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3 SANITARY SYSTEM

All labor and material shall be governed by requirements of the Milwaukee Metropolitan Sewerage District (MMSD) and the latest edition and all amendments thereto of the Standard Specifications for Sewer and Water Construction in Wisconsin (SWS), Public Service Commission (PSC) Rules and Wisconsin Department of Natural Resources (WDNR) Regulations, unless otherwise specified in these Specifications, whichever is more restrictive.

3.1 SPECIFICATIONS

3.1.1 SANITARY SEWER MAIN

3.1.1.1 MATERIALS

3.1.1.1.1 All pipe used for sanitary and private main interceptor sewers shall be:

- *Non-reinforced concrete, SWS 8.5.0*
- *Reinforced concrete, SWS, Section 8.6.0*
- *PVC (solid wall) SWS Section 8.10.0, ASTM D-3034, SDR-26*
- *PVC (solid wall, green in color for in-ground identification) SWS Section 8.20.0, AWWA C-900 or C-905*

3.1.1.2 DESIGN STANDARDS

3.1.1.2.1 Design flow coefficients as determined by the City Engineer, subject to the following:

3.1.1.2.1.1 Residential/Multi-Family (Per MMSD Flow Allocation Worksheet):

Base Sanitary Flow	*102 gpcd*
Max. Daily	*1,269 gpcd*
Residential densities are to be determined per MMSD Annual Cost Recovery Manual.	

3.1.1.2.1.2 Industrial & Institutional Areas (Per MMSD Flow Allocation Worksheet):

Base Sanitary Flow	*1,500 gpd/Acre*
Max. Daily	*3,250 gpd/Acre*

3.1.1.2.1.3 Large Commercial (Per MMSD Flow Allocation Worksheet):

Base Sanitary Flow	*2,250 gpd/Acre*
Max. Daily	*4,000 gpd/Acre*

3.1.1.2.2 Design flows and peaking factors are to be referenced to MMSD Rules and Regulations and as determined by the Engineering Services Division. Design objectives shall result in elimination, to the greatest extent possible, of all infiltration and inflow.

3.1.1.2.3 Minimum Main sizes:

Residential:	*8”*
Industrial / Commercial / Multi-Family & PUD:	*8”*
Shall accommodate future tributary areas as directed by the City Engineer.	

3.1.1.2.4 Slopes.

3.1.1.2.4.1 Minimum Slope: Pipes slopes shall achieve self-cleansing velocities for peak design flows as directed by the City Engineer. Generally, minimum velocity of 2.0 fps shall be met at half-full conditions.

Pipe Size	*Minimum Slope*
8”	*0.40 % (Dead end reach 0.60%)*
10”	*0.28 % (Dead end reach 0.40%)*
12”	*0.22 %*
15”	*0.15 %*
18”	*0.12 %*
21”	*0.10 %*
Other sizes	*Per Engineering Services Division.*

3.1.1.2.4.2 Maximum Slope of 4%

3.1.1.2.5 Complete sewer design calculations and sewer system plans are required with construction plan submittals.

3.1.1.2.6 Conceptual sewer system plans are required for proposed developments located within the Ultimate MMSD Service Area even if sanitary sewer currently is not available. A determination is needed at the conceptual stage that future gravity sewer systems will work when needed.

3.1.1.2.7 Center of manhole shall coincide with street centerline, and center of main shall be within 5 feet of centerline on curvilinear street segments.

3.1.1.2.8 Invert shall not be less than:

Distance below the centerline grade of the street	*Road ROW Width*
11.0 feet	*60/66-ft*
12.0 feet	*80-ft*
13.0 feet	*>80-ft and cul-de-sacs*

3.1.1.2.9 Minimum sewer depth shall be 8 feet from finished grade to top of pipe under exceptional circumstances and approval of City Engineer.

3.1.1.2.10 All sewer pipes shall be laid in accordance with SWS, Chapter 3.2.0

3.1.1.2.11 All connections to manholes shall be in accordance with SWS, Section 3.5.7. Connections to manholes with preformed troughs in the base shall be made in accordance with the procedure described in Section 3.1.7.3.5.

3.1.1.2.12 All sewer pipes shall terminate at the inside wall of the manhole. All annular spaces shall be filled with a mastic or cementitious filler to prevent the breakage of the pipe while jetting.

3.1.2 SANITARY SEWER LATERALS (From main to lot line)

3.1.2.1 MATERIALS

3.1.2.1.1 All pipe used for sanitary laterals shall be:

- *PVC (solid wall) SWS 8.10.0, ASTM D-3034, SDR-35 or 26*
- *PVC (solid wall) SWS, Section 8.20.0, AWWA C-900 or C-905*

3.1.2.1.2 Risers shall be as required by the plans in accordance with these standards or as pre-approved by the City Engineer.

3.1.2.1.3 Risers (shall be tees): Minimum depth below road centerline shall be per Section 3.1.1.2.8, or 5 feet below basement, whichever is greater. Sewer depth to be greater than 14 feet for riser. (Per SWS File Nos: 10A, 10B, 10C, 10D, & 10E).

3.1.2.2 DESIGN STANDARDS

3.1.2.2.1 Sites are allowed one (1) sanitary lateral connection. In special circumstances, additional laterals may be allowed with the written permission of the City Engineer and the Utility Manager.

3.1.2.2.2 Minimum size shall be 6” diameter.

3.1.2.2.3 Slope at ¼” per foot. Under exceptional conditions, the City Engineer may permit minimum slope = 1/8” per foot in ROW/easement.

