PIMA COUNTY
WASTEWATER RECLAMATION

SECTION 5
PUBLIC GRAVITY SEWER DESIGN STANDARDS

Engineering Design Standards

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Section 05

Public Gravity Sewer Design Standards

5.1 Sewer Lines

5.1.1 Location and Alignment

In accordance with Code, specifically 13.20.030(A)(1), public gravity sewers shall be located:

- Beneath the paved portions of public roads, streets, avenues, alleys and Right-of-Way, to the maximum degree possible, for sewer maintenance vehicle access (see Section ~~8~~7); or
- Beneath the paved portions of private streets and within dedicated Public Sewer easements.
- Beneath the paved portions of private streets dedicated as common area by final plat.

  The following language shall be used for the common area dedication on the final plat:

  1. Grantor hereby irrevocably grants and dedicates easements to Pima County for access, installation, construction, maintenance and replacement of public sewer systems in all common area " " designated by this plat: or
  2. Grantor hereby irrevocably grants and dedicates easements to the respective utility providers for access, installation, construction, maintenance and replacement of underground utilities and public sewer systems in all common area " " designated by this plat.

All new public gravity sewers shall be designed and located so as to be positioned within the paved portions of new streets to the maximum extent possible. This guideline shall be followed even in the case where adjacent lots may be required to utilize private, on-site mechanical wastewater pumping systems to achieve physical connection to the Public Sewer located beneath a street surface.

Due to environmental, operational and maintenance concerns, the location of sewers in the following areas/circumstances shall be avoided unless Special Approval is obtained from the Director or his/her delegate, on a case-by-case basis:

- Routing across, through and between lots;
- Within or along a wash or wash environment;
- Crossing a wash outside of a road Right-of-Way;
- Within a common area except those designated as paved private streets; and

- Within areas undisturbed by development.

All sewers located outside the paved portions of public roads, streets, avenues, alleys and Right-of-Way or paved private streets shall require specific sewer easements if special approval is granted.

If Special Approval is granted for placing a sewer within an unpaved common area, the following language shall be included on the final plat for the dedication of the sewer easement:

"Applicant hereby grants to Pima County ~~and public utility companies~~ all rights of way and easements as shown hereon for the purpose of access, installation, maintenance, construction, and replacement of public sewers. ~~and utilities and other uses dedicated by this plat.~~ Applicant agrees that all sewer rights-of-way and easements granted hereon shall conform to the PCRWRD Engineering Design Standards ~~2012~~2016, Section ~~8~~7 and, in particular, Subsection ~~8.5~~7.5."

Sewer lines shall be designed with a uniform slope, alignment (vertically and horizontally) and a constant diameter between manholes.

Curvilinear alignments for Public Sewer lines shall be avoided unless Special Approval is obtained from the Director or his/her delegate, on a case-by-case basis. Special Approval will not be issued unless there is absolutely no other practical solution. Cost savings shall not be the sole justification for allowing curvilinear alignments for Public Sewers.

5.1.2 Pipe Capacity

In accordance with AAC R18-9-E301(D), the capacity of new Public Sewer lines shall be designed to meet the following design flow criteria:

- AAC R18-9 Table 1 - Unit Design Flows;
- Dry weather peaking factors based on upstream population, as specified in AAC R18-9-E301(D)(b)(i);
- The ratio of the depth of flow in the pipe (d) to the diameter of the pipe (D) shall not exceed 0.75 for Peak Dry Weather Flow (PDWF) conditions ($d/D \leq 0.75$); and
- Accommodate Peak Wet Weather Flow (PWWF) when flowing full within any point in a sewer line.

For residential developments, unit design flows shall be based on 2.7 persons per single family dwelling unit and 80 gallons per person per day, unless otherwise Approved by the Department. The Department may elect to specify alternate PDWF ratios for d/D, based on development of the hydraulic model.

In accordance with AAC R18-9-E301(C), for new Public Sewers or expansions of existing Public Sewers involving new construction, the design flows and the basis for calculating these flows shall be documented in a Sewer Design Report. In addition to submitting the Sewer Design Report to PDEQ for review, a copy shall

also be submitted to the Department for determining the available capacity of existing Public Sewer conveyance and treatment facilities.

5.1.3 Velocity and Slope

A. Velocities

Gravity sewer lines shall be designed to ensure the positive flow of wastewater and provide self-cleansing velocities. Pursuant to AAC R18-9-E301(D)(2)(e), the minimum full-flow velocity shall be 2 fps when using a pipe roughness coefficient of 0.013 (Manning *n*), regardless of the material composition, age or condition of the sewer pipe. The equation for calculating the full-flow velocity in a circular pipe can be expressed as:

$$v_{FF} = \frac{1.486}{n} \times \left(\frac{D}{48}\right)^{2/3} \times S^{1/2}$$

where:

v_{FF}	=	Full-flow velocity [ft/sec]
n	=	0.013 [roughness coefficient]
D	=	Nominal pipe diameter [in]
S	=	Slope [ft/ft]

The minimum full-flow velocities required by the Department for 6 inch and 8 inch diameter sewer lines exceed the requirements of AAC and are summarized in Table 5.1.

Pursuant to AAC R18-9-E301(D)(2)(f), when velocities of 10 fps or greater are predicted to occur, the sewer line shall be either ductile iron or a pipe material of equal or better erosion resistance. Special provisions shall be considered to protect sanitary sewer manholes against shock, erosion and the increased generation of hydrogen sulfide gases.

B. Calculating Sewer Pipe Slopes

The design pipe slope shall be based on the horizontal pipe length, measured from the inside face of each connecting manhole on the sewer reach.

C. Minimum Slopes

Table 5.1 summarizes the minimum slopes required by the Department for Public Sewer lines.

Table 5.1
Minimum Slopes for Gravity Sewer Lines

Pipe Diameter (inches)	Minimum Slope (ft/ft)	*Full-Flow Velocity (ft/sec)
6 (terminal reach)	0.0110	3.0
8 (terminal reach)	0.0100	3.5
8 (non-terminal reach)	0.0044	2.3
10	~~0.0024~~0.0025	2.0
12	0.0019	2.0
15	0.0014	2.0
18	0.0011	2.0
24	~~0.00077~~0.0008	2.0
*Manning's (n) value of 0.013 used		

Increasing the diameter of a sewer line for the sole purpose of achieving a flatter slope to maintain the minimum depth of cover is not permitted.

5.1.4 Standard Pipe Materials

The following pipe materials are Approved by the Department for Public Sewer lines of less than 18-inch nominal inside diameter:

- Vitrified Clay;
- Ductile Iron; or
- Polyvinyl Chloride.

These pipe materials shall conform to the *Standard Specifications and Details*, Subsection 3.2.2.

For Public Sewer lines with a nominal inside diameter of 18 inches or greater, the Department retains the right to specify pipe materials on a case-by-case basis.

5.1.5 Casings for Sewer Lines

Where casings are required for new Public Sewer lines, the design shall conform to the requirements of either S.D. RWRD-100 or the agency having jurisdiction in the Right-of-Way, whichever is more stringent. A cathodic protection system shall also be considered in the design of casings for Public Sewer lines.

5.1.6 Cathodic Protection for DIP Sewer Lines

A corrosion report for the design of cathodic protection shall be submitted with the Design Drawings for pile-supported DIP or other buried sewer facilities with exposed metal surfaces. This requirement does not apply to direct-bury installations of DIP encased with polyethylene wrap or exposed installations of DIP with an Approved exterior coating.

The corrosion report shall evaluate the soil and any other conditions that may affect the exterior corrosion rate of the steel casings, steel piles and DIP. At a minimum, the corrosion report shall include the following for the native soils:

- Soil Classification and description;
- Earth Resistivity;
- Measure of acidity (pH);
- Oxidation Reduction Potential;
- Sulfides;
- Moisture Content (Relative);
- Potential Stray Direct Current;
- Experience with existing installations in the area;
- Cost of protective measures; and
- Life expectancy of the steel piles and DIP.

If the results of the corrosion report indicate that a cathodic protection system is necessary, a Design Report for cathodic protection shall be included with the submittal. Cathodic protection systems shall utilize magnesium anodes in lieu of impressed currents.

5.1.7 Cover

Cover shall be the vertical distance measured from the top of pipe to finished grade. The design of Public Sewers shall provide a minimum cover of 4 feet above the Public Sewer line and that portion of any Service Lateral that is located within a Right-of-Way. The depths of new Public Sewer lines from or connecting to existing shallow Public Sewer lines (less than 4 feet of cover), shall be evaluated on an "available-depth" basis.

Where the "available-depth" of existing Public Sewer lines does not allow for new Public Sewers to meet the minimum cover requirements, these requirements may be reduced with Special Approval from the Director or his/her delegate, on a case-by-case basis. Where Special Approval is obtained for new shallow Public Sewer lines, it shall be constructed of DIP or other pipe material, as Approved by the Department.

For Public Sewer lines crossing washes, see Subsection 5.1.11(A).

5.1.8 Separation from Potable Water Mains and Facilities

A. Potable Water Mains

Potable water mains and Public Sewer lines shall be separated in order to protect potable water systems from possible contamination. Separation shall be measured perpendicularly from the outside surface of the Public Sewer line to the outside surface of the potable water main. The minimum separation requirements shall conform to S.D. RWRD-108.

Where practical, the design of new Public Sewer lines and new water mains should provide for a horizontal separation of 6 feet from the outside surface of all manhole risers to the outside surface of a water main. The use of horizontal fittings in water mains to meet this design guideline (i.e. jogging around manholes), shall be avoided.

