DETAILED SPECIFICATIONS - WATER MAIN

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SECTION 1 – GENERAL

A. Standards

All work shall be done in accordance with relevant sections of the following documents:

a. State of Wisconsin, Department of Transportation, Standard Specifications for Highway and Structure Construction, 2010 Edition
b. Wisconsin Administrative Code
c. Standard Specifications for Sewer & Water in Wisconsin, latest Edition
d. DNR Chapter 811, Requirements for the Operation and Design of Community Water System
e. NSF/ANSI 61, Drinking Water System Components—Health Effects
f. Wisconsin Construction Site Best Management Practice Handbook, DNR
g. Wisconsin Manual on Uniform Traffic Control Devices (MUTCD)

B. Valve Operation

Operation of existing water main valves will be performed by the Kenosha Water Utility (KWU) or by contractor under supervision of KWU, with proper notice.

C. Engineer

The Engineer shall mean an authorized representative of the Kenosha Water Utility.

SECTION 2 – MATERIALS

A. Condition

All water pipe material and appurtenances shall be furnished by Contractor. All water main pipe and appurtenance materials shall be new unless prior written approval has been given by the KWU Director of Engineering. All water pipe and appurtenances shall be in accordance with the latest AWWA standards.

A copy of all shipping invoices shall be furnished with a sworn statement by manufacturer that the inspection and all specified tests have been made and the results comply with the requirements of the standards stipulated below. Any pipe or accessories found by the Engineer to be defective, damaged or not complying with the AWWA standard shall be rejected. The replacement of rejected materials shall be the responsibility of Contractor at no additional expense to Kenosha Water Utility.

All pipe and fittings shall be marked by the manufacturer showing the weight, class, manufacturer's name and year the pipe and fittings were manufactured.

B. Pipe Barrel

Acceptable pipe barrel material is ductile iron or PVC unless specified otherwise in the special conditions. Minimum pipe barrel diameter shall be 8” for main line water main.

All ductile iron pipe shall conform to AWWA C-151/ANSI A 21.51. Ductile iron pipe shall have a cement mortar lining and an internal seal coat in accordance with AWWA C-104/ANSI A 21.4. External seal coat shall be in accordance with AWWA C-151/ANSI A

21.51. Provide pipe with cable conductor welded on each end by the manufacturer, capable of carrying a 400-amp current. Brass wedges shall not be used. The class and wall thickness shall conform to Table 1, below in accordance with AWWA C-150/ANSI A 21.5 Table 15:

Table 1 Ductile Iron Pipe Class and Thickness

Pipe Size	Class	Wall Thickness
4”	53	0.32”
6”	53	0.34”
8”	53	0.36”
12”	52	0.37”
16”	52	0.40”
20”	52	0.42”
24”	52	0.44”
30”	52	0.47”
36”	52	0.53”

Polyvinyl Chloride (PVC) water pipe shall conform to the requirements of AWWA C-900 for sizes 4” through 12” and C-905 for 14” through 48” diameter. PVC pipe shall be furnished with integral elastomeric bell and spigot joints. PVC pipe provided shall be not less than pressure class 150 and no greater than dimension ration 18 (DR 18). Pipes shall have cast iron (CI) pipe equivalent outside diameters.

Contractor shall provide a #12-gage THWN solid copper tracer wire for all PVC pipe. Refer to section 3.J. Electrical Conductivity – PVC Pipe, in these specifications.

C. Joints

All pipes shall have bell and spigot ends designed for a rubber gasket push-on joint. All rubber gaskets for PVC pipe shall conform to ASTM F477. All rubber gaskets for ductile iron pressure pipe, fittings, and valves shall conform to AWWA C-111/ANSI 21.11 for rubber gasket joints.

Contractor shall furnish and install ductile iron pipe with joints having a cable conductor between socket and pipe end installed by the manufacturer to carry a 400-amp current. Brass wedges shall not be used.

Joints on all ductile iron fittings or valves shall be mechanical joint conforming to the latest revision of AWWA C-111/ANSI A 21.11 with rubber gaskets and fluorocarbon coated Cor-blue T-bolts and nuts unless specified otherwise.

D. Fittings

Ductile iron fittings shall conform to the latest revision of AWWA C-110/ANSI A21.10, or cast ductile iron compact fittings conforming to the latest revision of AWWA C-153/ANSI A 21.53.

Fittings shall be cement mortar-lined and have an internal seal coat conforming to the latest revision of AWWA C-104/ANSI A21.4. Exterior seal coat shall conform to AWWA C-110/ANSI A21.10 or AWWA C-153/ANSI A 21.53.

