

KNOXVILLE UTILITIES BOARD

DESIGN GUIDE FOR
CONSTRUCTION APPROVAL FOR
WASTEWATER GRAVITY SYSTEMS

2ND EDITION
OCTOBER 2008



Knoxville Utilities Board

Introduction to Design Guide for Wastewater Systems

The purpose of this document is to assist developers and design firms with successfully completing wastewater designs for proposed developments. This guide offers a standard set of templates that are proposed for wastewater system designs and outlines the minimum submittal information considered to be required by KUB for new systems such as subdivisions, extensions, upgrades, etc. The purpose of this guide is to improve the efficiency of reviews by reducing the number of re-submittals by the developer's design firm.

As a general rule, the first submittal should include only two paper copies of the design (also send a copy of the storm water and grading plans with the proposal) to KUB. One copy will be marked and kept by KUB, and the second will be returned to the designer with comments for revisions. Once the plans are ready for approval, KUB will notify the designer to submit the required number of copies and a Compact Disc (CD) with the proposed wastewater drawings attached as well as all required easement as applicable.

Documents contained in the Sections

Several items located in this package can help assist designers in document submittal requirements when preparing proposed wastewater plans and calculations. This guide is divided into several sections. The sections include parts A through E, focusing on required checklists that are used to approve general wastewater design projects, Sections F through I focusing on required checklists that are used to approve wastewater as-built submittals, and the latter sections give various wastewater design examples that relate to the previous checklist requirements mentioned.

Proposed Construction Approval for Wastewater Gravity Drawing Requirements (Sections A-H)

There are sets of wastewater design checklists that are used to review the plans in order to improve the efficiency of the review process. It is important that the designer view the checklist items before project submittal to KUB. If an item on the checklist is not identified in the project submittals, the plans will not be approved and will have to be corrected. Note that Sections A-H should be used for gravity wastewater sewer designs. The "Required Documents for Wastewater Submittals" page outlines all the required checklist items relevant to the type of design.

Additional Resources for Construction Approval of Wastewater Gravity Systems

KUB has provided numerous hyperlinks through our webpage to further assist in receiving approved plans. These additional resources include example designs, electronic KUB Border, electronic version of required construction notes, etc. Contact Engineering New Service for additional details of accessing this information.

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CHART A-1: Review Process -General Wastewater

Comment Number	First Date: _____	Second Date: _____	Review Criteria
1			The stormwater/grading plan (s) are submitted during initial review and if grading or stormwater changes.
2			If submitted design plans are of a project with multiple phases, all prior phases and their respective easements and final subdivision plans must already be approved, accepted, and recorded if this phase will connect to an earlier phase.
3			Design plans are 24" x 36" (D Size) drawings
4			Provided KUB border is used.
5			Title Block at the bottom of each sheet must include:
6			- Project name (Public or Private)
7			- Engineer's company, address and phone number
8			- Engineer's stamp (signed and dated)
9			- Developer's name, address, and phone number
10			North Arrow on all sheets
11			Vicinity Map (Upper right-hand corner)
12			Location, station number, and elevation of nearest TDOT or Knoxville survey control marker
13			City of Knoxville or TDOT survey marker is to be included on all site plan sheets. Elevations shall be related to City of Knoxville or TDOT elevation data. Elevations will not be assumed.
14			Property units given in table format.
15			Print out LandViewer drawing showing all utilities (i.e., water, sewer, gas, electric, storm, etc.). Date and initial in the printout and include in the project file.
16			Checklist of "potential permit documents" attached to first set of reviewed plans.
17			Reviewer dates and signs office copy of plans (KUB only)

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CHART B-1: Review Process -General Wastewater (Plan View)