B. Wells and Other Water Facilities

The separation requirements between wells and Public Sewers shall conform to AAC R18-5-502(C)(5).

5.1.9 Separation from Reclaimed Water Mains

Separation requirements for reclaimed water mains and Public Sewer lines shall be equivalent to the separation requirements for potable water mains per Subsection 5.1.8(A).

5.1.10 Separation from Other Utilities and Structures

A. Drainage ~~Culverts~~Facilities

Provide at least 2 feet of vertical clearance between stormwater drainage ~~culverts~~ facilities and Public Sewer lines. If this standard cannot be met, the Public Sewer line shall be replaced with DIP or approved equal. For drainage ~~culverts~~ facilities that parallel the Public Sewer line, the drainage ~~culverts~~ facilities shall be located outside the normal trench areas of the sewer per S.D. RWRD-104. Drainage ~~culverts~~ facilities shall not cross less than 45 degrees where possible.

B. Poles and Pole Footings

Poles and pole footings shall not be located closer than 2 feet to the outside of a Public Sewer line. If any Public Sewer lines are located in close proximity to a proposed pole location, the Sewer Plans shall include a detail for mitigating the conflict with this standard.

C. Railroad Crossings

If Public Sewer lines will be constructed across a railroad (Tucson Modern Streetcar excluded) the design shall conform to the requirements of the respective

railroad jurisdiction. In any such case, Public Sewer lines shall be protected within a steel casing that meets or exceeds the requirements per S.D. RWRD-100.

5.1.11 Washes and Stormwater Detention/Retention Basins

A. Washes

The placement of Public Sewers within or along a wash or wash environment shall be avoided unless Special Approval is obtained from the Director or his/her delegate, on a case-by-case basis. This restriction shall also apply to crossing a wash outside of a Right-of-Way. In cases where crossing a wash cannot be avoided, the sewer alignment should be located perpendicular to the direction of flow within the wash. Diagonal crossings have a greater potential for exposure, and should be avoided.

When Special Approval is obtained for crossing a wash, the design of the Public Sewer line shall meet the following criteria:

- Provide a minimum cover 4 feet per Subsection 5.1.7;
- Place the sewer line at a depth of at least 2 feet below the Total Scour Depth per the *Design Standards*, Appendix A, Subsection IV; and
- The sewer line material shall be ductile iron and extend a minimum of 10 feet beyond the Lateral Migration Setback limits per the *Design Standards*, Appendix A, Subsection V.

In cases where the minimum cover and Scour depth cannot be met, Special Approval by the Director or his/her delegate shall also be required for the design of Scour mitigation measures such as pile-supported sewer lines per S.S.D. RWRD-101 or alternative measures per the *Design Standards*, Appendix A, Subsection VI and S.S.D. RWRD-113.

The calculations for Total Scour Depth per the *Design Standards,* Appendix A, Subsection IV shall be included with the Sewer Plan submittal. If mitigation design measures for Scour are required, a Design Report for these design measures shall be included with the Sewer Plan submittal.

B. Stormwater Detention/Retention Basins

Public Sewer lines should not be located beneath stormwater basins and all reasonable design options must be exercised to avoid such locations.

5.1.12 Abandonment of Sewer Lines

Wherever possible, reaches of existing sewer pipe that are to be abandoned shall be completely removed. When the removal of sewer pipe is not feasible, it shall be abandoned-in-place per the *Standard Specifications and Details*, Subsection 3.2.3(H).

5.2 Manholes and Appurtenances

5.2.1 Placement of Manholes

Wherever possible, manholes should be located within the paved area of a Right-of-Way or within a Public Sewer easement. Manholes should be located along the centerline of paved streets or centered within a multi-use or driving lane. However, manhole location shall not interfere with street monumentation. The placement of manholes in the wheel path of vehicles shall be avoided. The placement of manholes in sidewalks, crosswalks, bike trails, wash crossings, back or side yards, behind walls, curbs or gutters shall also be avoided.

A manhole shall be provided at any of the following locations along the sewer alignment:

- A change in slope;
- A horizontal bend (horizontal deflection angles greater than zero);
- A change in pipe size;
- A change in pipe material (excluding DIP replacements and repairs);
- Where two or more incoming Public Sewer lines connect;
- A terminal end;
- The connection of an HCS/BCS that is 6 inches in diameter or larger; and
- For Public Sewer lines, 15 inches in diameter or larger, the connection of any size HCS/BCS or private sewer shall be avoided unless Special Approval is obtained from the Director or his/her delegate, on a case-by-case basis.

5.2.2 Spacing of Manholes

Pursuant to AAC R18-9-E301(D)(3)(a), the maximum spacing between manholes is summarized in Table 5.2:

Table 5.2
Manhole Spacing Requirements

Pipe Diameter (inches)	Maximum Manhole Spacing (feet)
8 to less than 18	500
18 to less than 36	600
36 to less than 60	800
60 and greater	1,300

Extending the reach length beyond maximum manhole spacing requirements to avoid a potentially high erosion area shall also require prior approval by ADEQ/PDEQ per AAC R18-9-E301(D)(2)(c)(iv).

5.2.3 Separation of Manholes from Pavement Items

A. Curbs and Gutters

The center of any new manhole (within pavement) should be located a minimum of 5 feet away from the gutter flow line ~~of a road~~. If this standard cannot be met, provide a watertight frame and cover per Subsection 5.2.13.

B. Survey Monuments

The center of any new manhole should be located a minimum of 5 feet away from any survey monument.

C. Speed Bumps

New speed bumps and speed humps should be located a minimum of 10 feet from the frame and cover of any existing manhole or cleanout.

5.2.4 Manholes in the Vicinity of Drainage Features

Manholes shall not be located in any of the following locations unless Special Approval is obtained from the Director or his/her delegate, on a case-by-case basis:

- A Wash or drainage channel;
- The overbank areas of a Wash, defined by the minimum Lateral Migration setback distances per Appendix A, Subsection V; or
- Stormwater detention/retention basins.

If Special Approval is obtained for the design of manholes in any of the preceding locations, the design shall include extra protection for hydraulic forces per the *Design Standards*, Appendix A, Subsection VI-6.5.7.2 and the use reinforced manhole joints per S.S.D. RWRD-209. A Design Report for the structural design of these manholes shall also be included with the Sewer Plan submittal.

5.2.5 Manhole Connections

The maximum number of Public Sewer line connections into a manhole is 4 (3 inlets and 1 outlet).

5.2.6 Horizontal Deflection Angles

Horizontal deflection angles are measured at a horizontal bend in a sewer line and require a manhole. The horizontal deflection angle is the change in angle between the incoming and the outgoing sewer line, as shown in Figure 5.1. Horizontal deflection angles are limited by the diameter of the outgoing sewer line, and are summarized in Table 5.3.

Figure 5.1
Horizontal Deflection Angles
(Plan View)

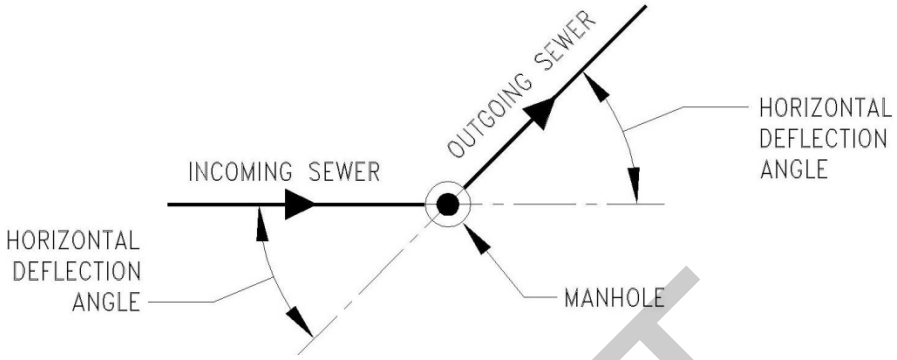


Table 5.3
Horizontal Deflection Angles

Outgoing Sewer Diameter	Maximum Horizontal Deflection Angle
Less than or equal to 10 inches	90°
Greater than 10 inches	60°

5.2.7 Diameter

The minimum diameter of a manhole (inside-diameter measured at the base) shall depend on the largest diameter of the connected pipes and the configuration of the flow channels (see S.D. RWRD-202). Where more than 3 sewer lines (excluding HCSs) connect into a new manhole, the minimum diameter shall be 60 inches. Where 3 or less sewer lines connect into a new manhole, the minimum diameter is determined as summarized in Table 5.4.

Table 5.4
Minimum Manhole Diameters for
3 or Less Sewer Line Connections

Largest Pipe Diameter or LPD (inches)	Minimum Manhole Diameter (inches)
6 to 10	48
12 to 18	60
Greater than 18	= (LPD x 5/3) + 36-in

For cast-in-place manholes or manholes with diameters greater than 60 inches, a special detail shall be provided on the Sewer Plans. At a minimum, the special detail shall provide the following information:

- Structural details for cast-in-place bases and manholes;
- Flow channel configuration;
- ~~with b~~Bench access per S.D. RWRD-202;
- Size and stacking configuration for precast manhole sections; and
- Size and type of frame and cover.

Structural design calculations for these manholes, sealed by an Arizona registered P.E., may also be required to be included with the Sewer Plan submittal.

5.2.8 Change in Slope

When a change in slope is required within a reach of gravity sanitary sewer, a manhole shall be provided. The manhole shall be designed:

- To avoid hydraulic jumps;
- To ensure full capacity without excessive head losses; and
- To avoid turbulence and the resultant release of hydrogen sulfide gas.