All fittings shall be mechanical joint by mechanical joint (MJ X MJ) with rubber gaskets and fluorocarbon coated Cor-blue T-bolts and nuts, unless agreed upon otherwise by the Engineer in writing.

All fittings shall have a pressure rating of 250 psi, except compact fittings, which shall be rated at 350 psi for sizes 3" through 24".

All fittings shall be installed with cable bonding across joints to conduct a 400-amp continuous current, when ductile iron pipe is used. The fitting shall be bonded from each pipe to each end of the fitting.

E. Valves

Resilient wedge seated gate valves shall conform to the latest revision of AWWA C-509 and shall be used for 4 inch, 6-inch, and 8-inch applications. Butterfly valves shall conform to the latest revision of AWWA C-504 and shall be used in all applications larger than eight inches.

Resilient wedge seated gate valves shall be as manufactured by AFC (American Flow Control), Kennedy, Clow, or Mueller and shall be mechanical joint with a minimum pressure rating of 200 psi. All valves shall close in clockwise turning operation with non-rising stems and a 2-inch square, tapered operating nut. All packing gland to bonnet and bonnet to body nuts and bolts shall be stainless steel.

Butterfly valves shall conform to the latest revision of AWWA C-504 and shall be as manufactured by, Kennedy, Dresser, M&H, Dezurik, or Pratt for larger than 8-inch applications. Valves shall be Class 150B cast iron or ductile iron body with o-ring shaft seals suitable for direct burial. The operator shall be self-locking and furnished with a permanent factory set stop at each end of travel. All valves shall close clockwise operating with 2-inch square, tapered operating nut. All nuts and bolts between the body and the actuator of the valve shall be stainless steel.

Joints for valves shall be mechanical joint with rubber gaskets and fluorocarbon coated Cor-blue T-bolts and nuts.

F. Tapping Valves and Sleeves

A tapping valve and sleeve shall be used for all wet taps larger than 2".

Resilient wedge seated tapping valves shall conform to the latest revision of AWWA C-509 and shall be resilient wedge seated gate valves as manufactured by AFC, Kennedy, Clow, or Mueller with a standard mechanical joint outlet on both ends.

Tapping sleeves shall be Smith-Blair stainless or epoxy coated Model 622 with a mechanical joint outlet and stainless steel bolts and nuts, Powerseal Model 3490 MJ, or Engineer approved equal. Seals shall be self-energizing rubber gaskets.

Tapping of existing water mains for all water connections 12" and under shall be done by the Kenosha Water Utility with excavation and backfill by the contractor. A minimum of

72-hour notice shall be provided to the Kenosha Water Utility. All materials shall be provided and installed by the Contractor per the manufacturer's recommendations.

G. Valve Boxes and Curb Boxes

Valve boxes shall be Armor 5-245-48 poly iron shaft screw type of adequate length to extend from the valve to the finished grade. Valve box covers shall be cast iron and clearly marked "Water". A valve box debris cover shall be installed manufactured by SW Services, Model DC-457 with LD-4 locking device, or approved equal. The debris cover shall be installed according to the manufacturer's specifications. Refer to the detail sheet. Valve box adaptors, by Adaptor, Inc. or equal, may be used to prevent settling or shifting of valve boxes and shall be installed in accordance with manufacturer's instructions.

Curb boxes shall be Armor 2-34-51, with a shaft diameter of 2 ½". Curb boxes shall have a plastic ring and cover and clearly marked "Water".

Valve box and curb box extensions shall be used as required when raising the top of the box to finished grade.

Valve boxes and curb boxes shall be considered incidental to the valve and curb stop installation.

H. Hydrants

Fire hydrants furnished under these specifications shall conform to AWWA C-502 for dry-barrel fire hydrants. Hydrants shall be compression type with 5 1/4 inch valve opening, 2 each 2-1/2 inch NST nozzle connections, 1 Kenosha Standard pumper connection (Traverse City Iron Works #405-26, 4 threads per inch and 5.812 inch diameter), and bury depth of 6-1/2 feet or as shown on the plans. The base shall have a 6-inch mechanical joint connection with a rubber gasket and fluorocarbon coated Cor-blue T-bolts and nuts.

Hydrant top operating nut and nozzle cap nuts shall be 1-1/4" pentagon. All hydrants shall close in clockwise direction.

Barrel extension length shall be determined by Engineer after installation.

Hydrants shall be Mueller Super Centurion 200 or Kennedy Guardian and shall be red in color. The contractor shall provide a final coat of red paint after installation.

Hydrant branch shall be a 6" diameter ductile iron pipe, Class 53. Each hydrant shall have an auxiliary valve. Refer to detail sheet for location of valve.

