Dec. 2007 version

Design and Installation Standards
For

UNDERGROUND IRRIGATION WATER CONVEYANCE

For Subdivision Developments

INTRODUCTION – These Standards were developed by the Wise Water Use Council (WWUC) of the Grand Valley in response to a need for guidance and standards for underground conveyance systems for raw irrigation water for subdivision developments. The intent of these standards is to compliment good engineering judgment and other acceptable industry standards by providing guidance and information related to the design and installation of plastic underground irrigation water delivery systems to and within new subdivisions.

All new underground irrigation water conveyance systems should comply with the existing standards of the responsible irrigation or drainage company, district, association, or other entity and be reviewed and certified by a Licensed Professional Engineer. In absence of standards by the responsible operating entity, these WWUC Irrigation Standards shall be followed, and in conflict or absence therein, sound engineering practices shall govern. Further guidance can be found in the Uni-Bell *Handbook of PVC Pipe: Design and Construction*, www.**uni-bell**.org/, or the Plastic Pipe Institute's *Handbook of PE Pipe*, www.plasticpipe.org/.

SCOPE – The focus of this standard is on underground plastic pipelines ranging from ½ inch to 27 inches in diameter which are closed to the atmosphere (meaning the pipeline is designed to be running full, not partially full as a storm or sanitary sewer).

Pipelines shall be designed and located to serve as an integral part of an irrigation water distribution or conveyance system to facilitate delivery of raw irrigation water to, and distribution within, subdivision developments.

Pipelines installed according to this standard shall be placed only in suitable soils where the bedding and backfill requirements can be fully met.

Specific requirements for the type, grade, class of pipe, trench backfill, and method of testing shall be shown on the drawings.

DESIGN QUANTITY – Prior to design, the engineer shall meet with the appropriate irrigation provider(s) to determine the water quantity available and discuss other conditions associated with the particular canal, lateral, or delivery headgate that should be addressed in the design. Prior to design the engineer shall ensure there is sufficient irrigation water available to serve the planned development. Design of the system shall be adequate to fully accommodate the irrigation water available or the water right, whichever is greater. Subdivision developments with an inadequate direct flowrate water supply available may require additional considerations including but not limited to: storage facilities, scheduling (including days on and off and maximum run-times), flow restrictive valves, and alternate landscaping techniques.

Systems shall be designed to properly deliver the correct volumes of water for the intended purpose. For proper irrigation water management, application systems for landscape trees and shrubs located in common areas shall be designed and zoned separately from individual lots.

MATERIAL SPECIFICATIONS – Plastic Pipe materials shall meet those identified in the Natural Resources Conservation Service (NRCS) specification 430 DD (www.nrcs.usda.gov/technical/ENG/material_specs.html). (This specification includes references to several types of plastic pipe materials and associated ASTM specifications.) Except for road rights-of-way the minimum acceptable class of plastic pipe shall be that having a pressure rating for water of 80 psi. As further required by local municipal or county construction codes, those pipelines within their road rights-of-way shall be Pressure Rated PVC (IPS) pipe conforming to ASTM D2241 and F477. The minimum pressure rating to be used in public rights-of-way shall be 160 psi. In addition, pipes installed under roadways, driveways and parking areas shall be designed for H-20 minimum live load.

Pipeline materials other than plastic may be necessary for complete system installation. Use of other materials should conform to applicable manufacturer's specifications.

WORKING PRESSURE AND FLOW VELOCITY - The pipeline shall be designed to meet all service requirements without the static pressure or operating pressure, whichever is greater, at any point exceeding 72 percent of the pressure rating of the pipe, nor the design flow velocity at system capacity exceeding 5 ft/s for full pipe flows.

If any of these limits are exceeded, special consideration must be given to the flow conditions and special design measures taken to adequately protect the pipeline against surge damage

FRICTION LOSSES - For design purposes, friction head losses shall be computed by the Hazen-Williams, Manning's, or other suitable equation, at the discretion of the design engineer, using a roughness co-efficient per manufacture recommendation. For a conservative realistic design, the engineer should consider using a friction factor indicative of a pipeline which has been in use for sometime.

INLETS AND OUTLETS – Pipeline inlets shall be designed to minimize intake of trash and sediment. Standard Drawings are available from several sources including the Natural Resources Conservation Service (NRCS), counties and municipalities, the web, or other sources.

Appurtenances required to deliver water from the pipeline to individual lots from non-pressurized systems (not pumped) shall have a 2 inch minimum diameter and tee off the side of the supply pipeline, then elbow up to the surface.

ISOLATION VALVES – Isolation valves should be placed at strategic locations, such as the main delivery points to a subdivision, in order to allow continued operation of the remainder of the system while repairs or maintenance are completed elsewhere. Isolation valves and gear operators shall be designed for direct bury applications.