5.2.9 Manhole Invert Drops

The flow channel, through the base of a manhole, shall be sloped to provide for a smooth transition of flow and minimize the deposition of solids. A minimum vertical change in elevation between the incoming pipe and the outgoing pipe, also known as the manhole invert drop, is required to provide for this slope. Manhole invert drops shall depend on the diameter of the connecting pipes and the horizontal deflection angle of the connecting pipes. For inlet and outlet pipes with the same diameter, see Table 5.5 for the required invert drops.

Table 5.5
Required Manhole Invert Drops
(Inlet and Outlet Pipes with Same Diameter)

Horizontal Deflection Angle	Invert Drop (feet)
0 to 9 degrees	Maintain Average Slope of Incoming and Outgoing Sewer Lines through Manhole; or Invert Drop = Manhole Diam. in feet x $(S_1 + S_2)/2$ Where: S_1 = Slope of incoming Reach S_2 = Slope of outgoing Reach
10 to 45 degrees	0.10
46 to 90 degrees	0.20

For inlet and outlet pipes with different diameters, invert drops shall be determined by matching the crown elevation of both pipes. In no case shall the diameter of the inlet pipe be greater than the diameter of the outgoing pipe.

The Department may allow an invert drop to be increased up to 2.5 ft to avoid the use of a Drop Manhole.

5.2.10 Future Connections into Manholes

For the design of new manholes, where a future sewer line is planned to connect into it, such as the case for development phasing, a block-out per S.D. RWRD-203 shall be required. The use of a projecting pipe at the new manhole, also known as a pipe stub-out, shall not be permitted unless the pipe stub-out is designated as private. In any such case, when construction of the future sewer line reach is completed, the existing pipe stub-out will be inspected and tested as part of the requirements for new Public Sewer construction.

For the design of a new sewer line connection into an existing manhole, the Department may require the manhole to be reconstructed or rebuilt. This requirement shall be determined after the existing manhole is assessed by the Department. The results of the assessment will depend on the condition of the manhole, flow channel configuration, steps location, and depth of flow.

5.2.11 Manholes in Flood-Prone Areas

Manholes that are located in the overbank areas of a wash or in areas prone to flooding may be subjected to Scour and lateral forces that may result in a structural failure. The design of new manholes located in such areas shall be avoided unless Special Approval is obtained from the Director or his/her delegate, on a case-by-case basis. If Special Approval is obtained, the following requirements shall apply:

- A detail of the precast concrete manhole shall be provided in the Sewer Plans;
- The rim elevation shall be a minimum of 1-foot above the 100-year flood elevation and the requirement for a concrete collar per S.D. RWRD-212 may be waived, where warranted;
- In no case shall the maximum depth of Scour at the manhole, per Appendix A, Subsection VI-6.5.7.1, expose any of the connecting sewer lines or the base of the manhole;
- Scour calculations shall be sealed by an Arizona Registered P.E. and included with the Sewer Plan submittal;
- If the maximum depth of Scour is 12-feet or less and three or less precast concrete sections (i.e. cones and risers) will be exposed, all precast concrete sections shall have reinforced manhole joints per S.S.D. RWRD-209;
- If the maximum depth of Scour is greater than 12-feet or more than 3 precast concrete sections (i.e. cones and risers) will be exposed, a structural

analysis shall be required and include the total lateral-loading on the manhole per Appendix A, Subsection VI-6.5.7.2; and

- If required, structural calculations shall be sealed by an Arizona Registered P.E. (Structural) and included with the Sewer Plan submittal.

5.2.12 Manhole Frames, Covers and Concrete Collars

Frames and covers for manholes shall be 24 inches in diameter and conform to S.D.s RWRD-213, -214 or -215. The use of 30-inch diameter frames and covers per S.D.s RWRD-216, -217 or -218 shall be required for shallow manholes or unique manholes where entry access is hindered.

At the discretion of the Department, the use of bolted frames and covers per S.D.s RWRD-215 or -218 may be required for manholes located within a bike or multi-use path, or in cases where additional security is needed.

For manholes located in paved roads, the transportation agency having jurisdiction in the Right-of-Way may require a concrete collar to be placed around the frame and cover. In these cases, this concrete collar shall meet the minimum requirements per S.D. RWRD-211. For manholes located in unpaved areas, a concrete collar per S.D. RWRD-212 shall be required.

Where proposed construction will disturb the frame and cover of an existing manhole, it's condition must be assessed by the Department to determine if additional modifications are required. These required modifications may include:

- A new concrete collar per S.D. RWRD-211 or -212;
- A grade adjustment per S.D. RWRD-305 or 306, requiring the elevation of the frame and cover to be adjusted, however, the existing cone section or flat top slab of the manhole remains intact;
- A reconstruction of the manhole, requiring the removal and replacement of the manhole to a specified depth, excluding its base; or
- A rebuild of the manhole, requiring the replacement of the entire manhole, including the base.

5.2.13 Watertight Frames and Covers

A watertight frame and cover per S.D. RWRD-214 or -217 shall be required where:

- ~~A manhole~~The manhole cover is located in a paved road and ~~the~~ its center ~~of the manhole~~ is ~~located within~~ less than 5 feet from the gutter flow line;
- ~~A frame and cover will be submerged under water during a 2-year storm event~~The manhole cover is in a location that will be inundated by stormwater ponding or concentrated flows; or
- ~~A manhole~~The manhole cover is located ~~in a pedestrian area, to reduce the potential for odor complaints~~near an area where people gather and/or nuisance sewer odors are known to exist.

For a continuous series of watertight frames and covers along a sewer alignment, manhole vent assemblies per S.D. RWRD-223 or -224 ~~shall~~ may be required by the Department. ~~If the spacing between watertight frames and covers is less than or equal to 500-feet, a vent assembly shall be required at every other manhole. If the spacing between watertight frames and covers is greater than 500-feet, a vent assembly shall be required at every manhole.~~The Department retains the right to determine the location and spacing of manhole vent assemblies on a case-by-case basis. The exposed portion of the vent assembly shall be located away from drainage channels and protected with Type 'A' post barricades per COT/PC Standard Detail 106 or as Approved by the Department. ~~The Department retains the right to modify the location and spacing of vent assemblies on a case-by-case basis~~.

5.2.14 New Manhole over Existing Sewer Line

Where a new manhole is proposed over an existing Public Sewer line, the horizontal and vertical locations of the existing sewer line should be verified by a field survey. If, during construction, the Contractor finds the horizontal or vertical location of the sewer does not match the Sewer Plans within acceptable tolerances per the *Standard Specifications and Details*, Subsection 3.3.3(C), the Sewer Plans shall be revised and re-submitted to the Department for conformance review and Acceptance before construction of the manhole continues.

5.2.15 Drop Manholes

The use of Drop Manholes shall be avoided unless Special Approval is obtained from the Director or his/her delegate, on a case-by-case basis. Special Approval will not be issued unless there is absolutely no other practical solution. Cost savings shall not be the sole justification for a Drop Manhole.

If Special Approval is obtained for a Drop Manhole connection, an external connection per S.S.D. RWRD-229 or -230 shall be used for Public Sewer lines. Internal Drop Manhole connections per S.S.D. RWRD-403 shall be limited to Service Laterals.

5.2.16 Corrosion Protection for Manholes

To protect the useful life of manholes, interior corrosion protection shall be required for a new manhole in any of the following cases:

- Manholes with pipe diameters of 18 inches and greater;
- Manholes located on smaller tributary lines that are within 200 feet of a manhole with pipe diameters of 18-inches and greater;
- A force main discharge manhole; or
- A manhole receiving flow from a sewer line with a slope greater than 10%.

Where interior corrosion protection is required for new manholes, it shall be specified in the Sewer Plans and conform to the requirements of the *Standard Specifications and Details*, Subsection 3.3.3(B)(viii).

5.2.17 Cleanouts

Manholes shall be provided at the terminal reach of Public Sewer lines. Cleanouts are not allowed. If an existing Public Sewer cleanout will be disturbed by proposed construction, the Department will determine on a case-by-case basis if it will be replaced with a manhole.

5.2.18 Flow Metering Stations

The requirement for new flow metering stations per S.S.D. RWRD-225 will be dictated by the Department on a project-specific basis. Special Approval by the Director or his/her delegate shall be required for proposed connections to existing flow metering stations or the relocation of existing stations.

5.2.19 Abandonment of Manholes

Wherever possible, existing manholes that are to be abandoned shall be completely removed. Where the complete removal of an existing manhole is not feasible, it shall be abandoned-in-place per the *Standard Specifications and Details*, Subsection 3.3.3(E).

5.3 Service Laterals (HCS/BCS)

5.3.1 Alignment of Service Laterals

The horizontal alignment of Service Laterals~~, also referred to as an HCS or BCS,~~ shall not violate the frontage of adjacent properties while traversing to the point-of-connection to the Public Sewer. The overall length of Service Laterals within Right-of-Way shall be minimized as required by the local agency having jurisdiction. The horizontal alignment of Service Laterals should be horizontally perpendicular to the sewer line where possible. Service Laterals located within Right-of-Way shall be horizontally straight without curves or bends.

The required slope of any Service Lateral within the Right-of-Way shall conform to local building codes. Where a conflict occurs with other utilities, the vertical rerouting of Service Laterals shall conform to S.D. RWRD-400.

5.3.2 Connections to Public Sewer

Service Laterals shall connect to the Public Sewer by method of a direct connection to the sewer line or in some cases, to a manhole. The following describes the criteria for determining the required method of connection.