I. Joint Restraint

Megalugs shall be used for all mechanical joints and shall be constructed of ductile iron with steel set screws. Setscrews shall be tightened to the torque recommended by the manufacturer. Ductile iron Megalugs shall be by EBAA Iron.
If approved by the Engineer, tie rods and duc-lugs may be used in lieu of a Megalug Restraining Harness as shown on the detail sheet.

Tie rods shall be used at locations where a direction or grade change is made and bends or tees are used, or at a dead end. Tie rods shall be 3/4-inch minimum diameter, threaded and zinc plated. The number and size shall be based on the pipe diameter as shown in the table on the detail sheet. Tie rods shall be connected through duc-lugs or eye-bolts and shall be double bolted. Eye bolts and duc-lugs shall be constructed of high strength, low alloy steel or ductile iron. A protective coating of Koppers 50, 505, or equal shall be applied to all tie rods, nuts, bolts, and duc-lugs.

A Megalug Restraining Harness shall be used on the bell and spigot of push-on pipe joints in proximity to bends as required by the Engineer or shown on the plans and shall be manufactured by EBAA Iron. The number of rods used in the joint restraint shall be according to the manufacturer's recommendation or the table in the detail sheet.

Joint restraint shall be considered incidental to the water main installation.

Joint restraint may be used in conjunction with thrust blocking concrete as shown on the plans or directed by the Engineer.

J. Thrust Blocking Concrete Buttress

Thrust blocking concrete shall be concrete of a mix not leaner than one (1) part cement, two and one-half (2 1/2) parts sand, five (5) parts stone and having a compressive strength of not less than 3,000 psi at 28 days. Backing shall be placed between solid ground and the fitting to be anchored. The area of bearing to be provided for 90 degree bends, tees, plugs and caps of various sizes are as shown in Table 2, below:

Table 2 Area of Bearing for 90° Bends

Pipe Diameter in Inches	Square Feet of Bearing
6	5
8	10
12	15
16	20
20	25
24	36

Bearing areas for fittings of less than 90 degrees may be less than those shown above if approved by Engineer.

Thrust blocking shall be poured against firm, natural ground and shall be formed in such a way that the water main joints will be kept free of concrete. All threaded fasteners and joints of the fitting being blocked shall be wrapped with polyethylene.

All concrete thrust blocking shall be approved by the Engineer before installation and prior to backfilling. Concrete thrust blocking shall be considered incidental to the water main installation.

K. Copper Service

Copper tubing shall be used for 1" to 2" service connections and shall be type "K", soft annealed seamless and manufactured in the USA. Service connections shall be a minimum of 1" in diameter. Service connections and fittings shall be in conformance with AWWA C-800.

Acceptable brass fittings include those manufactured by A. Y. McDonald, Mueller, or Ford. Corporation stops shall have AWWA taper or (CC) threads. All brass fittings for new service installation shall be flare type.

All corporation stops for new installations shall be flared ball type Mueller 300 model B-25000, A.Y. McDonald 4701 B, or Ford FB 600 Ballcorp. All curb stops shall be Mueller 300 model B-25204, A.Y. McDonald 6100, or Ford B22-XXX.

Rubber gasket compression fittings may be used to re-route, repair or re-connect existing copper or lead services. Corporation stops shall be Mueller 300 model B-25008, A.Y. McDonald 4701 BQ, Ford FB 1000Q. Curb stops shall be Mueller 300 model B-25209, A.Y. McDonald 6100Q, Ford B44-XXXQ.

Service saddles are required on ductile iron pipe for all service taps greater than 1-inch and on PVC pipe for all service taps. All service saddles shall be double strap and have an epoxy coated ductile iron body and stainless steel straps and nuts or they shall be 100% stainless steel. The saddles shall be Smith Blair 317, Mueller DR2S, or Ford FC 202.

Services larger than 2" shall be constructed in accordance with water main pipe and valve requirements, using a tapping valve and sleeve for the connection to the existing main. Service sizes may be 1", 1 ½", 2", 4", 6", and 8". 1 ¼" or 3" services are not allowed.

SECTION 3 - CONSTRUCTION METHODS - PIPE

A. Laying Pipe

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. If the pipe laying crew cannot put the pipe into the trench and in place without getting earth into it, Engineer may require that before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe. After placing a length of pipe in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material tamped under it except at the bells. Pipefittings that do not allow a sufficient and uniform space for joints shall be removed and replaced with pipe and fittings of proper dimensions to insure such uniform space. Precautions shall be taken to prevent dirt from entering the joint space.

At all times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by Engineer. This provision shall apply during

any breaks as well as overnight. If any water is in the trench, the plug shall remain in place until the trench is pumped completely dry.

Pipe shall be laid with bell ends facing the direction of laying, unless directed otherwise by Engineer.

