls without openings and constructer per the International Building Code, are allowed to be considered as separate fire-flow calculation areas. For Type I-A and Type I-B construction, the area for the three largest successive floors shall be used for the area calculation. Exception; For open parking garages the area of the largest floor shall be used.

F. Construction Types: All buildings are classified according to their construction type. Type I is least combustible and Type V is most combustible. The more combustible a building is and the more hazardous the use is, the more the maximum allowable area is limited. All construction types and use groups are allowed to have increased areas by using sprinklers. Below is a brief summary of Construction Types. For a complete and more detailed description please consult the International Building Code.

   1. Type I (I-A or I-B): Typically these are concrete frame buildings made of noncombustible materials. All of the building elements (structural frame, bearing walls, floors and roofs) are fire resistance rated.

   2. Type II (II-A or II-B): These buildings are constructed of noncombustible materials. Typically these are masonry bearing wall structures with steel studs for walls and steel bar joists for floor and roof structures. II-A has fire rated building elements (structural frame, bearing walls, floors, and roofs). II-B is the most common construction type for commercial buildings because the building elements are not required to be fire resistance rated but still must be non-combustible.

   3. Type III (III-A or III-B): Type III construction permits the exterior walls to be of noncombustible materials and the interior building elements of any material permitted by the code (combustible or non-combustible). This is typical of buildings with masonry bearing walls and wood roofs or floors. Fire-retardant-treated wood framing shall be permitted within exterior wall assemblies of a 2-hour rating or less.

   4. Type IV (IV-A or IV-B): Type IV construction (Heavy Timber, HT) is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid or laminated wood without concealed spaces. Fire-retardant-treated wood framing shall be permitted within exterior wall assemblies with a 2-hour rating or less. This construction is not common in Ohio except perhaps in some worship facilities.

   5. Type V (V-A or V-B): Type V construction is typically wood frame construction. V-A requires fire rated assemblies for all building elements (structural frame, bearing walls, floors, and roofs); this is often seen in older construction that predates sprinklers but still not commonly used. V-B is very common because it does not require any fire rating.

Table 19-3: FIRE-FLOW CALCULATION AREA (square feet)

FIRE-FLOW CALCULATION AREA (square feet)					FIRE-FLOW (gallons per minute)	FLOW DURATION (hours)
TYPE IA & IB	TYPE II-A & II-B	TYPE IV & V-A	TYPE II-B & III-B	TYPE V-B		
0 - 22,700	0 – 12,700	0 – 8,200	0 – 5,900	0 – 3,600	1,500	2
22,701 - 30,200	12,701 – 17,000	8,201 – 10,900	5,901 -7,900	3,601 -4,800	1,750	
30,201 – 38,700	17,001 – 21,800	10,901 – 12,900	7,901 – 9,800	4,801 – 6,200	2,000	
38,701 – 48,300	21,801 – 24,200	12,901 – 17,400	9,801 – 12,600	6,201 – 7,700	2,250	
48,301 – 59,000	24,201 – 33,200	17,401 – 21,300	12,601 – 15,400	7,701 – 9,400	2,500	
59,001 – 70,900	33,201 – 39,700	21,301 – 25,500	15,401 - 18,400	9,401 – 11,300	2,750	
70,901 – 83,700	39,701 – 47,100	25,501 – 30,300	18,401 – 21,800	11,301 – 13,400	3,000	3
83,700 – 97,700	47,100 – 54,900	30,301 – 35,200	21,801 – 25,900	13,401 – 15,600	3,250	
97,701 – 112,700	54,901 – 63,400	35,201 – 40,600	25,901 – 29,300	15,601 – 18,000	3,500	
112,701 – 128,700	63,401 -72,400	40,601 – 46,400	29,300 – 33,500	18,001 – 20,600	3,750	
128,701 – 145,900	72,401 – 82,100	46,401 – 52,500	33,501 -37,900	20,601 – 23,300	4,000	4
145,901 – 164,200	82,101 - 92,400	52,501 – 59,100	37,901 – 42,700	23,301 – 26,300	4,250	
164,201 – 183,400	92,401 -103,100	59,101 – 66,000	42,701 – 47,700	26,301 – 29,300	4,500	
183,401 – 203,700	103,101 – 114,600	66,001 – 73,300	47,701 -53,000	29,301 – 32,600	4,750	
203,701 – 225,200	114,601 – 126,700	73,301 – 81,100	53,301 – 58,600	32,601 – 36,600	5,000	
225,201 – 247,700	126,701 – 139,400	81,101 – 89,200	58,601 – 65,400	36,601 – 39,600	5,250	
247,701 – 271,200	139,401 – 152,600	89,201 – 97,700	65,401 -70,600	39,601 – 43,400	5,500	
271,201 – 295,900	152,601 – 166,500	97,701 – 106,500	70,601 – 77,000	43,401 – 47,400	5,750	
295,901 - Greater	166,501 - Greater	106,501 – 115,800	77,001 – 83,700	47,401 – 51,500	6,000	
--	--	115,801 – 125,500	83,701 – 90,600	51,501 – 55,700	6,250	
--	--	125,501 – 135,500	90,601 – 97,900	55,701 – 60,200	6,500	
--	--	135,501 – 145,800	97,901 – 106,800	60,201 – 64,800	6,750	
--	--	145,801 – 156,700	106,801 – 113,200	64,801 – 69,600	7,000	
--	--	156,701 – 167,900	113,201 – 121,300	69,601 – 74,600	7,250	
--	--	167,901 – 179,400	121,301 – 129,600	74,601 -79,800	7,500	
--	--	179,401 – 191,400	129,601 -138,300	79,801 -85,100	7,750	
--	--	191,401 – Greater	138,301 - Greater	85,101 – Greater	8,000	