HCS connections, 4 inches in diameter, shall connect to Public Sewer lines, less than or equal to 12 inches in diameter, by a direct connection per S.D. RWRD-401. HCS connections into manholes shall be avoided where possible. Non-perpendicular HCS alignments may be permitted to avoid connections into manholes. For non-perpendicular HCS alignments, the connection to the sewer line shall be located within the projected property lines of the lot it is servicing. If

the connection of an HCS into a manhole cannot be avoided, it may be allowed for the following types of manholes:

- A terminal manhole with no potential for a future sewer line extension (a maximum of 3 HCS connections); or
- A manhole located within a knuckle intersection (a maximum of 2 HCS connections).

Service Laterals and private sewer systems shall connect~~ions~~ into a Public Sewer manhole ~~may be allowed when~~in any of the following cases~~riteria are met~~:

- The internal diameter of the Service Lateral is equal to or one nominal size smaller than the diameter of the Public Sewer line (excludes a 4 inch HCS connection to an existing 6 inch diameter Public Sewer line);
- The nominal size of the Service Lateral is greater than 4 inches in diameter, regardless of the size of the Public Sewer line; or
- The Public Sewer line is 15 inches in diameter or greater, per Subsection 5.3.4.

5.3.3 Internal Drop Manhole Connections

Internal Drop Manhole connections per S.S.D. RWRD-403 shall be limited to Service Laterals. Internal Drop Manhole connections shall be avoided unless Special Approval is obtained from the Director or his/her delegate, on a case-by-case basis. Special Approval will not be issued unless there is absolutely no other practical solution. Cost savings shall not be the sole justification for an internal Drop Manhole. Special Approval for internal Drop Manholes may be issued for the following cases:

- A new HCS/BCS connection to an existing manhole where the slope will be greater than 45 degrees; or
- The presence of an existing obstruction that will not permit rerouting of the HCS/BCS per S.D. RWRD-400.

5.3.4 Direct Connections into 15-inch Diameter Sewer Lines or Greater

A manhole shall be required where a Service Lateral must connect to a 15-inch or greater diameter Public Sewer line unless Special Approval is obtained from the Director or his/her delegate, on a case-by-case basis. Special Approval will not be considered unless existing site conditions limit the ability to construct a new manhole and there is absolutely no other practical solution. Cost savings shall not be the sole justification for a direct connection. Special Approval for the direct connection of an HCS/BCS into a 15-inch or greater diameter Public Sewer line may be granted after the Public Sewer line has been assessed by the Department.

5.3.5 Private Cleanouts for Service Laterals

Pursuant to Arizona Blue Stake law (ARS 40-360.21 to 40-360.32), the Department is responsible for locating Service Laterals installed after December 31, 2005. For the purposes of accurately locating and marking an HCS/BCS within

the Right-of-Way, a private cleanout per S.D. RWRD-404, shall be required for either of the following cases:

- A new HCS/BCS connection to a Public Sewer line; or
- A full replacement, realignment or repair of an existing HCS/BCS.

The placement of private cleanouts in sidewalks, driveways, and other paved or hardscape areas shall be avoided. Private cleanouts shall also be located in either of the following:

- Within private property and a Public Sewer or utility easement; or
- Within a 10-ft × 10-ft Public Sewer easement adjoining and contiguous with the Right-of-Way, Public Sewer easement, or an expressed or implied private property utility easement.

For projects that do not require a Sewer Plan to be generated (e.g. single-lot developments, etc.) documentation that clearly identifies the final installed location of the HCS/BCS and the private cleanout shall be submitted to the Department.

5.3.6 Private Backwater Valves for Service Laterals

When the finished floor elevation of a connected building is 1 foot or less above the rim elevation of the first upstream manhole or cleanout, a private backwater valve shall be installed with the Service Lateral. Where the first upstream manhole diameter is greater than 5 feet, the elevation criteria shall be increased to 18 inches. In any such case, the first upstream manhole shall not have a bolted or watertight cover. The private backwater valve shall be installed on private property and not within the Right-of-Way or the Public Sewer easement.

5.3.7 Repair and Replacement of Service Laterals

Pursuant to Code, specifically 13.20.070, the property owner shall be responsible for the repair and replacement of the Service Lateral, including the connection to the Public Sewer and the private cleanout.

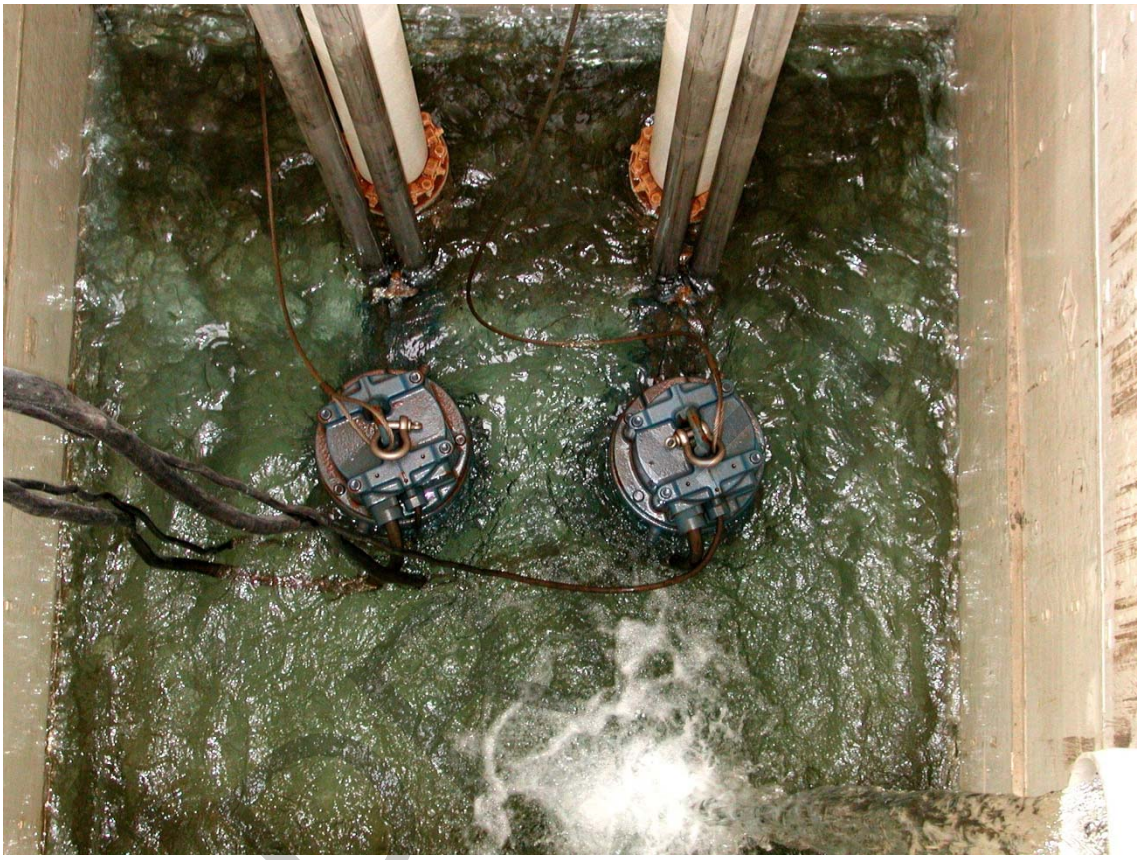
The property owner may request that the Department repair a damaged portion of the Service Lateral located within the Right-of-Way provided the damage was not caused by the property owner or his agents. The Department retains the right to approve or deny such requests on a case-by-case basis.

5.4 Graphical Requirements for Sewer Plans

The graphical requirements for Sewer Plans shall conform to the Department's current Sewer Plan checklist. A copy of the current checklist may be obtained from the Development Liaison group or downloaded from the Department's website.

Recommendations for wastewater flow management shall also be included with the submittal of the Sewer Plans. See Subsection 2.2 of the *Standard Specifications and Details* for more information.

PIMA COUNTY
WASTEWATER RECLAMATION



SECTION 6
WASTEWATER PUMPING SYSTEMS

Engineering Design Standards

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06

Wastewater Pumping Systems

6.1 General Classifications

This Section provides the design standards and guidelines for wastewater pumping systems that will be operated and maintained by the Department (i.e. public wastewater pumping systems). For wastewater pumping systems that will be owned, operated and maintained by private entities (i.e. private wastewater pumping systems), see Subsection 3.6. In accordance with, Code, specifically 13.20.035 and 13.20.40, the authorization of private wastewater pumping systems and their connection to Public Sewers must be Approved by the Department.

Wastewater pumping systems with projected Average Dry Weather Flows (ADWF) greater than or equal to 10,000 gpd are classified by the Department as major wastewater pumping systems. The design standards and guidelines provided in this Section are intended for major public wastewater pumping systems. For design guidelines regarding minor public wastewater pumping systems (ADWFs less than 10,000 gpd), see Subsection 6.12.

6.2 Planning and Design

The design of public wastewater pumping systems is considered a Special Project per Subsection 2.7. The type of wastewater pumping system (e.g. private or public) will be determined by the Department.

Special Approval, by the Director or his/her delegate, shall be obtained prior to proceeding with the design of a public wastewater pumping system. At a minimum, a sewer basin study shall be submitted to the Department for consideration. The sewer basin study shall include feasibility and cost analyses for alternative design solutions.