Pipe shall be laid with proper vertical and horizontal separation distance from any contamination source in conformance with Department of Natural Resources (DNR) Code NR 811.67.

Ductile iron pipe shall be installed according to AWWA 600 – Installation of ductile iron water mains and their appurtenances. PVC pipe shall be installed according to AWWA 605 – Underground installation of PVC pressure pipe and fittings for water main.

B. Bedding, Cover, Backfill

The bottom of the trench shall be undercut to provide a minimum of 4" inches of bedding material between the natural soil and the bottom outside barrel of the pipe to be installed. The bedding material will be tamped prior to the installation of the pipe. The pipe is to be entirely surrounded and covered to a height of at least 1 foot above the top with granular backfill material. Granular material shall be carefully placed by hand to fill completely all spaces under and adjacent to the pipe, and hand tamped in layers not exceeding 6 inches in thickness. In lieu of hand tamping the granular backfill, approved bedding stone may be placed to 1 foot over the pipe without compaction. Bedding, cover, and backfill materials shall be in conformance with Section 209 of the Standard Specifications. The first lift shall be 2 feet with each subsequent lift being no more than 18 inches. Refer to the detail sheet. Bedding, cover, and backfill shall be considered incidental to the cost of the water main installation.

C. Width of Trench

The maximum width of the trench excavation at the top of the pipe shall be the outside diameter of the pipe used plus 24 inches. This width may be increased to allow for stringers and sheathing when required.

All pipe to be laid in open-cut trench shall have 6-inch minimum clearance between the outside face of the pipe barrel and the face of the sheathing or sidewall of the trench.

D. Cutting Pipe

The cutting of pipe for inserting valves, fittings or closure pieces shall be done at right angles to the axis of the pipe in a neat and workmanlike manner without damage to the pipe or cement lining and to leave a smooth filed beveled edge.

The flame cutting of pipe by means of an oxyacetylene torch shall not be allowed.

E. Permissible Deflection at Joints

Whenever it is necessary to deflect pipe from a straight line, either in vertical or horizontal plane, to avoid obstructions or plumb stems, or where long radius curves are permitted, the maximum amount of deflection allowed shall be in accordance with pipe

manufacturer's installation guide and shall be approved by Engineer.

F. Depth of Pipe

All pipes shall be laid to depths shown on contract drawing, which shall normally be 6 feet of cover from finished grade to top of pipe. Where future streets are below existing grade, Contractor shall furnish sufficient cover of 4 feet for the water main unless specifically shown on the plans.

Insulation shall be placed in locations as shown on the plans or as directed by the Engineer.

Insulate water main wherever cover over water main is less than 5 feet. Use closed-cell extruded polystyrene boards (blue boards) with minimum dimensions of 2 inches thick and 2 feet wide (4 feet wide for pipe diameters greater than 12") where water main cover is between 3 ½ to 5 feet. A minimum of two layers shall be used, 4 inches total thickness.

Prior to placement of the polystyrene boards, bedding material shall be placed to a height of 6 inches over the top of the pipe, leveled, and compacted. The insulating boards shall be placed on the cover material with the long side parallel to the centerline of the water main for a minimum width of O.D. + 24 inches. The boards shall be placed in a staggered arrangement to eliminate continuous transverse joints. Each layer should be placed to cover the joints of the layer immediately below.

The first lift of backfill material shall consist of 6 inches of bedding material which shall be end or side dumped onto the insulation board and spread in such a manner that construction equipment does not operate directly on the insulation. This layer shall be compacted with equipment that exerts a contact pressure of 70 to 80 psi. Once this layer has been compacted to the specified density, the remaining layers of backfill may be constructed utilizing conventional procedures.

Insulating concrete shall be used to insulate the water main wherever water main cover is less than 3 ½ feet. Insulating concrete shall be placed around the entire main above the bedding material to a minimum thickness of 6 inches. Insulating concrete shall consist of 1 part Portland cement and eight (8) parts of perlite or vermiculite aggregate by volume. Clean water shall be added to the mixture in sufficient quantity to permit the mix to be workable with as little water as possible.

G. Length of Open Trench

Not more than 50 feet of trench shall be open at any one time in advance of the completed water main except upon written permission of Engineer. In no case shall such excavation extend at the same time across more than two parallel streets that intersect the street in which the work is being done.

H. End of Main

All dead ends on new mains or cuts to abandon old mains shall be closed with a mechanical joint plug or cap and Megalug as shown on the detail sheet.
All plugs shall have thrust blocking. Thrust blocking shall consist of hardwood or concrete blocks, placed tightly between the plug and undisturbed earth.