3.1.2.2.4 All connections to existing mains and manholes shall be in accordance with Section 3.1.3.

3.1.2.2.4.1 Lateral connections to manholes shall be pre-approved by the City Engineer. Connections to manholes in new construction shall not be above the outlet sewer crown and have a smooth paved channel constructed to convey lateral waste to main outlet channel.

3.1.2.2.4.2 Laterals may not connect to manholes except in cul-de-sacs (permanent end of line). In cul-de-sacs, special manhole detail and construction of benches and lateral pipe connections are required.

3.1.2.2.4.3 If it is deemed necessary to install a lateral to an existing manhole, and the manhole has to be cored and booted to accept this lateral, this manhole shall be vacuum tested according to the SWS.

3.1.2.2.5 Existing laterals not used in a development shall be abandoned at the main when a development, land division or building razing occurs. See Section 3.2.

3.1.2.2.6 Each habitable building shall have a separate lateral connection to the sewer main.

3.1.2.2.7 Sanitary laterals shall have a trench check dam installed at the property line. See Specification 3.1.4 and Detail Figure 20.

3.1.3 LATERAL CONNECTIONS

3.1.3.1 Connection of New Sanitary Laterals to Existing Mains shall be as follows based on existing main material:

3.1.3.1.1 ABS - Truss Pipe

- *Location - not closer than 36" to an existing joint or fitting.*
- *Hole - Core drill or saw-cut with appropriate cutting tools. Deliver "cut-out" to Construction Inspector or Utility Department representative.*
- *Connection Device - PREDCO Saddle System, or GPK or SEALTITE Gasketed PVC Saddle with stainless steel bands.*

3.1.3.1.2 Concrete Pipe

- *Location - not closer than 24" to an existing joint or fitting.*
- *Hole - Core with appropriate cutting tools. Deliver "cut-out" to Construction Inspector or Utility Department representative.*
- *Connection Device - PREDCO Saddle System or TAPRITE "MD" Cut-in.*

3.1.3.1.3 PVC Pipe

- *Location - Not closer than 36" to an existing joint or fitting.*
- *Hole - Core drill or saw-cut with appropriate cutting tools. Deliver "cut-out" to Construction Inspector or Utility Department representative.*
- *Connection Device - GPK or SEALTITE Gasketed PVC Saddle with stainless steel bands or PREDCO Saddle System.*

3.1.3.1.4 Vitrified Clay Pipe

- *Location - not closer than 24" to an existing joint or fitting.*
- *Hole - Core with appropriate cutting tools. Deliver "cut-out" to Construction Inspector or Utility Department representative.*
- *Connection Device - PREDCO Saddle System or TAPRITE "MD" Cut-in.*

3.1.3.1.5 Due to increasing incidents with plugs being left in sewer lines, the City of New Berlin Utility Department is requiring Contractors using muni-ball plugs in sanitary sewer mains to have their company name permanently applied to the plug. This shall be witnessed and documented by the project inspector and witnessed by a New Berlin Utility personnel. The New Berlin Utility shall be notified when this plug is installed and removed. This plug shall also be chained to the manhole step. The Contractor is required to remove the plug after the repair of punch list items is completed and then only when witnessed by a qualified inspector and a New Berlin Utility personnel

3.1.3.1.6 Prior to applying curing material on the concrete, the face of the curb shall be "branded" with a "S" designating the location(s) of sanitary laterals. Physical placement of the branding shall be reasonably accurate in a vertical plane above the respective lateral.

3.1.3.2 Connection of New Sanitary Laterals to Existing Sanitary Manholes will only be allowed on a case-by-case basis and when pre-approved by City Engineer and the Utility Department, and shall be subject to following requirements:

3.1.3.2.1 Location: Invert of new lateral may be permitted a maximum of 12" above spring line of outlet sewer, or use outside drop inlet per SWS for main sewers;

3.1.3.2.2 Hole: Core with appropriate cutting tools Deliver "cut-out" to Construction Inspector or Utility Department representative;

3.1.3.2.3 Connection Device: Kor-N-Seal boot or pre-approved equal with stainless steel snap-in ring.

3.1.3.2.4 Any lateral that is connected into a manhole shall have a smooth concrete bench/channel placed to convey lateral waste flow into mainline channel.

3.1.3.2.5 Prior to applying curing material on the concrete, the face of the curb shall be "branded" with a "S" designating the location(s) of sanitary laterals. Physical placement of the branding shall be reasonably accurate in a vertical plane above the respective lateral.

3.1.4 TRENCH CHECK DAM

3.1.4.1 MATERIALS

3.1.4.1.1 Clay material shall have no organic material and shall be compacted to 95 percent standard proctor. Or;

3.1.4.1.2 Pre-approved equals such as: AquaBlok®, slurry and others.

3.1.4.2 DESIGN STANDARDS

3.1.4.2.1 Trench check dam shall be installed on all sanitary laterals.

3.1.4.2.2 The check dam shall be located at the property line.

3.1.4.2.3 See Detail Figure No. 20.

3.1.5 SANITARY FORCE MAIN

3.1.5.1 MATERIALS

3.1.5.1.1 All pipe used for sanitary force (pressure) mains shall be:

- *PVC (solid wall) SWS 8.51.2, AWWA C-900 or C-905*
- *PVCO AWWA C-909, Class 150*
- *High density black Polyethylene Force Main Pipe SWS 8.51.3, ASTM F-714; or*
- *Ductile Iron Pipe SWS 6.18.x;*

3.1.5.1.2 All pipe shall conform to Ductile Iron Pipe OD.

3.1.5.1.3 Valves shall be:

- *Dezurik Series 100 Eccentric Valves*
- *cast iron epoxy-coated body, hard rubber-lined*
- *MJ*
- *low friction Buna-vee packing*
- *neoprene plug facing*
- *ABG6H6 actuator*
- *with stainless steel bolts*
- *and plug valve adaptor bracket with valve box*
- *Alternatives must be pre-approved by the City Engineer.*

3.1.5.2 DESIGN STANDARDS

3.1.5.2.1 Valve spacing not to exceed: 800 feet or ½ the length of the force main for mains less than 1,000 feet. For force mains in excess of 2,400 feet, valves shall be located at the ¼ points of the main up to noted maximum.