CHECK VALVES - For pumped pressurized systems, a non-slam check valve shall be installed between the pump discharge and the pipeline where back-flow may occur.

PRESSURE- RELIEF VALVES – For pressurized systems, a pressure-relief valve shall be installed as per the manufacturer's recommendation between the pump discharge and the pipeline as a means to release water if excessive pressure can build up when all valves are closed. Pressure-relief valves shall be installed on the discharge side of the check valve where a reversal of flow may occur. Variable frequency drive (**VFD**) pump systems will not require pressure relief valves.

AIR VACUUM RELIEF VALVES - To provide positive means for air escape during filling and general operation, and air entry while emptying, air-and-vacuum valves, open vents (hydraulic gradeline allowing) or combination air valves shall be installed as designed by the engineer.

VALVE PROTECTION – Buried drain, flush, and inline isolation valves shall be protected and accessed with an acceptable diameter PVC Risers with cap or, where practicable, irrigation standard type valve boxes. However, those within road rights-of-way shall be cast iron extension type of proper length to meet surrounding surface condition (flush with pavement, 1 inch above grade in dirt, etc.) or as specified by the local county or municipal construction codes.

FLUSHING - Means shall be provided for flushing the pipeline free of sediment or other foreign material, using a suitable valve installed at the distal end of the pipeline. Flush lines shall be of sufficient diameter to achieve a minimum velocity in the main pipeline of 1.5 fps and shall be of a diameter no less than ½ the diameter of the largest pipe it is flushing.

DRAINAGE - ***All construction shall be in accordance with existing storm water pollution regulations.*** Provisions shall be made for completely draining the pipeline. Drainage outlets shall be located at all low places in the pipeline. These outlets may

drain into dry wells or to points of lower elevation. If drainage cannot be provided by gravity, provisions shall be made to empty the pipeline by pumping or by other means.

DRY WELL DRAINS – Dry well drains shall be comprised of excavated pits located below the pipeline elevation, filled with 1 ½" diameter screened gravel, covered with 10 mil plastic or filter fabric, then backfilled by normal methods. The minimum volume of a dry well shall be approximately twice the volume of water remaining in the pipeline after draining through the lower delivery outlets or flush lines.

DESIGN DEPTH OF COVER – To prevent damage from sprinkler trenching or other homeowner excavating activity and unless otherwise required by the governing local county or municipality, the minimum recommended distance from top of pipe to minimum **finished** ground surface for underground delivery pipelines shall be 30 inches.

Other pipeline design guidelines referencing soil types and pipe loading can be found in the Uni-Bell *Handbook of PVC Pipe: Design and* Construction or the Plastic Pipe Institute's *Handbook of PE Pipe.*

TRENCH CONSTRUCTION - Where working conditions and right-of-way width permit, trenches in unimproved areas may be excavated with sloping sides in accordance with OSHA requirements.

The trench at any point below the top of the pipe shall be only wide enough to permit the pipe to be easily placed and joined and to allow the initial backfill material to be uniformly placed under the haunches and along the side of the pipe. The maximum trench width shall be 36 inches greater than the diameter of the pipe.

If the trench is precision excavated and has a semicircular bottom that closely fits the pipe, the width shall not exceed the outside diameter of the pipe by more than 10 percent.

The trench bottom shall be uniform so that the pipe lies on the bottom without bridging. Clods, rocks, and uneven spots that can damage the pipe or cause non-uniform support shall be removed.

If rocks, boulders, or any other material that can damage the pipe are encountered, the trench bottom shall be undercut a minimum of 4 inches below final grade and backfilled with bedding material consisting of sand or fine-grained soils.

Provisions shall be made to insure safe working conditions where unstable soil, trench depth, or other conditions can be hazardous to personnel working in the trench.

PLACEMENT - Care shall be taken to prevent permanent distortion and damage when handling the pipe during unusually warm or cold weather. Plastic pipe shall be allowed to come within a few degrees of the temperature it will have after it is completely covered before placing backfill, other than that needed for shading, or before connecting the pipe

to other facilities. The pipe shall be uniformly and continuously supported over its entire length on firm stable material. Blocking or mounding shall not be used to bring the pipe to final grade unless backfilled with flowable fill.

For pipe with bell joints, bell holes shall be excavated in the bedding material, as needed, to allow for unobstructed assembly of the joint and to permit the body of the pipe to be in contact with the bedding material throughout its length.

Note – It is recommended that electric supply or control wires for pumps or valves buried in conjunction with underground conveyance systems be installed beneath the pipeline.

JOINTS AND CONNECTIONS - All joints and connections shall be designed and constructed to withstand the design maximum working pressure for the pipeline without leakage and to leave the inside of the pipeline free of any obstruction that may tend to reduce its capacity below design requirements. All fittings and connections including couplings, reducers, bends, tees, and crosses, shall be installed according to the recommendations of the manufacturer using the recommended pipe lubricant, or solvent and cement for each particular connection.