I. Polyethylene Encasement
All ductile iron pipe and fittings, tees, crosses, valves, hydrants, etc., shall be polyethylene encased per AWWA C-105/ANSI A 21.5 specifications. The polyethylene shall be of the material, color, and size as listed in the AWWA standard. The method of polyethylene encasement shall be by the use of the polyethylene tube meeting Method "A" as detailed in the AWWA C-105 specifications. Connecting pipe and service lines shall be wrapped with polyethylene for a distance of 3 feet away from the ductile iron pipe. The encasement shall be free of defects such as holes, tears, blisters, or thinning out at folds. The polyethylene film supplied shall be clearly marked at a minimum of every 2 feet along its length, containing information according to AWWA C-105. Prior to installing the polyethylene, all nuts, bolts, tie rods and fasteners not stainless steel or fluorocarbon coated Cor-Blue shall be completely coated with an approved bituminous protective coating, Koppers 50, 505, or equal. The polyethylene encasement shall be secured with a thermoplastic tape with a pressure sensitive adhesive face capable of bonding to metal, bituminous coating and polyethylene. This work is considered incidental to the water main installation.

J. Electrical Conductivity - PVC Pipe
If PVC water main pipe is used, a #12-gage THWN solid copper tracer wire shall be installed with the pipe. The wire shall be blue in color. The wire shall be centered over the top of the pipe and taped at 10 ft. intervals, using thermoplastic tape with a pressure sensitive adhesive face. The wire shall extend across all ductile iron fittings and valves. The wire shall be brought to three feet above ground level adjacent to each hydrant and coiled up in a piece of 4" PVC sewer pipe extending from final grade to the bury flange along the length of the barrel, with a clean out plug on top. Refer to the detail sheet. Cost of wire and access pipe shall be considered incidental to the water main installation.

K. Electrical Conductivity - Ductile Iron Pipe
Electrical conductivity shall be provided across all ductile iron pipe, fittings, valves, and hydrants by use of a cable bond welded to each end of the pipe and on each side of the fitting or valve. Cad welded areas shall be completely coated with an approved bituminous protective coating, Koppers 50, 505, or equal. Lead tipped gaskets shall NOT be used. This work is considered incidental to the water main installation.

SECTION 4 - CONSTRUCTION METHODS - TEES AND BENDS

A. Location
Tees shall be located where shown on the plans.

Bends shall be located where shown on the plans or where deflections of pipe are required that are greater than those recommended by the pipe manufacturer.

Refer to Section 2.D. for fitting material requirements.

B. Anchorage and Thrust Blocking
Tees and bends deflecting 22.5° or more on all mains shall be provided with thrust blocking and either Megalugs or tie rods and bolts as specified in the Kenosha Water

Utility Standard Detail and described in Section 2.I & J. Engineer shall have the authority to rule out the use of certain kinds of anchorage or thrust blocking depending on the situation.

C. Polyethylene Encasement
Refer to Section 3.I. for material and installation requirements.

D. Electrical Conductivity – PVC Pipe Mainline
Refer to Section 3.J. for material and installation requirements.

E. Electrical Conductivity - Ductile Iron Pipe Mainline
Refer to Section 3.K. for material and installation requirements.

SECTION 5 - CONSTRUCTION METHODS - VALVES

A. Location and Elevation
Valves in water mains shall be attached with a minimum 2 ft. length of pipe to tees or crosses unless otherwise specified in the plans.

If the valve operating nut will be greater than 6.5 ft deep, extension rod(s) shall be added to raise the operating nut to within 3 to 4 ft. of the established ground elevation, at the direction of the Engineer.

Valves shall be located as shown on the plans or as directed by the Engineer. The maximum spacing between valves shall be in accordance with the DNR Code NR 811.63. Location of the operating nut for butterfly valves shall be as shown on the plans or as directed by the Engineer.

Refer to Section 2.E. for valve requirements.

B. Valve Boxes and Valve Pits
A valve box or a valve pit shall be provided for every valve.

A valve box shall be provided for every valve which has no gearing or operating mechanism or in which the gearing or operating mechanism is fully protected with a cast iron grease case. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut of the valve with the box cover flush with the surface of the finished grade or such other level as may be directed by Engineer.

Valve boxes shall be as described in Section 2.G. The valve box shall extend from the valve to finished grade. The valve box may be installed upon the valve with the use of a valve adaptor, as manufactured by Adaptor, Inc. (or equal). Install adaptor in accordance with the manufacturer's instructions. Any valve box that becomes shifted or filled during backfilling shall be entirely uncovered and reset.

A masonry valve pit or precast manhole shall be provided for every check valve or valve

which has exposed gearing or operating mechanism. A bitumastic sealer shall be placed between each section of the valve pit. The valve operating nut shall be readily accessible for operation through the opening in the manhole, which shall be set flush with the surface of the finished pavement or such other level as may be specified. Pits shall be so constructed as to permit minor valve repairs and protect the valve and pipe from impact where they pass through the pit walls. Vaults shall be provided with an access manhole frame, cover, and ladder rungs as shown on the plans.