If Special Approval is obtained for a public wastewater pumping system, the design shall adhere to all applicable design codes and standards, including, but not limited to:

- This Section (Section 6);
- AAC R18-9-E301 – 4.01 General Permit;
- State of Arizona OSHA for General Industry;
- NEMA and NEC standards; and
- All applicable fire codes, including, but not limited to, NFPA 820.

6.3 Capacity Phasing

The requirement for additional design provisions for expanding the capacity of wastewater pumping systems for future development will be evaluated on a project

specific basis. As a general guideline, where the projected timeline for the development of future phases or neighboring properties within the contributing sewer basin is greater than 20 years, the design capacity should be limited to the known development. However, where the development of future phases or neighboring properties within the contributing sewer basin is likely to occur within a 20 year period, or if the extent of development cannot be ascertained with any accuracy during the design period, additional design provisions for capacity expansion may be required.

6.4 Site Requirements

6.4.1 General

A. For general development planning purposes, the minimum lot size for a wastewater pump station site should provide for a minimum yard area of 9,000 sf that is generally flat and surrounded by a perimeter wall. The yard should be square or rectangular in shape, having a maximum length to width ratio of 2:1 (i.e. 140-ft x 70-ft). The lot size shall also meet the minimum requirements of the local zoning code.

B. The required size for a wastewater pump station site is a direct function of the Department's ability to safely and efficiently maneuver maintenance vehicles to specific components within the yard, as described in the following:

- The front of a combo-cleaner sewer truck to the wet well;
- A truck-mounted crane to the pumps and manifold piping;
- A chemical truck to the storage tanks; and
- A fuel truck to the emergency generator.

C. Wastewater pump station sites shall not be located in a Floodway. For sites located in flood-prone areas, the yard of the pump station site shall be elevated at least 1-foot above the elevation of the 100-Year Flood. Wastewater pumping systems shall also be protected from scour, in accordance with the *Scour Procedures and Guidelines* provided in the *Design Standards*, Appendix A.

D. The ingress/egress access driveways shall be unrestricted and provide year round all-weather maintenance vehicle access from the nearest paved roadway within Right-of-Way. The driveways shall also be paved or stabilized in accordance with S.D. RWRD-111. A minimum vertical clearance height of 20-ft shall be provided for the driveway and vehicle maneuvering areas within the yard.

E. Incorporate design provisions for the future possibility of gravity conversion.

F. A masonry wall, measuring 8 feet in height, shall be provided to secure the yard. This wall shall have two 20-ft wall openings, each with double-swing security gates with hinged gate wheels. A man-way gate, 3 feet in width, shall also be incorporated into gate design. All security gates shall be a tubular-steel picket design. A level concrete slab shall be provided in front of the gates to support the gate wheels and facilitate full-open position.

G. Warning signs that provide the Department's 24-hour emergency phone number shall be placed in a location that is visible from the security gate.

H. The grading design for the site shall ensure that ponding will not occur within the yard. ~~Soils within the yard shall be compacted and stabilized with pavement or ground cover to withstand H-20 loadings. A 2-inch layer of ½-inch rock is an Acceptable ground cover for the yard~~Driveways and drivable areas for equipment access shall be stabilized per Subsection 7.7.1 at a minimum.

I. Lighting shall be provided for the yard and the control panels. Light shields for pole-mounted lights should be provided to minimize light pollution to adjacent homes. Electrical power outlets (110 Volt/20 Amp GFCI) shall be provided no greater than 50-feet away from the wet well and pipe manifold. Manual switches for yard lighting shall be provided within a secure panel at the entrance gate and at the control panel.

J. If a standby generator is required, a minimum clearance of 4 feet shall be provided on all sides.

K. A 1.5-inch potable water service shall be provided into the pump station site for the following fixtures:

- A 1.5-inch flushing hydrant, located no greater than 20-feet from the wet well and preferably within the concrete slab for the manifold piping; and
- If chemical odor control facilities are used, an emergency eyewash and shower unit.

L. A primary backflow prevention assembly shall be installed at the service line entering the site in accordance with the water purveyor's requirements. A secondary backflow prevention assembly shall also be installed for the emergency eyewash and shower unit.

M. Landscaping requirements for the areas outside of the yard shall conform to the local land-use or HOA codes and consider a low-maintenance and drought-tolerant design.

N. As a result of the U.S. Department of Homeland Security having classified pump stations as "critical infrastructure", heightened security measures shall be provided. Due to the sensitive nature of site security, specific design requirements are excluded from this document. Each project must be evaluated on a case-by-case basis and specific security requirements will be established at that time by the Department. For additional information relative to pump station security requirements, the Design Engineer should contact the Sanitary Engineering Manager.

O. Depending on the site location, offsite radio repeater towers may be required for the Department's SCADA system. The property for the repeater towers must be procured for the Department prior to final Acceptance of the pump station.

6.5 Pumps

6.5.1 General Requirements

A. Pump stations shall use duplex submersible wastewater pumps with each pump sized to handle the design flow. Refer to the Department's List of Approved Products for the recommended pump manufacturers. Pumps shall be equipped with three phase 480-volt electric motors. The pumps shall operate at a constant drive speed no greater than 1,780 rpm unless otherwise Approved. The use of Variable-Frequency Drive (VFD) pumping systems shall be avoided unless Special Approval is obtained from the Director or his/her delegate, on a case-by-case basis.

B. The selected pumps shall be in the manufacturer's preferred operating range. This range and the system curve shall be indicated on the pump curve. The pumps shall be as close as possible to the best efficiency point of the pump curve, using the lowest horsepower motor that can be found to perform the required pumping rate.

C. As part of the project, a third (spare) pump and two original equipment manufacturer (OEM) pump rebuilt kits shall be provided and delivered to the Department's Conveyance Division.

6.5.2 Additional Features

A. The pump removal system shall use Type 316 stainless steel guide rails. Pumps shall be equipped with a sliding guide bracket that allows for installation and removal without entering the wet well. This bracket shall align the pump discharge with the discharge connection elbow for a watertight seal. The discharge connection elbow shall be attached to and supported by the floor of the wet well, and bear all static and dynamic forces from the pumps. The pumps shall not bear any direct load on the guide rails or the floor of the wet well.

B. The pump connection to the discharge connection elbow shall be accomplished by employing a simple downward motion without rotation of the pump or removal of bolts, nuts or other fasteners.

C. Each pump shall be attached to a lifting chain suspended from a hook located near the opening of the hatch. The chain shall be attached to the pump with a shackle.

6.6 Wet Wells

6.6.1 General Requirements

A. Wet wells should be rectangular in shape and constructed of pre-cast concrete sections per the *Standard Specifications and Details*, Subsection 3.3.3(B)(iii) or cast-in-place concrete per the *Standard Specifications and Details*, Subsection 3.3.3(B)(v).

B. The interior of the wet well shall ~~be coated or lined to protect it from corrosion~~have an Approved interior corrosion protection. Refer to the Department's List of Approved Products for the recommended coating and lining manufacturers.

C. Wet wells with depths greater than 25 feet shall be avoided unless Special Approval is obtained from the Director or his/her delegate, on a case-by-case basis.

D. The floor of the wet well shall have a self-cleaning sump design that minimizes low velocity regions where sediments build up. The sump design shall use a minimum slope of 1:1 towards the pump intakes. The sump design shall allow for the flow of water into the pump intakes to be uniform, steady and free from swirl and entrained air, in accordance with the Hydraulic Institute. Grit manholes are not allowed.

E. The required storage volume of the wet well shall provide for a maximum of 6 pump cycles per hour and a minimum of 2 pump cycles per hour for ultimate design flow conditions. Pump cycle times shall not exceed the maximum frequency as recommended by the pump manufacturer. The storage volume shall also be designed to:

- Provide a minimum horizontal cross-sectional area of 20 square feet;
- Provide a minimum of 5.5 feet between the floor of the wet well and the invert of the lowest gravity influent line and a minimum pump operating range of 3.0 feet, whichever is greater;
- Keep the pump motors submerged at all times;
- Prevent surcharging of the gravity influent line(s); and
- Allow for proper pump and level controls.

6.6.2 Additional Features

A. All equipment within the wet well shall be non-sparking and explosion-proof. The wet well shall not contain any equipment requiring regular or routine inspection or maintenance that would require staff to enter the wet well.

B. All ancillary hardware in the wet well shall be Type 316 stainless steel, including but not limited to: brackets, hooks, chains, shackles, fasteners, bolts, nuts and washers. Fastenings in concrete shall use epoxy in place anchor bolts. Expansion anchors are not allowed. Refer to the Department's List of Approved Products for the recommended concrete anchor manufacturers.

C. All penetrations into the walls of the wet well shall be either cut with a core hole saw or formed. All pipe and conduit connections into the wet well shall be watertight. Electrical and chemical conduits shall be sealed to prevent the passage of hazardous gases into the junction boxes and control panels.

D. The wet well influent line shall be equipped with an influent tee or baffle made of PVC or type 316 stainless steel materials.

E. A vertical, fixed ladder shall be provided in the wet well. Refer to the Department's List of Approved Products for the recommended ladder manufacturers.

F. Hooks shall be provided near the hatch opening for hanging the pump wires, one for each pump.

G. Access hatches shall be made from aluminum or type 316 stainless steel materials. Features shall include: a locking system, a safety net or grate and an automatic hold open mechanism. Refer to the Department's List of Approved Products for the recommended hatch manufacturers. Access hatches shall provide for a clear opening area that allows for safe and efficient maintenance operations including:

- Pump removal by a hoist or crane without personnel entry;
- Vacuum-cleaning of the wet well floor with a combo-truck; and
- Personnel entries using a tripod.