Comment Number	First Date:	Second Date:	Review Criteria
18			Plan & profile can be any scale used from a standard engineering scale, such as 1"=5' (profile), 1"=20', 1"=50', 1"=100', etc.
19			All existing public utilities and associated easements are shown where appropriate (i.e. water, sewer, gas, electric, storm, etc.)
20			Bold all proposed wastewater utilities and features and reduce line weight for other utilities in order to clarify the project's items of interest.
21			Represent existing wastewater mains by dashed lines. (Refer to provided drawing legend.)
22			Represent proposed wastewater mains by solid continuous lines (Refer to provided drawing legend.)
23			Station 0+00 is located at the downstream end of the wastewater main and is on the left side of each drawing sheet.
24			Location where project/phase completion will occur is clearly shown (i.e. E.O.L.)
25			Clearly label line designations throughout proposed project
26			Clearly indicate the location and station number of all important appurtenances. Manholes (existing and proposed) are described by the line stationing (i.e., MH STATION 0+50) and the KUB MH number for existing manholes.
27			Clearly label each proposed pipe's material and size. Include pipe length on profile view.
28			Minimum pipe size shall be 8 inch diameter for gravity wastewater mains
29			Clearly indicate locations of storm water mains, catch basins and detention ponds (existing and proposed).
30			All stormwater mains not running parallel to sewer mains are shown in profile view.

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CHART B-2: Review Process -General Wastewater (Profile View)

Comment Number	First Date:	Second Date:	Review Criteria
31			Plan & profile can be any scale used from a standard engineering scale, such as 1"=5' (profile), 1"=20', 1"=50', 1"=100', etc.
32			All existing public utilities and associated easements are shown where appropriate (i.e. water, sewer, gas, electric, storm, etc.)
33			Bold all proposed wastewater utilities and features and reduce line weight for other utilities in order to clarify the project's items of interest.
34			Represent existing wastewater mains by dashed lines. (Refer to provided drawing legend.)
35			Represent proposed wastewater mains by solid continuous lines (Refer to provided drawing legend.)
36			Station 0+00 is located at the downstream end of the wastewater main and is on the left side of each drawing sheet.
37			Location where project/phase completion will occur is clearly shown (i.e. E.O.L.)
38			Clearly label line designations throughout proposed project
39			Clearly indicate the location and station number of all important appurtenances. Manholes (existing and proposed) are described by the line stationing (i.e., MH STATION 0+50) and the KUB MH number for existing manholes.
40			Clearly label each proposed pipe's material and size. Include pipe length on profile view.
41			Minimum pipe size shall be 8 inch diameter for gravity wastewater mains
42			Clearly indicate locations of storm water mains, catch basins and detention ponds (existing and proposed).
43			All stormwater mains not running parallel to sewer mains are shown in profile view.

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CHART C-1: Review Process - Site Plan View

Comment Number	First Date: _____	Second Date: _____	Review Criteria
Plan View General:			
44			Rights-of-way (ROW), edges of pavement, driveways and property lines are shown and labeled.
45			Existing and proposed streets and street names are shown (actual street names used) if known.
46			Future development in adjacent parcels is addressed in the design by either providing easements for future extensions or extending utilities to allow immediate access for future phases.
47			Show all building footprints and other proposed structures such as pool, garage, clubhouse, etc., on drawing plan that impact the design.
48			Existing houses shall be given consideration during the design of the proposed wastewater system. Finished floor elevations (FFE) and basement elevations for existing houses shall be shown on drawings as required.
49			Ensure that figure numbers from KUB's Standards and Specifications are used for appropriate appurtenances.
50			Show vegetation.
Main & Lateral Locations:			
Comment Number	First Date: _____	Second Date: _____	DO INSTALL
51			Street right-of-ways
52			Easements
			DO NOT INSTALL
53			Paved areas
54			Berms or any crossing detention basins
55			Wastewater mains shall not be installed in the same trench with other utilities unless approved by KUB Engineering in writing prior to the preparation of design plans
Horizontal Separation:			
56			Horizontal separation between water and wastewater mains is at least 10 feet
57			Minimum horizontal separation shall be greater than or equal to 3 feet between the sanitary sewer and storm water sewer mains measured from the outside of the pipes.
58			When horizontal separations are less than 3 feet, the sanitary sewer pipe material specifications shall be C900 or C905 (SDR 18) PVC Pipe, or Class 150 Ductile Iron Pipe with Protecto 401. Pipe sections between manholes shall be the same material.