Shoring and concrete forms shall be removed from valve pits upon completion.

C. Polyethylene Encasement
Refer to Section 3.I. for material and installation requirements.

D. Electrical Conductivity – PVC Pipe Mainline
Refer to Section 3.J. for material and installation requirements.

E. Electrical Conductivity - Ductile Iron Pipe Mainline
Refer to Section 3.K. for material and installation requirements.

SECTION 6 - CONSTRUCTION METHODS - HYDRANTS

A. Location
Hydrants shall be located at a maximum spacing of 600’ in accordance with the DNR Code NR 811.64 and as shown on the plans.

The grade of the hydrant shall be set by Engineer. Nozzles shall be 21 inches ± 3 inches above finished ground elevation.

The hydrant shall be set at a distance of 3 feet from the back of curb and 7’ from the perpendicular property line if near an intersection, unless specified otherwise in the plans. Refer to the detail sheet.

Refer to Section 2.H for material requirements.

B. Positions
All hydrants shall stand vertically plumb and shall have their pumper nozzles parallel with the curb line.

C. Painting
All hydrants shall be field painted red at completion of testing. This shall apply to barrel extensions, nozzles, and flange bolts. All hydrants shall be completely painted at completion of all testing.

D. Connection to the Main
Each hydrant shall be connected to the anchoring tee at the main with a 6-inch gate valve, except as otherwise directed. Refer to the detail sheet. The hydrant lead from the main to

the hydrant shall be 6-inch ductile iron, Class 53.

E. Hydrant Drainage in Permeable Soils
Wherever a hydrant is set in soil that is permeable, drainage shall be provided at the base of the hydrant by placing coarse gravel or crushed stone mixed with coarse sand from the bottom of the trench to at least 6 inches above the drain opening in the hydrant base. No drainage system shall be connected to a sewer.

F. Hydrant Drainage in Impervious Soils
Wherever a hydrant is set in clay or other impervious soil, a drainage pit 2 feet in diameter and 3 feet deep shall be excavated below each hydrant and filled completely with 3/4 inch clear stone under and around the base of the hydrant and to a level of 6 inches above the drain opening. No drainage pit shall be connected to a sewer. Refer to the detail sheet.

G. Hydrant Anchoring and Thrust Blocking
All hydrants shall be anchored to the main. Megalugs, tie rods, anchoring fittings, or an Engineer approved combination shall be used as field conditions dictate. Refer to the detail sheet.

If hydrants are tied to the main with tie rods, then they shall have two (2) tie rods with a diameter of 3/4 inch. Tie bolts or duc-lugs shall be used at each end.

In addition to being anchored to the main, all hydrants shall have hardwood or concrete block thrust blocking at the end of the hydrant trench, and under the base of the hydrant. Blocking shall also be placed under the hydrant auxiliary valve.

H. Polyethylene Encasement
Refer to Section 3.I. for material and installation requirements.

I. Electrical Conductivity – PVC Pipe Mainline
Refer to Section 3.J. for material and installation requirements.

J. Electrical Conductivity - Ductile Iron Pipe Mainline
Refer to Section 3.K. for material and installation requirements.

SECTION 7 - CONSTRUCTION METHODS - COPPER SERVICES

A. Installation
Services shall be installed complete by Contractor. Refer to Section 2.K. for material requirements.

Tapping of the main for installation of services shall only be done after:

a. The main has been properly flushed,
b. 2 consecutive bacteriological “safe” samples have been taken, and
c. Hydrostatic tests have been successfully completed.

No service connection shall be backfilled until checked by Engineer for leaks while the main pressure is applied.

All taps for services shall be made while the main is turned on and is under pressure. 1 inch taps may be directly tapped into a ductile iron main. Service saddles are required on ductile iron pipe for all service taps greater than 1-inch and on PVC pipe for all service taps.

Water service stubs 1" through 2" may be installed in the same ditch as the sewer service stub and shelved or staked to the side of the ditch, in accordance with Department of Commerce (DOC), Chapter Comm 82.

The depth of the service shall be no less than 5-1/2 feet, nor more than 6-1/2 feet of cover from the established grade as shown on the plans. Any curb stop operator deeper than 6.5 ft. shall have an extension rod added to raise the operator to a depth between 3 and 4 ft., at the direction of the Engineer.

All service stubs shall be flushed and have a 6" to 12" "tail piece" attached to the curb stop with the free end flattened (peened) before backfilling. Refer to the detail sheet.