H. Depending on the size and weight of each pump, the Department may require a hoist bracket to be installed on the top slab of the wet well for quick setup of a portable hoist for pump removal.

I. Wet wells shall use a passive gravity ventilation system where the air volume in the wet well is either increased or decreased as the level fluctuates. The diameter of the vent pipe shall be sized to vent at a rate equal to the maximum pumping rate of the station, however, not to exceed a maximum velocity of 600 feet per minute (fpm). The vent pipe shall not be placed in a location that will hinder access to the wet well.

J. Level monitoring within the wet well and pump on/off shall be controlled by an ultrasonic level sensor. A redundant float level control system shall also be provided. Water level control mechanisms shall be supported by brackets that are attached to the interior wall of the wet well.

6.7 Manifold Piping and Appurtenances

For the purposes of this document, manifold piping and appurtenances shall include all pipes, valves, meters, pigging access and other equipment located between the connection to the pumps and the connection to the force main.

6.7.1 General Requirements

A. All valves, manifold tees, flow meters and pigging access, shall be located above ground. The placement of manifold piping and appurtenances within a valve vault shall be avoided unless Special Approval is obtained from the Director or his/her delegate, on a case-by-case basis.

B. All manifold piping shall be flanged DIP (Class 125 flanges) with an Approved interior lining, and conform to the requirements of the *Standard Specifications and Details*, Subsection 3.2.2(D). Manifold piping located inside the wet well shall have an exterior coating that is equivalent to the Approved interior coatings for DIP pipe.

Refer to the Department's List of Approved Products for recommended DIP interior linings.

C. An Approved flexible compression coupling shall be provided between each pump and the check valve to facilitate the replacement of valves and accommodate slight alignment adjustments. Couplings shall be provided in locations that are restrained to prevent movement due to hydraulic forces in the manifold piping.

D. A flanged spool piece, with a minimum length of 8 inches, shall be provided on both sides of valves and flow meters to facilitate bolt access.

E. An Approved check valve shall be provided between each pump and the manifold connection. Refer to the Department's List of Approved Products for recommended check valves.

F. An Approved isolation plug valve shall be provided between each check valve and the manifold connection. Refer to the Department's List of Approved Products for recommended isolation plug valves.

G. An Approved air relief valve (ARV) shall be provided at each high point in the manifold piping and the force main. An Approved drain valve shall be provided at the base of air relief valves. Refer to the Department's List of Approved Products for recommended air relief valves and drain valves. The recommended locations for ARVs within the manifold piping are:

- Between each pump and the check valve; and
- Between the pigging wye and the flow meter.

H. An Approved pressure gauge shall be provided at the tee of the manifold. Refer to the Department's List of Approved Products for the recommended pressure gauge manufacturers.

I. An emergency bypass port shall be provided in a location between the manifold tee and the flow meter. The port shall be oriented where it can easily connect to a portable pumping unit that can be setup in a location that will not hinder vehicular maintenance access to the wet well. The pump-out port shall have the same diameter as the manifold piping and be comprised of a wye or tee fitting, an Approved isolation valve, and an Approved pump-out port connection. Refer to the Department's List of Approved Products for the recommended isolation valves and bypass port connections.

J. An Approved wastewater flow meter, suitable for outdoor installations and integration with the Department's SCADA system, shall be installed with the manifold piping. The length of straight pipe for the flow meter shall conform to the manufacturer's requirements. Refer to the Department's List of Approved Products for the recommended wastewater flow meters.

K. Access for pig launching shall be incorporated with the manifold piping and utilize a 45 degree wye fitting. The cap of the pig launching wye shall be secured using a Victaulic coupling or Approved equal, in lieu of a flanged-bolted cap. The cap

shall be vertically located a maximum of 4 feet from the floor. A snubber rod or frame shall be attached to the cap of the pig launcher to hold the pig in place prior to launching. An Approved isolation valve shall be provided between the pig launching wye and the floor. An Approved drain valve shall be provided between the isolation valve and the pig launching wye.

L. A pig retrieval device shall also be provided with the project.

6.7.2 Additional Features

A. All exposed manifold piping, fittings and valves shall be painted with an Approved exterior paint. Refer to the Department's List of Approved Products for the recommended exterior paints. Paint thickness on the nuts and bolts shall not hinder tool access.

B. Manifold piping shall be supported by steel or concrete pipe supports, designed in accordance with DIPRA requirements. All flanges shall be a minimum of 12-inches from the floor. The axis of the horizontally supported pipes should not be at a height greater than 30-inches.

C. A continuous concrete slab shall be provided for the above-ground manifold piping and appurtenances. The concrete pad shall provide 6 inches of containment depth and be sloped to direct incidental drainage into a local drain. The local drain shall have a type 316 stainless steel drain grate cover. Piping for the local drain shall be a minimum diameter of 4 inches and connect directly into the wet well. A P-trap shall be installed with this piping to prevent sewer gases from escaping through the local drain.

6.8 Force Mains and Appurtenances

6.8.1 Force Mains

A. Force mains shall be constructed of butt-fused HDPE pipe conforming to the requirements of the *Standard Specifications and Details*, Subsection 3.2.2(E). The installation and field testing of force mains shall conform to the requirements of the *Standard Specifications and Details*, Subsection 3.2.3(D)(v).

B. The design and installation of HDPE force mains shall conform to AWWA M55 and the Handbook of PE Pipe, latest edition, available through PPI. In addition to these requirements, the design of force mains shall also meet the following criteria:

- The pressure rating of force main piping shall not be less than twice the normal operating pressure and occasional pressure surges;
- The vertical alignment of the force main shall be on a continuous grade that provides gravity drainage throughout; and
- A minimum depth of Cover of 4 feet shall be provided for the force main.

C. Pumping velocities through the force main shall be a minimum of 3 fps and a maximum of 7 fps per AAC R18-9-E301(D)(4)(a). The Department recommends a minimum pumping velocity of 4 fps.

D. Where changes in the horizontal alignment of a force main are required, long radius bends shall be used in lieu of bend fittings. Where use of bend fittings cannot be avoided, the maximum bend shall be 45 degrees. For joint installations with gravity sewer, the minimum horizontal clearance between the force main and the gravity sewer shall not result in the horizontal jogging of the force main around manholes per S.D. RWRD-500.

E. For blue stake marking, tracer wire per S.D. RWRD-500, shall be installed with the force main. The tracer wire ends shall be protected within test stations per S.D. RWRD-501. Test stations shall be located outside of vehicular traffic lanes and adjacent to each of the following locations:

- The vertical bend where the pigging station connects to the force main;
- The manhole that the force main discharges into; and
- At every bend.

F. The location of force mains shall also be marked with visible monuments per the *Standard Specifications and Details*, Subsection 3.2.3(E) and S.D. RWRD-503. Monuments shall be provided directly above the force main, at spacing intervals no greater than 250-feet, and at every bend.

G. ARVs shall be protected in precast concrete vaults conforming to ASTM C478. Vaults shall be secured with a grated and lockable cover. Vault shall be out of vehicular and pedestrian traffic. The top of the vault shall be a minimum of 1-foot above finish grade and adjacent flood elevations.

H. The end of the force main shall connect into a Public Sewer manhole per S.D. RWRD-502.

6.9 Odor Control Measures

A. All wastewater pumping stations shall provide odor control measures. The recommended method is chemical injection. The method of aeration is not allowed.

B. A continuous concrete slab shall be provided within the yard of the pump station site for a chemical storage tank. The concrete pad shall provide 6 inches of containment depth and be sloped to direct incidental drainage into a local drain. The local drain should be located outside the footprint of the chemical storage tank and have a type 316 stainless steel drain grate cover. Piping for the local drain shall be a minimum diameter of 4 inches and connect directly into the wet well. A P-trap shall be installed with this piping to prevent sewer gases from escaping through the local drain.

C. The minimum size of the chemical storage tank shall either not require to be refilled at a frequency greater than once per month or not be less than 2,500-gallons, whichever is greater. The material of the tank and chemical lines shall be UV resistant.

D. A shade structure shall be provided for the chemical storage tank and odor control equipment.

E. Two peristaltic pumps (primary and spare) shall be provided for pumping chemicals from the storage tank into the wet well. The chemical pumps and related controls shall be secured in an Approved pad lockable panel. Chemical injection lines shall be plumbed through conduit sleeves into the top of the wet well and shall be capable of being flushed and cleaned with water. Chemical injection lines into the wet well shall be replaceable without requiring entry into the wet well.

F. An emergency eyewash and shower unit shall be provided in a location that is accessible from the chemical injection panel.

G. The Design Engineer should contact the Department's Odor Control Unit to determine any additional or special design requirements.

6.10 Electrical and Controls

6.10.1 General

A. The minimum conduit size shall be 1-inch and shall not be more than half-full of the conductor(s). A separate electrical conduit shall be provided for:

- Each pump;
- The ultrasonic level sensor; and
- Each level control float.

B. The pump wire connections shall be ~~secured~~ intrinsically safe in an Approved electrical panel in an above-ground location that will not hinder maintenance access to the wet well.

C. The pump station shall be equipped with Approved pump control system that will be integrated with the Departments radio telemetry system. The Design Engineer shall contact the Department's Conveyance Division for details.

D. The pump station control system shall be secured in an Approved electrical control panel. Refer to the Department's List of Approved Products for the recommended electrical control panels. The pump station control panel shall be painted white and ventilated as needed to maintain temperatures within the recommended operating range for electrical equipment. The pump station control panel shall be mounted to an equipment support and shade structure per S.D. RWRD-504 with the front of the panel facing to the north. Power to the pump station control panel shall have an isolated breaker.