3.1.5.2.2 Minimum design depth shall have 8 feet of cover.

3.1.5.2.3 Buried tracer location wire is required above the force main.

3.1.5.2.4 Maximum spacing of location boxes: 400 feet or as directed by the City Engineer.

3.1.5.2.5 Velocity/Size:

- *Hazen-Williams formula "C" value of 120.*
- *Velocity 2.0 – 6.0 fps for lowest energy pumping cost, as approved by the City Engineer.*

3.1.5.2.6 High/Low Points:

- *Air relief valve sizing calculations shall be submitted with Plans.*
- *Clean-outs shall be installed at designated points.*
- *6-ft. diameter manhole enclosures shall be installed.*

3.1.6 POLYETHYLENE WRAP & CORROSION PROTECTION

3.1.6.1 MATERIALS

3.1.6.1.1 Polyethylene film materials shall comply with SWS, Section 8.21.0.

3.1.6.2 DESIGN STANDARDS

3.1.6.2.1 All metallic pipe, fittings and valves shall be wrapped and protected per SWS, Section 4.4.4 and 4.4.5.

3.1.7 SANITARY MANHOLES

3.1.7.1 MATERIALS

3.1.7.1.1 All sanitary manholes shall be pre-cast concrete with integral base, with cone top section, Comply with ASTM C-478; 4,000 psi concrete.

3.1.7.1.1.1 Reinforced concrete flat slab as optional, with pre-approval required by the City Engineer and as shown on the Plans.

3.1.7.1.2 The manholes shall be sized as follows:

Downstream Pipe Size	Minimum Manhole I.D.
24" or less	48"
> 27"	Special Design requiring City Engineer Approval
Sampling Manhole	48"

3.1.7.1.3 All sanitary manhole cone sections shall have a minimum 3" internal vertical surface at the bottom and 2" outside vertical surface at the top.

3.1.7.1.4 All pre-cast manhole barrel joints shall be made with preformed butyl rubber gasket material (ie. 'Easy Stik' or equal).

3.1.7.1.5 All chimney joints, including the frame-chimney joint, and all barrel & cone section lifting holes shall be sealed with a cementitious grout with a struck joint. Grout shall be premixed, non-metallic, high-strength, non-shrink, Pennegrout® by IPA Systems, or approved equal, which meets requirements of ASTM C-191 and C-827 as well as CRD C-588 and C-621. When mixed to a mortar or "plastic" consistency, the grout shall have a minimum 1-day and 28-day compressive strength of 6,000 and 9,000 psi, respectively. Dry stacking of riser rings or flat decks shall not be permitted. They shall be laid in a bed of grout as described above.

3.1.7.1.6 All manholes constructed with a frame/cone internal rubber seal shall conform to SWS 8.42.0 and the following:

- *Cretex 26" LSS 0-6 Internal Chimney Seal Part No. 092845; or*
- *Cretex 26" LSS 6-12 Internal Chimney Seal Part No. 092855, or*
- *Cretex 26" LSS 12-18 Internal Chimney Seal Part No. 092865; or*
- *Pre-approved equal.*

3.1.7.1.6.1 Only one rubber sleeve and one additional extension shall be allowed in a newly constructed manhole. The internal seal and extension, if needed, shall overlap a minimum of 2" with the frame and cone for proper sealing.

3.1.7.1.7 The installation of external chimney seals may be used in all new construction, including easement areas, with pre-approval of the City Engineer. External seals shall be marked on the as-built.

3.1.7.1.8 An external sealing wrap shall be placed at all joints between pre-cast manhole sections. The external sealing wrap shall meet, or exceed, the requirements of ASTM C-877, Type II. External joint seals shall be MacWrap, as manufactured by Mar-Mac Manufacturing Co. Inc., or pre-approved equal.

3.1.7.1.9 Coal-tar epoxy coating (two coats @ 8.0 mils DFT each, totaling 16 mil DFT) shall be applied in accordance with SWS 8.49.2 to the exterior of ALL manholes prior to delivery to the project site. The coating material shall be equal to:

- *Tnemec Series 253 H.S. Tnemec Tar; or*
- *ICI Devoe DEVTAR 5A; or*
- *Pre-approved equal.*

3.1.7.1.9.1 Each manhole section shall be inspected and marked for proof of inspection prior to delivery to the project site. Manholes sections that are not properly coated with coal-tar epoxy will be rejected and shall be removed from the project site.

3.1.7.1.10 Any manhole located within 1,000 feet of a facility with food service/grease trap must have internal surfaces coated with Strong Seal and Raven Coating or a pre-approved alternate. Due to premature deterioration of concrete from hydrogen sulfide gases, this has become necessary. This is in addition to the external application of 16 mils of coal tar epoxy.

3.1.7.1.11 Internal back-plastering of the cone and chimney will not be permitted.

3.1.7.1.12 Waterproofing mastic shall be placed over all lift holes and exterior of manhole chimneys that are approved to remain raised above existing grade. Trowelable grade mastic, Tremco 60 or approved equal, shall be generously applied to a minimum 50 mil WFT.

3.1.7.1.13 All frame/casting adjusting rings shall be reinforced concrete rings having 26" I.D. The minimum height for a chimney section shall be the height associated with the proper placement of one 2" adjusting ring. Paving rings which have an adjustable diameter are not allowed.