All 1" services shall have a curb box and all services 1 ½" or larger shall have a valve box. Curb box or valve box extensions shall be used as required to raise the box to finished grade. Refer to Section 2.G for box material requirements.

All services not being connected immediately to the building shall be marked with a 2" x 4" stake, 8' long, painted blue. The stake shall be placed vertically at the end of the curb stop box to locate the termination for future extension. Refer to the detail sheet.

B. Bedding, Cover, Backfill

The bottom of the trench shall be undercut to provide a minimum of 4" inches of bedding material between the natural soil and the bottom outside barrel of the service pipe to be installed. The bedding material will be tamped prior to the installation of the pipe. Approved bedding stone shall be placed to 1 foot over the pipe. Compaction is not needed when using bedding stone. Bedding, cover, and backfill materials shall be in conformance with Section 209 of the Standard Specifications. The first lift shall be 2 feet with each subsequent lift being no more than 18 inches. Refer to the detail sheet.

C. Location

The location of the curb stop shall be 7 feet from the property line and a minimum of 1.5' from any sidewalk, unless otherwise indicated on the plans. Refer to the detail sheet.

If directed by the Engineer, one 80 inch, #5 re-bar shall be vertically placed at each curb stop stub in lieu of a curb box or valve box at time of backfilling. Top of the rod shall be set flush with the existing ground.

D. Electrical Conductivity - Service Pipe
A #12-gage THWN solid copper tracer wire with blue colored insulation shall be installed with the service pipe. The wire shall be centered over the top of the pipe and shall extend from the building foundation to the main. The service tracer wire shall be connected to the water main pipe tracer wire and wrapped with electrical tape. The service tracer wire shall be brought to grade in the curb box. Refer to the detail sheet. Cost of wire and access pipe shall be considered incidental to the water service installation.

E. Insulation
Services shall be insulated wherever the depth of cover is less than 5 feet or where a storm sewer passes within 2 feet of the service. Insulation shall be a minimum of 2" thick.

A minimum of 3 inches of compacted bedding material shall be placed over the water service followed by the polystyrene board insulation. Where a storm sewer passes over the water service, there shall also be a minimum of 3 inches of bedding material between the insulation and the storm sewer pipe. Where a water service passes over a storm sewer, a minimum thickness of 3 inches of bedding material shall be placed over the storm sewer pipe followed by the polystyrene board insulation and a minimum of 3 inches of bedding material between the insulation and the water service.

SECTION 8 - WATER MAIN DISINFECTION

A. General
The interior of all pipe and fittings shall be kept as free as possible from dirt and foreign matter.

Contractor shall disinfect the water main in accordance with specification AWWA C-651, Standard for Disinfecting Water Mains as noted.

The hydrostatic testing shall be completed after disinfection has been completed, if the new main has been connected to the Kenosha Water Utility system.

All disinfection shall be considered incidental to the water main installation.

B. Flushing
Water main shall be flushed by Contractor prior to disinfection except when the continuous feed or tablet methods are used. When the continuous feed or tablet methods are used, water main shall be disinfected for a period of not less than 24 hours before flushing.

Flushing velocities shall not be less than 2.5 feet per second.

Water main shall be flushed by opening each hydrant on the main, progressing from the hydrant closest to the connection of the existing distribution system unless drainage from the hydrant requires otherwise. Flushing time and procedure shall be determined by Engineer.

Contractor shall provide all fire hose, taps, flushing plugs, pipe, and fittings as needed for flushing. Contractor shall obtain a water meter from the Kenosha Water Utility and install in the flushing discharge line to measure the flushing water used.

C. Methods of Chlorination

Approved forms of chlorine shall be calcium hypochlorite, sodium hypochlorite, or chlorine gas. Do not use calcium hypochlorite intended for swimming pool disinfection. This material has been sequestered and is extremely difficult to eliminate from the pipe after the desired contact time has been achieved.

Approved disinfection procedures are the continuous feed method, slug method, and tablet method. These methods are described in detail in AWWA C-651, on file at the Kenosha Water Utility Engineering Division.

D. Disinfection Procedure

1. Inspect all materials to be used to ensure the integrity of the materials.
2. Prevent contaminating materials from entering the water main during storage and construction.
3. Remove any materials that enter the water main.
4. Chlorinate any residual contamination that may remain, and flush the chlorinated water from the main.
5. Protect the existing distribution system from backflow caused by hydrostatic pressure testing and disinfection procedures.
6. Document that adequate chlorine levels contacted each pipe to provide disinfection.
7. Determine bacteriological quality by laboratory test after disinfection.