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CHART C-2: Review Process - Site Plan View (continued)

Comment Number	First Date:	Second Date:	Review Criteria
Manholes:			
59			Clearly indicate the delta angles at each manhole to indicate direction of the up-stream sewer main (Delta angles shall be 90 degrees or less)
60			Clearly indicate stub out elevations and locations for <u>future</u> laterals and wastewater mains at manholes.
61			Connections into manholes shall be greater than 34 degrees if at same elevation or at least 2 foot vertical separation.
Laterals:			
62			Clearly present the proposed locations of all proposed laterals
63			Each customer (lot or unit) shall have its own sewer lateral connection.
64			All typical gravity laterals shall have a minimum diameter of 6 inches PVC (SDR 26). Show cleanout locations.
65			<p>Each customer's (lot or unit) sewer lateral length from the main, depth at the main, and distance from the nearest downstream manhole are shown</p> <div> </div> <p>WHERE: A = FT length of the lateral from the main to the property line B = FT of depth where the lateral taps into the sewer main C = FT from the nearest downstream manhole</p>

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CHART D-1: Review Process - Profile View

Comment Number	First Date:	Second Date:	Review Criteria
Vertical Separation:			
66			Vertical separation must be labeled between wastewater mains and all utilities to include water and stormwater lines.
67			Wastewater and water mains have at least 18 inches of vertical separation measured from outside pipe to outside pipe.
68			Minimum vertical separation shall be greater than or equal to 24 inches between the outside of sanitary sewer mains and the outside of storm water sewer mains.
69			When vertical separations are less than 2 feet between wastewater and stormwater, the sewer pipe shall be constructed with Class 150 Ductile Iron Pipe with Protecto 401, and the lower pipe shall be exposed down to the spring and encased in concrete.
Line Slopes:			
70			Minimum slopes based on the size of the main are illustrated in KUB Standards and Specifications section 02532. Strongly recommend slopes greater than minimum required slope.
71			If gravity sewer main exceeds a slope of 10%, Z-lock gaskets are required and labeled.
72			In gravity sewer where the slope of a sewer line is in excess of 20%, the line shall be constructed of mechanical joint ductile iron pipe with concrete anchors and the pipe joint must be completely encased in concrete
73			Slopes over 30% are not permitted.
Wastewater Main Depth:			
74			Minimum depth of cover for gravity wastewater lines in roadways and other traffic-bearing areas is 48 inches for PVC, HDPE, and CCFMP and 30 inches for Ductile Iron. In non-traffic-bearing areas (easements), the minimum cover is 30 inches no matter the pipe material.
75			Investigate options to shallow deep mains.
76			Wastewater carried in PVC pipe shall not have more than 17 feet of cover . If over 17 feet, ductile iron piping with Protecto 401 coating should be utilized.
77			Where applicable indicate fill compaction specifications that meet KUB standards.

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CHART D-2: Review Process - Profile View (continued)

Comment Number	First Date:	Second Date:	Review Criteria
Material:			
78			When ductile iron pipe must be used on a portion of a new sewer line segment, the entire length of sewer must be installed with Ductile Iron pipe. No flexible couplings will be permitted on new construction to convert to PVC between manholes.
79			Polyvinyl chloride (PVC) pipes and fittings shall meet or exceed an SDR 26 for pipe from 4 inches to 15 inches in diameter for gravity sewer excluding clean-outs until they are available in SDR 26.
80			HDPE pipes and fittings shall be a minimum of SDR 17 with DIP outside pipe diameters, external green stripe, and heat fusion welded joints for gravity sewer.
Manholes:			
81			Clearly indicate the location of clay water stops (upstream of all manholes) to prevent water from draining through the gravel bedding.
82			Maximum spacing for manholes shall be 400 feet for pipe diameters of 21 inches and smaller and 500 feet spacing for connecting pipes larger than 21 inches
83			Manhole rim / surface elevations with correct numerical stationing is shown
84			All manhole invert (IN and OUT) elevations are clearly shown.
85			Difference in the invert elevations of two sewers intersecting in a manhole is 2 feet or more, a drop manhole is required
86			Each tap into an existing manhole must be mechanically cored
87			Verify that the appropriate A- or Z-lock gasket is used for the particular pipe material.

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CHART E-1: Review Process - Easements

Comment Number	First Date:	Second Date:	Review Criteria
88			All required easements and/or subdivision plats shall be submitted, approved, and recorded before the new wastewater system will be accepted.
89			The deed instrument number shall be clearly indicated on the plans. If multiple instrument numbers exist for the development, then each instrument number shall be listed.
90			Easements are indicated on plans for sewer laterals which cross private property to serve another lot if approved by KUB.
91			With project easements, a 15-foot wide permanent utility easement exists 7.5 feet on either side of all water & wastewater mains as installed, plus an additional 10 foot utility construction & maintenance easement as required, necessary to install and maintain mains.
92			If a joint permanent easement (JPE) with utilities is used rather than public Right of Way then the JPE must include "with utilities" to remove the requirement for a utility easement.