3.1.7.1.13.1 For new manholes, the maximum height of adjusting rings above the cone as measured from the top of the cone or slab top is 16". If more than 16" of adjusting rings are needed to set the casting to finished grade, then an additional barrel section shall be installed on the manhole.

3.1.7.1.13.2 When rehabilitating existing manholes, the maximum height of adjusting rings above the cone as measured from the top of the cone or slab top shall be 22". If more than 22" of adjusting rings are needed to adjust the casting to finished grade, then an additional barrel section shall be installed on the manhole.

3.1.7.1.14 All manhole steps shall comply with SWS, Section 8.40.0 A or B.

3.1.7.1.15 All sanitary manhole lids (except for sampling manholes) shall be solid, gasketed lids (self sealing) with "T" gasket equal to Neenah or approved equal on style R-1660 or R-1661 "K" Platen.

3.1.7.1.16 All new and rehabilitated manholes located in easements and floodplains shall have Neenah Foundry R-1915-S1 water tight frames, gasket, and bolt down covers.

3.1.7.1.17 All manhole lids installed on manholes in public sanitary systems shall have the words "City of New Berlin" stamped on the top surface. Reference #1660 – 5260 Neenah Foundry.

3.1.7.1.17.1 The maximum number of lids that can be order through the Utility Department is 50. Manhole lid price is subject to change, contact the Utility Department for pricing. The costs of the lids would be paid to the Utility Department. CONTRACTOR shall pick up the lids from the Utility Department with a 24 hour advance notice. Payment is due before the lids can be picked up.

3.1.7.1.17.2 Sampling manholes are described in Section 3.1.8.

3.1.7.2 DESIGN STANDARDS

3.1.7.2.1 Maximum distance between manholes = 400 feet, per Administrative Code NR-110.

3.1.7.2.2 Slope through manhole:

Angle (degrees)	Drop (feet)
0 to 10	0.10-ft. drop
>10 and <30	0.15-ft. drop
≥30 degrees	0.25-ft. drop

3.1.7.2.3 Finished frame grade

- *Floodplain areas: 2.0 feet above the 100-yr flood elevation. When practicable, grade earth at 5H:1V slope around manhole.*
- *Turf & easement areas: at finished grade*
- *Pavement areas: 3/8" – ½" below pavement surface, set parallel with centerline gradient.*

3.1.7.2.4 Frame/Lid: All sanitary manholes shall have a heavy duty frame with solid, gasketed self-sealing lid (T-Gasket) with concealed pick holes. Sealed bolted-down lids/frames shall be required in ROW/easement areas in floodplains.

3.1.7.2.5 Frame/Cone Seals: External seals are preferred and acceptable. Internal rubber boot and a maximum of one extension may be installed in new manholes. An additional extension may be required when rehabilitating existing manholes.

3.1.7.2.6 Manhole chimney height:16" maximum and 2" minimum for manholes.

3.1.7.2.7 Sampling manholes and exterior grease tanks shall be required as directed by City Engineer. See the Sampling Manholes section of these specifications.

3.1.7.2.8 All pre-cast manhole barrel sections shall be rotated to align all manhole steps vertically in the manhole.

3.1.7.2.9 Outside drop connections shall be provided in accordance with SWS. Inside drop connections for mains or laterals will not be permitted

3.1.7.2.10 As subsequent improvements are made to any existing manhole, chimney heights shall be reconstructed to meet the requirements of this section.

3.1.7.3 INSTALLATION

3.1.7.3.1 Manhole barrel joint(s) gasket material ('E-Z-Stik') shall be placed firmly against the lower third of the vertical slope of each joint and shall be of the volume necessary to fill the annular space of the joint. Lifting holes shall be grouted with Pennegrout and struck smooth on the interior and exterior surfaces, followed by an application of waterproofing mastic on the exterior surfaces. The chimney joints shall be grouted with Pennegrout. The grout shall extend the full width of each grade ring and each joint shall be struck-off vertically, even with the inside and outside chimney surfaces.

3.1.7.3.2 Rim elevations for manholes located in paved areas shall be set 3/8" – ½" below the asphalt binder grade elevation. Ramping of manholes will not be allowed.

3.1.7.3.3 Internal rubber frame-cone seals shall be installed within 5 working days after the binder pavement coarse has been placed, or the finished grading completed for the project or site on non-pavement area manholes. The internal seal bands shall be lubricated per manufacturer's recommendations prior to installation and tightening.

3.1.7.3.4 Final adjustments to raise rim elevations to 3/8" – ½" below the grades shown on the final paving plans shall be made by installing adjusting reinforced concrete rings as needed just prior to placement of the final lift of the pavement (surface course).

3.1.7.3.5 When sewer pipes are connected to manholes with a preformed trough in the base, any pipe placed in the trough and extending beyond the interior wall of the manhole, shall have the portion of the pipe extending above the edges of the trough trimmed back to the interior wall of the manhole. The top edges of the pipe shall match in elevation the top edges of the trough.

3.1.8 SAMPLING MANHOLES

3.1.8.1 MATERIALS

3.1.8.1.1 Sampling manholes shall be 48" I.D. pre-cast concrete with integral base, with cone top section as standard and reinforced concrete flat slab as optional, with pre-approval required by the City Engineer.

3.1.8.1.2 Sampling manholes shall be equipped with Neenah R-1740 B or R-1916 H or approved equal frame and lids and internal chimney seal(s). External seals are allowed.