Continuous Feed Method – Place calcium hypochlorite granules in the main during construction, completely fill the main to remove all air pockets, flush the completed main to remove particulates, and fill the main with potable water. Calcium hypochlorite granules shall be placed at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500-foot intervals. The potable water shall be chlorinated so that after a 24-h holding period in the main there will be a free chlorine residual of not less than 10 mg/l. The quantity of granules to be placed is shown in Table 3 below which is based on AWWA C-651 Section 4.4 Table 1:

Table 3 Calcium Hypochlorite Granule Quantities for Water Main Disinfection

Pipe Diameter		Calcium Hypochlorite	
in.	mm	oz	g
4	100	1.7	57
6	150	3.8	113
8	200	6.7	200
10	250	10.5	300
12	300	15.1	430
14 and Larger	350 and Larger	D^2 x 15.1	D^2 x 427.9

Tablet method – Place 5-g calcium hypochlorite tablets in each section of pipe as it is being installed. Also, place one tablet in each hydrant, hydrant branch, and other appurtenances. The main shall be filled with potable water when installation is complete at a velocity no greater than 1 ft/s. Air shall be eliminated from the line. Water shall remain in the pipe for at least 24 hours. If the temperature of the water is less than 41°F, the water shall remain in the pipe for at least 48 hours. A detectable chlorine residual should be found at each sampling point after the 24 hour period. Table 4 below, which is based on AWWA C-651 Section 4.4 Table 2, shows the number of tablets required.

Table 4 Number of 5-Gram Calcium Hypochlorite Tablets to Obtain 25 mg/l

Pipe Diameter		Pipe Length, ft (m)	
in	mm	18 (5.5)	20 (6.1)
4	100	1	1
6	150	1	1
8	200	2	2
10	250	3	3
12	300	4	4
16	400	6	7

($0.0012d^2L$, where d is the diameter in inches and L is the length of pipe section in feet.)

Slug Method – Place Calcium Hypochlorite granules in the main during construction. The granules shall be placed in the same manner as done in the continuous feed method. Completely fill the main to eliminate all air pockets. Flush the main to remove particulates. Slowly flow through the main a slug of water dosed with a chlorine concentration of 100 mg/l. Ensure that all parts of the main and appurtenances will be exposed to the highly chlorinated water for a period of not less than three hours.

E. Bacteriological Samples

Water samples shall be collected and tested by Kenosha Water Utility personnel. All mains and water services larger than 2 inches require two consecutive "safe" samples, taken at least 24 hours apart. At least one set of samples shall be collected from every 1200 feet of the new water main, plus one set from the end of the line and at least one set from each branch. If more than two samples from the same location are unsafe, the contractor may be charged for additional sampling and flushing.

SECTION 9 - HYDROSTATIC PRESSURE TESTS

A. General

Hydrostatic tests will be required in accordance with AWWA C-600 and C-605 for ductile iron and PVC pipe, respectively.

When the new pipe is connected to the existing Kenosha Water Utility system, hydrostatic testing shall be done after flushing and obtaining bacteriological "safe" test results.

The Engineer shall be present during the hydrostatic testing conducted by Contractor. A minimum 24-hour notice to the Engineer is required prior to test. Contractor shall supply

all testing equipment. Equipment must be adequate and appropriate for application at Engineer's discretion.

All hydrostatic testing shall be considered incidental to the water main installation.

B. Pressure Test

All pipe shall be subjected to a hydrostatic pressure of a minimum of 150-psi pressure at the highest point along the test section. The test pressure shall not be less than 1.25 times the stated working pressure of the pipeline measured at the highest elevation along the test section and not less than 1.5 times the stated working pressure at the lowest elevation of the test section. In no case shall the test pressure exceed the design pressure limit for any pipe, thrust restraint, valve, fitting, or other appurtenance. The pressure shall be held for a minimum of two (2) hours.

The pressure test gauge shall be 0-300 psi, 4-inch dial, liquid filled with an accuracy of less than 1% of span. Gauge shall be Wika Model 4271662+LF2 Series 213.53 Glycerine Liquid Filled, or approved equal.

Contractor shall expel all air from the pipe before applying test pressure. This shall be done through hydrants, blow-offs, or special taps at high points in the line.

Once all air has been expelled, the section of main to be tested shall be pumped up to the test pressure using chlorinated water. Pumps, gauges, and all necessary apparatus shall be supplied by Contractor.

After test pressure has been attained, the pump or pumpline valve shall be closed and disconnected from the water main. The system shall be allowed to stabilize at the test pressure before conducting the hydrostatic test. The test pressure gauge shall be monitored for a minimum of two (2) hours. Any loss in pressure in excess of 5 psi indicates a failure of the pressure test.

Any section of pipe not passing the pressure test shall have all leaks located and repaired by the contractor. That section of pipe will then be retested until it passes the pressure test.