CHART F-1: Review Process - Road & Water Crossings

Comment Number	First Date:	Second Date:	Review Criteria
93			Clearly indicate road bores (casing, carrier pipe sizes, and materials) on both the plan and profile view.
94			Ductile iron pipe with concrete encasement at all joints or HDPE is used for wastewater transport beneath waterways that have a continuous flow of water or as described in the approved ARAP permit.

CHART G-1: Review Process - Abandonment & Removals

Comment Number	First Date:	Second Date:	Review Criteria
95			Clearly label abandoned lines throughout proposed project
96			Abandoned sewer pipes 12 inches and larger shall be filled with flowable fill if not completely removed from the ground
97			Abandoned sewer pipes located under existing/proposed buildings are filled with flowable fill if not removed completely from the ground regardless of size.
98			When manholes are abandoned, a note indicates that Part 3.09, Section 02530 of KUB Standards and Specifications have been met for manhole abandonment

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CHART H-1: Review Process - Notes

Comment Number	First Date:	Second Date:	Review Criteria
Wastewater Flow Control Notes			
99			Wastewater flow must be maintained in the existing sewers, in accordance with Section 02542 Sewer Flow Control. Whenever pipe-laying progresses to the point where this flow must be interrupted, the CONTRACTOR shall plug the sewer upstream of the construction and provide by-pass pumping to the downstream manhole. All downstream pipes, manholes and appurtenances must be tested and acceptable to the OWNER to receive wastewater flow. Discharging raw wastewater to natural waterways will not be permitted. The CONTRACTOR shall provide, maintain, and operate all the temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units) as necessary to intercept the sewage flow before it reaches the point where it would interfere with his/her work, carry it past his/her work and return it to the exiting sewer downstream of his/her work. CONTRACTOR will be liable for clean-ups, fines, and any other problems that may occur.
100			The CONTRACTOR shall submit to the OWNER, for approval, a description of the bypass pumping methodology, and bypass pumping plan before the CONTRACTOR commences sewage bypass pumping.
101			Provide adequate capacity and size to handle existing flows plus additional flow that may occur during periods of a rainstorm. Estimate peak amounts of flow to be bypassed and provide bypass flow capacity of at least 125 percent of peak flow estimate.
102			Operate and maintain flow control system 24 hours per day, 7 days per week including holidays, as required to control flow.
103			Refer to Section of 02542, Sewer Flow Control of KUB Standards and Specifications for required submittals and requirements.
Wastewater Construction Notes			
104			Road right-of-ways shall be graded and sloped to required specifications or as approved by KUB prior to staking and installing wastewater mains.
105			The Developer's Authorized Representative shall stake the proposed wastewater main layouts, property corners, and easement locations, etc...prior to construction to allow ample time for KUB's inspectors to inspect the layouts prior to construction. KUB will determine if staking may be required prior to approval of plans.
106			Construction materials must meet KUB specifications. KUB representatives must approve materials submittals prior to construction.
107			Wastewater main installation must be inspected by KUB. Contact KUB field services at least three (3) working days prior to construction at 558-2786. Trenches shall be left open and not backfilled until inspected by KUB.
108			Contact KUB field services at least three (3) working days prior to construction at 558-2786 to inspect from cleanout to structure when project is located outside of City of Knoxville Limits.

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CHART H-2: Review Process - Notes