3.1.8.1.3 Sampling manholes shall be vacuum tested, have chimney seals installed, and have bolt down gasket covers.

3.1.8.1.4 The exterior walls of the manhole shall be coated with coal-tar epoxy per SWS, Chapter 8.49.2, (2 coats at 8 mil DFT minimum each, totaling 16 mil DFT minimum) to the exterior of all sampling manholes prior to delivery to the project site. The coating material shall be equal to:

- *Tnemec Series 253 H.S. Tnemec Tar; or*
- *ICI Devoe DEVTAR 5A; or*
- *Pre-approved equal.*

3.1.8.1.4.1 Each manhole section shall be inspected and marked for proof of inspection prior to delivery to the project site. Manholes sections that are not properly coated with coal-tar epoxy will be rejected and shall be removed from the project site.

3.1.8.1.5 An external sealing wrap shall be placed at all joints between precast manhole sections. The external sealing wrap shall meet or exceed the requirements of ASTM C-877, Type II. The external joint seals shall be MacWrap, as manufactured by Mar-Mac Manufacturing Company, Inc. or pre-approved equal.

3.1.8.2 DESIGN STANDARDS

3.1.8.2.1 The approach section of pipe approaching the primary gauging device must be straight for a distance of at least 20 pipe diameters with no connections, drops, or bends.

3.1.8.2.2 The slope of the approach distance shall be no more than 1%.

3.1.8.2.3 When installing a primary gauging device, the slope of the downstream outlet pipe should not be less than the upstream pipe slope. Free fall conditions should exist.

3.1.8.2.4 There should be no grade changes, angle points, or connections at the structure.

3.1.8.2.5 The sides of the channel must be plumb and straight throughout the manhole.

3.1.9 GREASE INTERCEPTORS

All buildings with food service preparation on-site (now or at any future time) shall be required to install, maintain and operate an exterior or interior grease interceptor tank sized in accordance with the Department of Safety and Professional Services (DSPS). State plumbing reviews by the DSPS must be completed before a plumbing permit will be issued. Construction of the Grease Interceptor shall, in addition to requirements of the Plumbing Code, conform to the following standards. These standards are intended to minimize the potential for groundwater infiltration and inflow or rainwater from entering the sanitary sewer system via this system component.

3.1.9.1 MATERIALS

3.1.9.1.1 INTERIOR GREASE INTERCEPTOR

3.1.9.1.1.1 Interior grease interceptors shall be constructed in a watertight manner of one of the following materials

- *Precast reinforced concrete*
- *Reinforced monolithic concrete*
- *Cast iron*
- *Coated 12-gauge steel*
- *Vitrified Clay*
- *Fiberglass*
- *Plastic*

- *Other approved materials*

3.1.9.1.2 EXTERIOR GREASE INTERCEPTOR

3.1.9.1.2.1 Exterior grease interceptors shall be pre-cast concrete with integral base when required by the City Engineer and shown on the Plans.

3.1.9.1.2.2 Exterior grease interceptors shall be equipped with water-tight locking frame and lids.

3.1.9.1.2.3 The exterior walls of the tank shall be coated with coal-tar epoxy per SWS, Chapter 8.49.2, (2 coats at 8 mil DFT minimum each, totaling 16 mil DFT minimum). The coating material shall be equal to:

- *Tnemec Series 253 H.S. Tnemec Tar; or*
- *ICI Devoe DEVTAR 5A; or*
- *Pre-approved equal.*

3.1.9.1.2.3.1 Coating(s) shall be applied in accordance with the coating manufacturer's recommendations and preferably at the place of tank manufacture. Each manhole section shall be inspected and marked for proof of inspection prior to delivery to the project site. Alternate waterproofing materials and application may be used if pre-approved by the City Engineer. Manhole sections that are not properly coated with coal-tar epoxy will be rejected and shall be removed from the project site.

3.1.9.1.2.4 All barrel joints shall have a mastic or gasket type joint seal. The exterior shall be wrapped with an additional joint seal that meets requirements of ASTM C-877, Type II, such as "Mac-Wrap" or pre-approved alternate.

3.1.9.1.2.5 All manhole or tank access or inspection chimneys shall be back-plastered on the exterior with mortar and a trowelable grade mastic. Mastic shall be Tremco 60 or approved equal. The interior of the access or inspection chimney(s) shall not be backplastered and shall have an internal chimney boot or seal installed after construction is inspected. The internal chimney seal shall be equal to Cretex or approved equal.

3.1.9.2 DESIGN STANDARDS

3.1.9.2.1 The approach section of pipe approaching the tank must be straight for a distance of at least 20 pipe diameters with no connections, drops, or bends.

3.1.9.2.2 There should be no grade changes, angle points, or connections at the structure.

3.1.9.2.3 In Flood Plain Areas: Tank access or inspection chimneys shall be 2.0 feet above 100-yr Flood elevations as determined via FEMA Mapping.

3.1.9.2.4 When practicable, grade earth at 5H:1V slope around manhole openings. In paved areas, slope drainage away from the manhole openings.

3.1.9.2.5 Because inlet and outlet pipe slopes are critical, the location of the exterior grease trap tank shall require prior approval of the City Engineer for location and grades. For projects requiring prior Site Plan Approval requirements, this site element must be included on the Site Plan Submittal(s).

3.1.10 LIFT STATIONS

Consult with Engineering Services Division and the Utility Wastewater Department for design requirements.

3.1.11 TRACER WIRE

3.1.11.1 MATERIALS

3.1.11.1.1 Copperhead high strength Tracer Wire or pre-approved equal.

3.1.11.1.2 Tracer wire shall be a #12 AWG fully annealed, high carbon 1055 grade steel, high strength solid copper clad steel conductor, insulated with a 30 mil, high-density, high molecular weight polyethylene insulation, and rated for direct burial use at 30 volts.