E. If the ADWF is project to be greater than 10,000 gpd, an Approved standby generator shall be provided. The standby generator shall meet the following criteria:

- Powered by a diesel engine;
- Equipped with a silencing muffler;
- Capable of running both pumps simultaneously (1 pump may delay start); and

- Capable of being operated for 24-hrs at full load.

F. The generator transfer switch shall be automatic and shall meet the requirements of the generator's manufacturer.

G. The electrical construction documents for wastewater pumping systems shall be prepared and sealed by an Arizona Registered P.E. (Electrical).

6.11 Submittals

6.11.1 Design Submittals

A. Design Reports for public wastewater pumping systems shall be sealed by an Arizona Registered P.E. (Mechanical or Civil) and submitted to the Department for review and Approval. At a minimum, Design Reports for public wastewater pumping systems shall provide the following information:

- Projected sewer design flows (Include a map identifying the sewer basin areas being served);
- Wet well volume and control levels (Include pump cycle times for 25%, 50%, 75% and 100% build-out levels);
- Fittings and equivalent lengths;
- Total dynamic head calculations;
- Pump selection (Include the system curve plotted on the pump performance curves for single and combined pump operation);
- Force main sizing;
- Water hammer and surge control measures (if necessary);
- Capacity of the gravity system being discharged into;
- Chemical injection system and tank sizing for odor control measures;
- Estimated operation and maintenance costs;
- Manufacturer's technical data for recommended pump station appurtenances and equipment; and
- If necessary, measures for protecting the wastewater pumping system from flooding and/or Scour (may be provided by separate document).

B. The Sewer Plans for a public wastewater pumping systems shall be prepared in accordance with the following general requirements:

<u>All Sheets:</u>

- Scaled and plotted on 24-inch x 36-inch sheets;
- Use a minimum lettering height of 1/8 inch;
- Include the Department's plan tracking number (e.g. G-20xx-xxx);

<u>Cover Sheet:</u>

- Include the words "Public Wastewater Pump Station and Force Main" in the project title;
- Include a sheet index and a general location map;

- Include separate signature blocks for Acceptance by the PCRWRD Deputy Director of the Planning and Engineering Division, and the PCRWRD Deputy Director of the Conveyance Division;
- Reference the design basis of bearing and elevation;
- Include general notes to the contractor, as Approved by the Department, and special provisions (may be continued on the second sheet);
- Sealed by an Arizona Registered P.E. (Civil);

Site Plan:

- Provide a site plan for the pump station site with a maximum scale of 1-inch = 10-feet;
- Include existing and proposed contour elevations at 1-foot intervals;
- Include design details for all site work including, however not limited to: grading, drainage, utilities, paving and landscaping;
- Include horizontal control data for property lines, easements, perimeter wall, manholes, concrete structures, driveways, etc.;
- In the case of a station malfunction, identify the location and elevation of the nearest upstream gravity manhole that an SSO would occur;
- Sealed by and Arizona Registered P.E. (Civil);

Wet Well and Manifold Piping:

- Provide a detailed plan and profile of the wet well and manifold piping, at a maximum scale of 1-inch = 2-feet;
- Include pertinent wet well elevations, including, but not limited to, pipe connections, level controls, wet well floor, top of wet well, etc.;
- Include callouts for all manifold piping and appurtenances;
- Include a pump schedule;
- Sealed by and Arizona Registered P.E. (Civil);

Force Main:

- Provide a plan and profile of the force main with a horizontal scale of 1-inch = 40-feet and a vertical scale of 1-inch = 8-feet;
- The force main plan may be submitted as a separate document if it is a joint installation with a new public gravity sewer;

Electrical:

- Provide an electrical site plan, line diagrams control diagrams and detail;
- Sealed by and Arizona Registered P.E. (Electrical);

Structural:

- Provide a structural plan for masonry walls, concrete and cast-in-place manhole structures;
- Sealed by and Arizona Registered P.E. (Structural);

6.11.2 Construction Submittals

A. The Contractor shall be responsible for preparing and submitting an Operation and Maintenance (O&M) Manual to the Department, prior to the final Acceptance of construction for the wastewater pumping system. At a minimum, the O&M submittal shall meet the following requirements:

- Include 2 hard copies (loose-leaf binder with tabbed indexes) and 1 digital PDF copy;
- Include a table of contents;
- Provide the manufacturer's technical and operation manuals for all installed pump station appurtenances and equipment; and
- Provide instructions for the safe handling of chemicals and the cleanup of spills.

B. The requirements for the As-Built Plans for wastewater pumping systems shall conform to the *Standard Specifications and Details*, Subsection 1.4.7.

6.12 Exceptions for Minor Public Wastewater Pumping Systems

The Department reserves the right to modify or waive specific standards in this Section for the design of a minor public wastewater pumping system. The use of a specific package pump station shall require Special Approval from the Director or his/her delegate, on a case-by-case basis.

PIMA COUNTY
WASTEWATER RECLAMATION

SECTION 7
EASEMENTS AND MAINTENANCE ACCESS

Engineering Design Standards

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Section 07

Easements and Maintenance Access

7.1 Requirements for Public Sewer Easements

The following requirements for the design of Public Sewer easements are pursuant to Pima County Code of Ordinances 13.020.030(A) and are based on the Department's goal to provide safe and efficient maintenance access to Public Sewers.

7.1.1 Horizontal and Vertical Alignment

The design of Public Sewer easements shall conform to the following requirements:

- AAC R18-9-E301(D)(2)(l);
- S.D.s RWRD-109, -110 and -111;
- Easements should be horizontally centered along the sewer line and at each manhole, to the highest degree possible;
- For sewer depths less than or equal to 10 feet, the minimum width for sewer easements shall be 20 feet;
- For sewer depths greater than 10 feet, the minimum width for sewer easements shall be twice the depth of the sewer line (invert to finish grade) and rounded up to the nearest 5 feet;
- Public Sewer easements shall be specific ~~exclusive~~ to Public Sewers, unless otherwise Approved by the Department on a case-by-case basis~~;~~
- The driving surface shall have longitudinal slopes not greater than 9.0% unless otherwise Approved by the Department on a case-by-case basis, and cross slopes not greater than 2.0%.
- Provide a 20-foot landing area in front of each manhole with a relatively flat surface (2.0% maximum slope in any direction);
- Easements shall provide all-weather maintenance access to all manholes~~;~~ and
- Dead-end easements shall be avoided, except for flow-through sewers that are constructed to the subdivision/development boundary during initial sewer installation.

The Department reserves the right to modify or waive any of these requirements on a case-by-case basis (i.e. existing sewer easements).

7.1.2 Short Access Easements

The safety of the public and of the Department's maintenance staff will not be compromised; therefore, adequate visual and navigational room must be available within the Public Sewer easement and the Right-of-Way. In certain cases, Public

Sewer easements may be designed so that the Department's maintenance vehicles can navigate safely in reverse. A right-angle turn-around, per S.D. RWRD-110 may be waived when the following criteria are met:

- The Public Sewer easement is a straight line and does not exceed 150 feet in length to the last manhole within the easement;
- The safety of the maintenance vehicle will not be hindered by heavy traffic, difficult terrain and other factors; and
- No obstructions exist for the vehicle or driver to navigate within the Public Sewer easement or onto the Right-of-Way at the beginning of the easement.

7.2 Conveyance of Public Sewer Easements

Unless a prior agreement exists between the developer and the Department, the developer shall be responsible for the acquisition of all Public Sewer easements and Right-of-Way needed to construct, access and maintain new Public Sewers.

Where a new Public Sewer easement is required for a new subdivision, it must be dedicated by the final plat.

If a Public Sewer easement cannot be dedicated by final plat, it must be dedicated by separate instrument and the recording information referenced on the associated Sewer Plan. If the easement is not associated with a Sewer Plan, only the dedication and recordation will be required.

Complete detailed and accurate descriptions for all new Public Sewer easements shall be submitted to the Department for review after the initial review of the Design Drawings has been completed and prior to the next plan submittal.

A request for a Public Sewer easement should include all vital information necessary to accurately portray the location of the easement to the Pima County Real Property Services. The submittal shall include:

- A legal description of proposed sewer easement(s), sealed by an Arizona Registered Land Surveyor;
- A location map of proposed sewer easement(s) with parcel, adjacent property ownership and street identification labels (8½" × 11");
- The company's name, address and phone number;
- Copy of deed evidencing current ownership; and
- The Department's project reference number for a Subdivision Plat or Sewer Plan.

The dedication of Public Sewer easements shall grant the following rights to the Department:

- The Department or its Contractor has the right to install, anywhere within the Public Sewer easement, temporary or permanent underground or above-ground facilities that may be required to monitor, operate, maintain, repair or replace Public Sewers;

- The Department assumes no liability for damage to, or removal of, any vegetation, above-ground or underground facilities, surface treatments, materials, equipment, or structures placed within the easement or within 20 feet above the surface of the easement by anyone other than the Department or its Contractor;
- The property owner shall be liable for injury to personnel and/or damage to maintenance vehicles or construction equipment that results from contact with any prohibited encroachments anywhere within the full width of the Public Sewer easement or within 20 feet above the surface of the easement, or from any actions necessary to remove such encroachments from the easement;
- Liability for injury or damage shall include personnel and equipment of the Department and its Contractors; and
- The Department has no obligation to provide advance notice to property owners in emergency conditions, however, the Department will endeavor to provide advanced notice to property owners when it is known that a Public Sewer easement will be accessed for maintenance or construction.