Comment Number	First Date:	Second Date:	Review Criteria
Wastewater Construction Notes (continued)			
109			Contractor must have a valid State of Tennessee municipal utility license for construction of wastewater mains.
110			An A-lock or Z-lock gasket shall be provided for each wastewater main or lateral connecting to a new manhole. Each tap to an existing manhole must be mechanically cored and properly booted.
111			The contractor must install laterals installed across streets before any surface cover is finalized to include paving, concrete driveways, etc.
112			Water stops shall be installed in sewer line trenches no more than 500 feet apart to prevent water from draining through the gravel bedding. The stops shall consist of compacted clay at least three (3) feet thick from the bottom of the trench to the top of the trench. The stops shall be cut a minimum depth of two (2) feet into both walls of the trench. The preferred location of a water stop is upstream of each manhole. All stream crossings shall include water stops on both sides of crossing.
113			**NOTE: ONLY INCLUDE NOTE THE FOLLOWING WHERE APPLICABLE
114			Manhole and Main Line Abandonment Procedures:
115			A. Cut all pipes on the outside of the manhole, and plug with brick and mortar.
116			B. Brick and mortar all pipe openings inside the manhole including drop connections and laterals
117			C. Remove the manhole ring, lid, and grade rings. Disposal of all manhole materials shall be at the discretion of the OWNER. Precast cones and risers shall also be removed if they are exposed.
118			D. Manholes shall be fill with backfill material as specified in Section 02321, Unclassified Excavation and Backfilling for Utilities.
119			E. Lines to be abandoned that enter an existing manhole to remain shall be cut on the outside of the manhole and the inlets shall be plugged with brick and mortar to ensure a watertight structure.
120			F. Abandoned pipe 12 inches and larger shall be filled with flowable fill if not completely removed from the ground.
121			G. Abandoned pipe underneath existing/proposed buildings shall be filled with flowable fill if not completely removed from the ground.
General Wastewater Notes			
122			All sanitary sewer lines and appurtenances shall be installed in accordance with the Knoxville Utilities Board's Standard Sewer System Specifications and Details.
123			Location of all existing utilities is approximate. Contractor shall field locate all existing utilities prior to excavation.
124			All pipe shall be installed in the presence of the Owner.
125			Utilities shall be installed after grading has been completed and approved before any surface cover is finalized to include paving, concrete driveways, etc.

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CHART H-3: Review Process - Notes

Comment Number	First Date:	Second Date:	Review Criteria
General Wastewater Notes (continued)			
126			Trench design and safety for pipeline construction is solely the responsibility of the contractor and shall conform with all applicable local, state, and OSHA regulations.
127			Requirements for proper trench and backfill operations must meet or exceed City of Knoxville, Knox County, and TDOT Standards.
128			After completing each section of the sewer, all debris and construction materials shall be removed from the work site as well as smoothly grading the disturbed ground surface on the project site.
129			The Contractor shall obtain plastic warning tape for wastewater mains and bury it one foot above the entire length of each lateral. A 3/8-inch diameter steel rebar shall be driven into the ground at the end of each lateral and painted green. The buried end of the rebar shall be bent to form a hook.
130			Sanitary sewer flow control (Section 02542 of KUB Standards and Specifications) requirements are fully understood and implemented in the wastewater project.
131			Any field changes to approved plans must be approved by the appropriate KUB representative before construction.
132			A copy of the latest approved set of utility plans designated by the KUB RED stamp must be present during all times of construction of the appropriate utilities.
Gravity Sewer Notes			
133			Lasers shall be used to install all wastewater lines.
134			All requirements for installation of gravity sewer (Part 3 in section 02532 of KUB Standards and Specification) are to be understood by the contractor and fully implemented in the entire wastewater project.
135			All requirements for sewer laterals (Part 3 in section 02532 of KUB Standards and Specification) are to be understood by the contractor and fully implemented in the entire wastewater project.
136			All requirements for testing of gravity sewers (Part 3 in Section 02532 of KUB Standards and Specifications) are to be understood by the contractor and fully implemented in the entire wastewater project.
137			The minimum wastewater lateral has a 6 inch diameter PVC (SDR 26) from the main to the property line or edge of easement.
138			All sewer laterals shall include 6 inch tees of the same material as the sewer mains.
139			Two way directional cleanout tees will be required on all laterals. Cleanouts should be located at the property line or easement line in most cases and shall be SDR 35 manufactured by Plastic Trends, Inc.
140			All laterals and cleanouts shall have caps with screwed plugs installed.
141			All sewer appurtenances are required to have watertight fittings.
142			All requirements with flexible couplings and saddle tees (Parts 2.02 and 2.03 in Section 02532 of KUB Standards and Specifications) are to be fully understood and implemented.
143			Sewer service laterals shall be connected to cleanout as depicted in Figure 2-02532-B, Section 02542 of KUB Standards and Specifications. Sewer service laterals shall not be connected to service risers or lateral components of cleanout.

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