3.1.11.1.3 Tracer wire shall be laid parallel with and above centerline of the main, fittings and service line, and taped at maximum of 10-foot intervals.

3.1.11.2 DESIGN STANDARDS

3.1.11.2.1 Tracer wire on sanitary sewer shall be installed as required by the Utility Department.

3.1.11.2.2 Tracer wire shall be required on all force mains.

3.1.11.3 INSTALLATION

3.1.11.3.1 Contractor shall verify during backfilling of cover material that the tracer wire has remained on top of the main.

3.1.11.3.2 Branch or connections with the tracer wire shall require 10 full turns of exposed and undamaged copper-to-copper contact and watertight wrap to prevent corrosion or any deterioration of electrical conductivity (i.e. Western Union Splice).

3.1.11.3.3 Tracer wire shall be terminated at start-end points and all intermediate valve boxes.

3.1.11.3.4 A ½" diameter PVC electrical conduit placed inside of the valve box shall carry the wire from bottom to top of each valve box. A 1.5-ft. pigtail of excess tracer wire shall stick out of the top of the conduit.

3.1.12 BEDDING/COVER/BACKFILL

3.1.12.1 MATERIALS

3.1.12.1.1 Pipe Bedding/Cover: In accordance with SWS, as follows -

- *Flexible wall pipe shall be Class "B" up to 12" above top of pipe; 3/8" limestone chips.*
- *Rigid wall pipe with diameters equal to or less than 21" shall have 3/8" limestone chips up to 12" above top of pipe.*
- *Rigid wall pipe with diameters greater than 21" shall have ¾" limestone chips up to 12" above top of pipe.*
- *Ductile Iron pipe shall be Class B to 12" above top of pipe, torpedo sand.*
- *Fittings/Valves shall be Class B to 12" above top of pipe, torpedo sand.*

3.1.12.1.2 Cover Material: In accordance with SWS, Section 8.43.3. No stone, rock or other similar material with a sieve size greater than 1" shall be permitted.

3.1.12.1.3 Granular Backfill: In accordance with SWS, Section 8.43.4. No stone, rock or other similar material with a sieve size greater than 3" shall be permitted. In spot construction in trench lengths less than 50 feet, granular backfill shall be crushed limestone per SWS, Section 8.43.6.

3.1.12.1.4 Spoil Backfill: In accordance with SWS, Section 8.43.5. No stone, rock or other similar material with a sieve size greater than 3" shall be permitted within 2.0 ft. above the pipe.

3.1.12.1.5 Slurry Backfill: Aggregate slurry in accordance with SWS, Section 8.43.8 and requirements of City Engineer, or in accordance with street opening permit, when issued. In special cases, City Engineer may direct the use of Sand Slurry consisting of 50 pounds of fly ash and a ½ bag of Portland cement per cubic yard of mix.

3.1.12.2 DESIGN STANDARDS

3.1.12.2.1 Backfill in accordance with all street opening permit(s), generally will be slurry aggregate. All areas greater than 5 ft. from a paved surface (and above a 45-degree intercept line) may receive suitable spoil backfill as provided herein.

3.1.12.3 INSTALLATION

3.1.12.3.1 Care shall be taken by the Contractor when backfilling to prevent any movement of the pipe from proper alignment and grade. Contractor is responsible for determining that the finished sewer remains at the required elevation and grade.

3.1.12.3.2 Mechanically compact all trench backfill to a minimum 95% standard Proctor density per SWS, Section 2.6.14(b). The initial lift to be compacted shall have a 2 ft. loose thickness. Each subsequent lift to be compacted shall have a maximum 18" loose thickness. Contractor shall place smaller lifts if the required compaction cannot be achieved.

3.1.13 CASING PIPE

3.1.13.1 MATERIALS

3.1.13.1.1 Installation of sewer lines and force mains within casings shall be accomplished by using Stainless Steel Casing Spacers installed in accordance with the manufacturer's recommendations. Spacers shall be:

- *Cascade Style CCS; or*
- *PowerSeal 481; or*
- *Pre-approved equal.*

3.1.13.1.2 End seals shall be installed on either end of each casing and shall be one of the following:

- *Cascade Style CCES; or*
- *PowerSeal 4810 ES; or*
- *Pre-approved equal.*

3.1.13.1.3 Force main piping within the casing shall be installed with mechanical joints and mega-lugs.

3.1.14 INSULATION

3.1.14.1 MATERIALS

3.1.14.1.1 Minimum of 2" thick styrofoam plastic foam boards as manufactured by :

- *Upjohn; or*
- *Dow Chemical Compan, or*
- *Pre-approved equal.*

3.1.14.2 DESIGN STANDARDS

3.1.14.2.1 All sanitary sewer pipes (mains, force mains & laterals), having less than 5.0 ft. of cover material, shall be insulated.

3.2 ABANDONMENT

3.2.1.1 General

3.2.1.1.1 All existing sanitary sewer mains and service lines, that will not be used in new or re-used in reconstruction of existing building sites, shall be abandoned at the main.

3.2.1.1.2 Abandonment shall be witnessed by the City Inspector or a Utility Representative.

3.2.1.1.3 Main and/or service abandonment at the street main shall be a condition of any site demolition permit(s) issued or in the case of duplication, service lines that will remain unused on new construction.

3.2.1.1.4 All excavations within public rights-of-way shall require City and/or County Permits.

3.2.1.1.5 Excavations within 5 ft. of and under paved surfaces shall be backfilled with Slurry Aggregate per the SWS to within 1.0 ft. of surface, followed by appropriate street restoration and not less than 3-inch of binder and 2-inhc of wearing surface bituminous pavements.