Fittings and valves of materials other than plastic shall be adequately protected from corrosion inside and outside by a method specified by the design engineer

THRUST CONTROLS - Thrust control shall be installed in pipelines of 4" diameter or greater and with working pressures of 25 psi or greater. Abrupt changes in pipeline grade, horizontal alignment, or reduction in pipe size normally require an anchor or thrust block to absorb any axial thrust of the pipeline. Thrust control is also needed at the end of the pipeline and at in-line isolation valves.

Thrust blocks and anchors must be large enough to withstand the forces tending to move the pipe, including those of momentum and pressure as well as forces due to expansion and contraction. The pipe manufacturer's recommendations for thrust control shall be followed.

TRACER WIRE - A continuous, insulated, single strand, toning wire shall be installed with all non-metallic pipes. Material and installation shall be in accordance with Article 340, Underground Feeder and Branch-Circle Cable: Type UF, of the National Electrical Code Handbook. The toning wire shall be looped up at all valve boxes. Maximum individual runs without loops shall not exceed 1000'.

INSTALLATION OF TRACER WIRE - Toning wire shall be placed on and duct taped to the top of the pipeline at minimum 5 foot intervals. Splicing shall be accomplished using direct bury splice kits and the recommended procedures therein.
The installer shall be responsible for testing the toning wire with an electronic locator to ensure there is complete continuity of signal.

Toning wire shall be looped up and accessible at all pipe inlets, outlets that span 20' or greater from the mainline, valve boxes, road crossings, pipe terminations, and anywhere else common sense dictates along distribution pipelines.

TESTING - The pipeline shall be tested for pressure strength, leakage, and proper functioning. The test may be performed before backfilling or any time after the pipeline is ready for service.

Tests for pressure strength and leaks shall be accomplished by inspecting the pipeline and appurtenances while the maximum working pressure is maintained and all joints and connections are uncovered, or by observing normal operation of the pipeline after it is put in service. Partial backfill needed to hold the pipe in place during testing shall be placed as specified in "Initial Backfill". Any leaks shall be repaired and the system retested. The pipeline shall be tested to ensure that it functions properly at design capacity. At or below design capacity, there shall be no objectionable flow conditions. Objectionable flow conditions shall include water hammer, continuing unsteady delivery of water, and damage to the pipeline, or detrimental discharge from control valves.

Alternate inspection and testing procedures can be found in the Uni-Bell *Handbook of PVC Pipe: Design and Construction* or the Plastic Pipe Institute's *Handbook of PE Pipe.*

INITIAL BACKFILL - Hand, mechanical, or water packing methods may be used. The initial backfill material shall be soil or sand that is free from rocks or stones larger than 3/4 inch in diameter. At the time of placement, the moisture content of the material shall be such that the required degree of compaction can be obtained with the backfill method to be used. The initial backfill material shall be placed so that the pipe will not be displaced, excessively deformed, or damaged. If backfilling is done by hand or mechanical means, the initial fill shall be compacted firmly around and above the pipe as required to provide adequate lateral support to the pipe.

If the water packing method is used, the pipeline first shall be filled with water. The initial backfill before wetting shall be of sufficient depth to insure complete coverage of the pipe after consolidation. Water packing is accomplished by adding enough water to dike reaches of the trench to thoroughly saturate the initial backfill without excessive pooling. After the backfill is saturated, the pipeline shall remain full until after the final backfill is made. The wetted fill shall be allowed to dry until firm before beginning the final backfill.

FINAL BACKFILL – Final backfill shall meet the following requirements unless otherwise required by the governing local county or municipality. The final backfill material shall be free of large rocks, frozen clods, and other debris greater than 3 inches in diameter. The material shall be placed and spread in approximately uniform layers so that there will be no unfilled spaces in the backfill and the backfill will be level with the natural ground or at the design grade required to provide the minimum depth of cover after settlement.

Rolling equipment shall not be used to consolidate the final backfill until the design minimum depth of cover has been placed. All special backfilling requirements of the pipe manufacturer shall be met.

AS BUILT DRAWINGS – As-built drawings shall be prepared following the complete installation of the system. These drawings shall show the location (vertical and horizontal) of the pipeline and all appurtenances referenced to the same grid system used in utility composite drawings required by the approving city or county entity. As-built drawings shall be filed with the city, county, HOA, and irrigation provider as required.

OPERATION AND MAINTENANCE - Specific requirements for the operation and maintenance of pipelines shall be included on the standard plan. Operation and maintenance needs shall be discussed with the Home Owners Association (HOA) representative(s) prior to acceptance by the HOA. A complete operation and maintenance plan shall be included with as-built drawings and conveyed to the HOA at the time of acceptance. A written warranty stating the installer shall be responsible for all materials and workmanship for a period of one year following installation, shall also be included with the as-built drawings.