Any construction, development, planting or landscaping within the Public Sewer easement shall conform to the maintenance access requirements and guidelines per Subsections 7.5, 7.6 and 7.7.

7.3 Temporary Construction Easements

Where temporary construction easements are required for construction activities that extend beyond the limits of the Public Sewer easement, they shall be specified on the Sewer Plan.

7.4 Abandonment of Public Sewers and Easements

To request the abandonment of an existing Public Sewer asset, Public Sewer easement, Right-of-Way or license agreement, an application for the release of Public Sewer easements shall be completed and submitted to the Pima County Real Property Services along with any required fees and information. If Approved, the facility, easement, Right-of-Way or license agreement shall be released by separate instrument.

The abandonment of Public Sewer assets shall conform to Subsections 5.1.12 and 5.2.19, and the *Standard Specifications and Details*, Subsections 3.2.3(H) and 3.3.3(E).

7.5 Maintenance Access and Encroachments within Public Sewer Easements

Structures, impediments or other features located within a Public Sewer easement or Right-of-Way that may hinder or prevent vehicular maintenance access to manholes, shall not be permitted without Approval from the Department. These features include:

- Walls, fences, swimming pools, gazebos, water fountains, sculptures, or any permanent or temporary structures etc.;
- Steep ~~surfaces,~~ slopes (refer to Subsection 7.1.1)~~exceeding 9.0%~~ or other conditions that may subject maintenance vehicles to sliding,~~ or~~ loss of traction or overturning;
- Abrupt changes in terrain, such as vertical curbs, retaining walls or drainage channels;
- Surface treatments that could cause maintenance equipment to become stuck or damaged, such as:
  - Sand or uncompacted soil;
  - Sharp rocks, rip-rap or boulders; and
  - Vegetative or organic ground cover.
- Trees, cacti and other vegetation that hinders maintenance vehicle access per Subsection 7.7;
- Objects that may cause injury to maintenance workers or damage to maintenance equipment; and
- The storage of vehicles (temporary or permanent), equipment or materials, by the property owner, unless Approved by the Department.

Where walls or fences are required by a property owner to limit maintenance access through a Public Sewer easement, a minimum 16-foot wide gate or a gate equivalent to the width of the existing easement, with an Approved locking system, shall be provided. No obstructions shall exist that cause the overhead clearance to be less than 20-feet. The owner of the gate shall be responsible for its full operation and for maintaining unrestricted 24-hour access for the Department. The construction of a wall, fence, gate or any other encroachment within Public Sewer easements shall require:

- Acceptance of the construction documents for the wall, fence, gate or other encroachment; or
- The recording of an encroachment agreement with the Department for the wall, fence, gate or other encroachment.

7.6 Maintenance Access within Right-of-Way

Where new sewers are not placed beneath the paved portions of roads, surface improvements sufficient to provide the Department's sewer maintenance vehicles with unrestricted year round, all-weather access to the Public Sewer manholes may be required, in accordance with Code, specifically 13.20.030(A)(1). The required surface improvements shall accommodate the weight and turning radius of the Department's combo-cleaner trucks and conform to the requirements for turn-around areas.

For manholes that are located within Right-of-Way but outside paved areas (e.g. shoulders, sidewalks, medians, traffic circles, etc.), the design shall consider the Department's ability to safely and efficiently maneuver a combo-cleaner truck to these manholes.

The design for providing a safe and efficient maintenance access driveway to each manhole located outside the paved areas of Right-of-Way shall consider:

- Replacing existing vertical curb with a 16 foot wide driveway;
- Providing all-weather maintenance access;
- Providing a stabilized surface treatment per S.D. RWRD-111;
- Providing a minimum 20-foot landing area for a combo-cleaner truck to park in front of each manhole with a relatively flat surface (2.0% maximum slope in any direction, unless otherwise Approved by the Department on a case-by-case basis);
- Providing post barricades, lockable gates or other types of removable barriers, Approved by the Department, to limit public access;
- Increasing the thickness of concrete to 6-inches for sidewalks, ramps, driveways, etc.;
- Avoiding the placement of irrigation and utility boxes within the maintenance access driveway;
- Constructing a concrete collar per S.D. RWRD-212;
- Adjusting the frame and cover to an elevation above finish grade to minimize wet weather inflow and inadvertent burial;
- Providing a 20-ft x 20-ft clearance zone throughout the maintenance access driveway; and
- The landscaping and planting guidelines for Public Sewers per Subsection 7.7.

The Department has the authority to take whatever action (e.g. cutting, trimming, moving, removal, etc.) is deemed necessary to gain maintenance access to Public Sewers that are restricted by vegetation, obstacles or structures. The Agency having jurisdiction over the respective Right-of-Way is ultimately responsible for maintaining, repairing or replacing these items originally placed by a Project.

7.6.1 Dead-end Streets and Cul-de-Sacs

When Public Sewers are located in a public or private cul-de-sac or other public or private permanent dead-end street, the street shall be designed with adequate turn-around area for the Department's combo-cleaner trucks. Refer to the latest version of the *Pima County Subdivision and Development Street Standards* for the minimum design criteria for dead-end streets and cul-de-sacs.

7.6.2 Traffic Circles

The design of traffic circles near or surrounding a Public Sewer manhole is strongly discouraged by the Department. If a traffic circle must be in the same location as a Public Sewer manhole, the design shall consider:

- Providing curb openings for combo-truck maintenance access if the center of the manhole cover is greater than 3 feet away from the curb;
- Placing the curb opening in a location that will minimize disturbance to the flow of vehicle traffic during sewer maintenance operations;

- Raising the frame and cover elevation so as to direct drainage away from the manhole and avoiding water harvesting; and
- Providing a sustainable landscaping and planting design that will not hinder maintenance access to manholes.

Deep-rooted trees and other aggressive root vegetation shall be avoided. Landscaping shall be limited to flowers, grasses, shrubs, and other small plants that can either be driven over or removed easily and quickly in the event that the manhole must be accessed for maintenance.

7.7 Landscaping and Planting Guidelines for Public Sewers

Planting within Public Sewer easements ~~shall~~shall ~~not be allowed~~ only be allowed with Special Approval. Trees with branches or roots having the potential to extend into Public Sewer easements shall be avoided. The Department assumes no liability for damage due to the removal of tree branches or roots that extend into Public Sewer easements. ~~The design of Public Sewers located in environmentally sensitive areas in accordance with S.S.D. RWRD-112, shall be avoided unless Special Approval is obtained from the Director or his/her delegate, on a case-by-case basis.~~

In special cases where Public Sewers must be located outside paved or stabilized areas, the design of landscaping and planting shall adhere to the following guidelines:

- Limit planting to small shrubs and ground cover within 10 feet of sewer lines, provided that they can be driven over by a vehicle and do not contain spikes or thorns that can damage tires or hinder access by maintenance personnel;
- Select plants that will not develop root systems that will reach sewer facilities (contact the Department for a list of excluded plants);
- Select plants that will not interfere with visual and maintenance vehicle access to manholes;
- Do not place irrigation equipment within the maintenance vehicle access driveway to each manhole;
- Show the location of Public Sewer lines and manholes in the landscaping and planting design; and
- Provide a certification on the cover sheet, sealed by the Landscape Architect, declaring that the project was designed in accordance with the landscaping and planting guidelines for Public Sewers per Subsection 7.7.

The Department reserves the right to review the design of landscaping and planting that is proposed near Public Sewer. The Department assumes no liability for damage due to the cutting back or the removal of plants that hinders maintenance access to Public Sewer manholes.

7.7.1 Stabilized Surface Treatments

For Public Sewer easements located outside of paved areas, a stabilized surface treatment, per S.D. RWRD-111, shall be provided for clear and unrestricted vehicular maintenance access to Public Sewer manholes.

Stabilized surface treatments may not be appropriate in all cases, such as wash or channel crossings, or in environmentally sensitive areas. In such cases, the Design Engineer should coordinate with the Department early in the planning process to find a solution for providing vehicle maintenance access to Public Sewer manholes, while conforming to all applicable Federal, State and local environmental laws, and regulations.

7.7.2 Manholes in Right-of-Way

For Public Sewer manholes located outside the paved areas within Right-of-Way, both vehicle maintenance access and visual access shall be a top priority. In these cases, the design of any improvements within the Right-of-Way shall adhere to the following guidelines:

- Provide visual access to the manhole cover from the closest travel lane;
- Provide the ability for the Department's combo-cleaner trucks to safely and efficiently pull off the road and access the manhole;
- Provide a relatively level 6-foot diameter area around the manhole cover to allow working room for setup of a tripod and related safety equipment when manhole entry is required;
- Minimize impacts to traffic flow for regular maintenance operations being performed at the manhole; and
- Preserve or improve the current maintenance vehicle access to an existing manhole.

A maintenance vehicle access lane, having a width of 16 feet, shall be provided to the manhole cover and kept free of objects that may hinder vehicle access to the manhole. These objects include, but are not limited to, shrubs, trees, boulders, riprap and drainage swales. Planting design shall locate tree trunks at least 16 feet away from a manhole and a sufficient distance so that the ultimate canopy will not overhang the maintenance vehicle access driveway. The manhole elevation shall be a minimum of 2 inches above finish grade and, under no circumstances, shall it be buried under landscaping or surface materials.

For existing manholes, if a concrete collar is not present, a concrete collar per S.D. RWRD-212 may be required.