3.2.1.1.6 In special circumstances, when approved in writing by the City Engineer and the Utility Manager, sanitary sewer service lines may be temporarily made inactive at the right-of-way or easement boundary. Sanitary sewer lines shall be plugged or capped to be made water tight at the property line. Sewer service lines not abandoned at the main shall meet the following conditions:

- *As part of the demolition permit, a certified check or Letter of Credit, in the amount of $5,000 per lateral, shall be submitted to the City Engineer to guarantee the permanent abandonment of the service at the main is completed in a timely manner.*
- *Any service line that is not abandoned at the main shall be subject to separate “availability” or “ready to serve” charges in the interim period until properly abandoned.*
- *Sanitary lines made inactive in this manner shall be marked with a marker post placed 1 ft. from the end of the pipe and extending from the pipe to 3 ft. above the ground surface and painted a brilliant green color.*
- *The location of the terminal pipe locations shall be surveyed or otherwise “tied” to permanent objects that will remain undisturbed at the site, with an as-built drawing provided to the City Engineer and Utilities Department for record purposes.*

3.2.1.2 Sanitary Sewer

3.2.1.2.1 All sanitary lines shall be abandoned at the street main fitting by disconnecting and removing 2 - 3 ft. of pipe and installing a water-tight cap or plug at the main fitting and on the abandoned line.

- *For Poly Vinyl Chloride (PVC) gasketed fittings, a Spigot Plug shall be installed.*
- *A cured in-place plug will be allowed to abandon services deemed by the Utility to be 100% effective.*
- *For PVC solvent weld or glued joint fittings, a gasketed Cap shall be installed on an undisturbed and undamaged max. 1.0 ft. spool piece.*
- *For Concrete, Vitrified Clay, ABS/Truss, DIP or CIP (NOT soil pipe), a PVC Spigot Plug shall be installed using the appropriate Fernco coupling onto an undisturbed and undamaged max. 1.0 ft. spool piece.*
- *All Cast Iron Soil Pipe shall be removed and ONE of the above procedures used.*
- *If connection to the main is via a "break-in", then an appropriate length of main shall be cut and removed, with an identical length of PVC SDR 35 or 28 installed using appropriate Fernco couplings.*
- *"Buffalo type" saddles are not acceptable for concrete and PVC pipe materials. Use of solvent weld or glued caps or plugs will not be acceptable.*

3.2.1.2.2 Sanitary or other special manholes or structures that are part of an abandoned system shall also be abandoned by removing the casting, chimney and cone or corbel sections, followed by plugging the outlet and inlet pipe(s) with non-shrink cementitious grout.

3.2.1.2.3 The manhole barrel shall be filled with crushed stone compacted to 95% minimum standard Proctor density.

3.2.1.2.4 The property owner shall be responsible for proper disposal of all manhole components removed. All waste materials shall be removed from pipelines and structures before abandonment.

3.3 INSPECTION

When starting an installation, the farthest downstream location of the new sanitary sewer system shall have a plug installed and maintained by the utility Contractor. That plug shall not be removed until the system has been accepted by the City Engineer and deemed operational by the City and/or the Utility Department.

3.3.1 SUBMITTALS AND SAMPLES

3.3.1.1 All materials of each type or use shall be from a single manufacturer. Contractor shall submit for approval six (6) sets of material specifications, certification and testing results by manufacturer on EACH material item required on the Project.

3.3.2 ACCEPTANCE TESTING

3.3.2.1 General

3.3.2.1.1 Deflection and Leakage tests in accordance with SWS and under supervision of the Engineering Project Inspector and the Wastewater Utility.

3.3.2.1.2 All sewer pipes shall be laid uniformly to line and grade. Noticeable variation from true alignment and grade will be considered to be sufficient cause for rejection of the work by the City. Care should be taken to insure that the entering pipe is forced tightly against the last pipe laid.

3.3.2.1.3 Sanitary main and lateral alignment shall be uniform in line and grade as measured from the inlet to the outlet of the pipe section. Vertical misalignment of greater than ¾" in a single pipe section or a sag in the pipe grade extending for more (longer) than one-and-one-half (1.5) sections of pipe shall be cause for rejection. Any correction by the Contractor shall be at no cost to the City or Utility.

3.3.2.1.4 Two (2) business days notice is required to be given to the City's Inspector and the Wastewater Utility.

3.3.2.1.5 All water that is used for construction purposes will be charged at the current rates for such use. A PERMIT IS REQUIRED FROM THE WATER UTILITY PRIOR TO ANY WATER USE.

3.3.2.2 Tests

3.3.2.2.1 Deflection testing for flexible mains shall be at the 95% of specified minimum I.D.

3.3.2.2.2 Leakage testing shall include all installed system components, such as mains, branches, laterals, risers and taps to the terminus of lines installed. For each foot that the test section is below ground water level, the test pressure shall be increased by 0.43 PSI for each foot that the average ground water height for the test section is above the spring line. In absence of recorded data on ground water table above pipe invert, it shall be assumed to begin at six (6) feet below finished manhole grade. Therefore, the minimum increase in test pressure shall be 6.6 psi and the maximum test pressure shall be 10.0 psi.

3.3.2.2.3 Sanitary Manholes shall be vacuum tested for leakage in accordance with standard test methods outlined in ASTM C-1244-93 or current edition, and minimum test time periods of:

42" & 48" dia. manholes	60 sec.
60" dia. manholes	75 sec.
72" dia. & greater manholes	90 sec.

3.3.2.2.4 Interior manhole walls to be vacuum tested shall be dry. As required by MMSD, sanitary manholes shall be vacuum tested from the lid down to the invert. If a vacuum test fails, all remedial sealing is to be done on the exterior of the manhole prior to re-testing following proper curing time. Manholes receiving repairs shall be vacuum tested again after repairs are completed.

3.3.2.2.5 As an alternative, sanitary manholes may be vacuum tested from the top of the cone to the invert provided that the frame/cone internal seal and extension, if installed, are water tested during installation as required by MMSD. Reports summarizing the vacuum testing shall be submitted to the Utility Department.

3.3.2.2.6 Follow hydrostatic testing procedures outlined in SWS, Section 4.15, at 100 psi and no leakage.

3.3.2.2.7 Testing of both internal and external seals must be with a gallon of dyed water behind the seal for a period of 1 minute without any leakage through the bottom clamp.

3.3.2.2.8 Prior to pre-punch list work, tracer wires shall be tested by Contractor prior to City accepting the work. The Utilities Department has the option to spot check the continuity of the tracer wires.

3.3.2.2.9 As part of the pre-punch list work, Contractor shall be required to clean newly installed sewer mains and have a closed circuit television (CCTV) inspection of all sanitary sewer mains at no cost to the City or Utility Department. Contractor shall also be required to clean sewer mains and have a closed circuit television (CCTV) inspection of any sewer main at new lateral connections or abandonment.

3.3.3 CLEANING

3.3.3.1 Cleaning Precautions

- *During the cleaning process, all efforts shall be made to keep foreign materials and water from adjoining sewer systems.*

- *Contractor shall clean all sanitary sewer line sections between manholes using high-velocity jet, or mechanically powered equipment. All dirt, sand, rocks, and other solid or semi-solid material resulting from the construction of the system shall be removed before acceptance.*

3.3.3.2 Contractor shall be required to repair all visible damage and leaks in the mains.

3.3.3.3 This procedure is in addition to any testing required by SWS and/or MMSD.

3.3.3.4 Acceptance of sewer line cleaning and construction will be made upon the successful completion of the CCTV inspection and to the satisfaction of the Utility Department. If the CCTV inspection shows the cleaning to be unsatisfactory, the Contractor shall be required to re-clean and re-inspect the sewer line until the cleaning is shown to be satisfactory.

3.3.3.5 During Manhole Rehabilitation Projects:

- *Verify the cleanliness of all manholes that were adjusted as part of the Contract including cleaning of the steps. Advise the contracted inspector of any questionable manholes where cleanliness may be in question. Contractor shall be responsible for bringing this information to the attention of the Utilities Department contact identified at the Pre-Construction Meeting.*
- *All sanitary sewers shall be left in a completely cleaned condition after manhole rehabilitation has been completed. All mortar, construction debris and asphalt shall be removed from lid slots, between the manhole lid and frame, as well as on the manhole walls and bench to the sewer flow line. All flow lines must be cleaned, allowing flow without obstructions. If Utilities Department personnel have to remove any debris that is left in structures and/or sewer lines after the manhole adjustments have been completed, time and equipment costs will be billed to the Prime Contractor.*

3.3.4 CCTV

3.3.4.1 Contractor has the option to contract directly with the Utility Department for performing CCTV inspection. A copy of the CCTV video and report shall be provided to the Utility Department.

3.3.4.2 Color videotape recordings of the data shall be made by the Contractor. Copies of each videotape, in USB digital format (USB flashdrives) or approved media, shall be provided to the Utility Department. PipeTech Compatible P.A.C.P. codes are required.

3.3.4.3 A set of system map Plan Sheets shall be included with all CCTV report books.

3.3.4.4 Videotape recording playback shall be at the same speed that it was recorded. Slow motion or stop motion playback features may be supplied at the option of the

Contractor. Title to the tape will remain with the Contractor. Contractor shall have all necessary playback equipment readily accessible for review by the Utilities Department during the project. Cost of making DVD or CD-ROM copy sets shall be paid by the Contractor.

3.3.4.5 Video Recorded data shall follow NASSCO PACP Guidelines.

3.3.4.6 Record Keeping Standards

3.3.4.6.1 General:

3.3.4.6.1.1 The primary objective of the CCTV phase of the project is to compile accurate information as to the general and specific conditions of the sewer pipe being inspected from a structural, maintenance and physical dimension perspective. Accordingly, the most important tool in assessing the condition of the sewer pipe is via a uniform and accepted consistent standardized mode of categorizing, designating and quantifying the observations.

3.3.4.6.1.2 All CCTV Operators shall be trained and certified via NASSCO in the Pipeline Assessment and Certification Program (PACP) to provide standardization and consistency in the proper and accurate interpretation of observations for defects and other conditions, and the categorizing, designating and quantifying and recording their observations.

3.3.4.6.2 Documentation of the CCTV Results

- *Television inspections may be documented through the use of in-house or in-vehicle computer system that incorporates Pipeline Assessment and Certification Program (PACP) standard data format. This system must be Windows compatible on DVD, CD-ROM, or USB flash-drives.*
- *All defects and general information on the pipe being viewed along with a detailed index for retrieving the information shall be supplied to the Utility Department as part of the final report.*
- *One set each of DVD, CD-ROM, or USB flash-drives shall be delivered to the Utility Department.*
- *This media material shall become property of the New Berlin Utility.*
- *Television inspection logs shall be typed or computer printed and shall be acceptable to the Utility Department.*
- *Printed location reports shall clearly show the location, in relation to the adjoining manholes, of each source of infiltration discovered.*
- *Other data of significance including location of building and house service connections and other discernible features shall be recorded.*
- *A voice recording on DVD, CD-ROM, or USB flash-drive shall make brief and informative comments on the sewer conditions.*