June, 2020

TO: All holders of Wastewater Standard Details

SUBJECT: Revisions to Wastewater Standard Details

The attached Wastewater Standard Details drawings were revised to reflect current standard construction methods, practices and procedures, and details were cleaned up to remove conflicting information, and for better clarity. Materials were not reviewed, vetted, or revised as a part of these revisions. Future revisions may include structural and material updates.

The most prominent, and only structural update in this set of revisions was to the inlet details. The original details were only to be used for inlets up to 6 feet deep, and were limited in length to a single, double or triple Number 16 inlet, or 6', 9' or 12' for Number 14 inlets. The new inlet details are applicable for inlets up to 12 feet deep, and up 75 feet long.

The attached Standard Details are to be used for all storm and sanitary sewer construction done under the jurisdiction of the City and County of Denver, Department Transportation and Infrastructure. These standards are to be used in conjunction with the technical specifications and the established ordinances of the City and County of Denver and in case of conflict, the technical specifications which are to be used in conjunction with these standards shall govern.

These drawings may be updated from time to time and the user is responsible for obtaining updated or revised standards. The City shall not be held liable for use of outdated standards by the contractor, consultant, developer, or engineer.
CITY AND COUNTY OF DENVER
WASTEWATER STANDARD DETAILS

APPROVED BY:

[Signature]

CITY ENGINEER
JUNE 2020
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<th>TITLE</th>
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<td>23</td>
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<td>MANHOLE STEPS</td>
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TABLE 1. Bd, Bf, Bp VALUES

<table>
<thead>
<tr>
<th>D</th>
<th>Bd (k)</th>
<th>Bf (k)</th>
<th>Bp (k)</th>
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<tr>
<td>4'-0&quot;</td>
<td>3.5</td>
<td>6.0</td>
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<td>8'-0&quot;</td>
<td>5.5</td>
<td>6.0</td>
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<td>10'-0&quot;</td>
<td>6.5</td>
<td>6.0</td>
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<td>12'-0&quot;</td>
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<td>14'-0&quot;</td>
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<td>16'-0&quot;</td>
<td>11.5</td>
<td>6.0</td>
<td>12.0</td>
</tr>
<tr>
<td>18'-0&quot;</td>
<td>13.0</td>
<td>6.0</td>
<td>12.0</td>
</tr>
</tbody>
</table>

1. DOES NOT APPLY TO PRIVATE TRENCHING SYSTEMS.
2. WHEN SHORING IS NOT APPLICABLE, MINIMUM TRENCH WIDTH SHALL BE 12" FROM OUTSIDE OF PIPE ON EITHER SIDE OF TRENCH.

PAY ITEM NOTES:

P1. Bd = PAY ITEM FOR PAY ITEM 20-2 ASPHALT SURFACE COURSE PAYMENT—DYN HARD THICKNESS (5\# HYD THICKNESS) AS SHOWN IN TABLE UNLESS OTHERWISE SHOWN ON PLANS.
P2. Bf = PAY ITEM FOR PAY ITEM 20-2 ASPHALT BASE COURSE PAYMENT—DYN HARD THICKNESS (5\# HYD THICKNESS) AS SHOWN IN TABLE UNLESS OTHERWISE SHOWN ON PLANS.
P3. Bf = PAY ITEM FOR PAY ITEM 20-1 ROUGH TRENCHING (GALLEY) PAYMENT—DYN HARD THICKNESS (5\# HYD THICKNESS) AS SHOWN IN TABLE UNLESS OTHERWISE SHOWN ON PLANS.
P4. PAYMENT WILL NOT BE MADE FOR EXCAVATION OUTSIDE OF THE LIMITS SHOWN ABOVE DUE TO SLOPING OR RECHING TRENCH OR OTHER CONSTRUCTION MOWS OR METHODS.
P5. PAYMENT WILL NOT BE MADE FOR REMOVAL, REPLACEMENT, OR RELLOCATION OF CURB AND GUTTER, UTILITIES, SIDEWALKS, STRUCTURES, ETC. OUTSIDE THE MAXIMUM LIMITS OF EXCAVATION.
TRENCHING AND BEDDING

TYPICAL CUTOFF WALL LOCATIONS

CUTOFF WALL NOTES:
2.1 Normal spacing is 1200", typically at corner of each side of curb to street, or as specified on plans or as directed by the City.
2.2 When groundwater is encountered, install cutoff wall per detail.

TYPICAL CUTOFF WALL LOCATIONS

TABLE 2. CONCRETE BEDDING REQUIREMENTS

<table>
<thead>
<tr>
<th>NOMINAL DIAMETER D</th>
<th>MINIMAL THICKNESS t</th>
<th>WIDTH OF CONCRETE OR ARCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot; &amp; Smaller</td>
<td>4&quot;</td>
<td>0.0 + 6&quot;</td>
</tr>
<tr>
<td>21&quot; TO 24&quot;</td>
<td>5&quot;</td>
<td>0.0 + 6&quot;</td>
</tr>
<tr>
<td>27&quot; TO 33&quot;</td>
<td>8&quot;</td>
<td>0.0 + 8&quot;</td>
</tr>
<tr>
<td>36&quot; TO 43&quot;</td>
<td>10&quot;</td>
<td>1.25 OD</td>
</tr>
<tr>
<td>48&quot; &amp; Larger</td>
<td>1 1/4&quot; D</td>
<td>1.25 OD</td>
</tr>
</tbody>
</table>

LEGEND
D = TRENCH WIDTH, INCLUDING SHORING (SEE S-301.1)
D = INSIDE DIAMETER OF PIPE, OR SPAN DIMENSION FOR ARCH OR ELEVATION
D = OUTSIDE DIAMETER OF PIPE
D = CONCRETE BEDDING THICKNESS
GRANULAR BEDDING REQUIREMENTS

GRANULAR BEDDING NOTES:

3.1 THESE DETAILS ARE TYPICAL FOR NORMAL CONDITIONS. FOR INSTALLATIONS OTHER THAN THESE (SUCH AS EMBANKMENT OR TUNNEL INSTALLATIONS, ETC.), EXCAVATION, BEDDING AND BEDDING REQUIREMENTS SHALL BE DESIGNATED ON THE CONSTRUCTION DRAWINGS AND SHALL BE DESIGNED IN ACCORDANCE WITH THE REFERENCES NOTED IN THE EP&D MANUAL. PRACTICE NO. 9, A.S.C.E. MANUAL NO. 37 LATEST EDITION AND APPROVED BY THE DESIGN ENGINEER. FOR UNSTABLE OR UNSAFE BEDDING CONDITIONS, TRENCH AND BEDDING DETAILS SHALL BE A SPECIAL DESIGN.

3.2 ULTIMATE BUCKLE LOADS AND STRUCTURAL DESIGN OF PIPE OR CONDUIT SHALL BE BASED UPON SUB-TRANSMISSION WITH AS SET FORTH IN THE AMERICAN CONCRETE PIPE ASSOCIATION DESIGN MANUAL.

3.3 BEDDING SHALL BE MECHANICALLY PLACED IN 6" LAYERS AND SMALL CORRESPOND TO CEMENT CLASS 67 GRADATION SIZE 61 (PER CDOW STANDARD CONSTRUCTION SPECIFICATIONS, SECTION 5.00 AND TABLE 3 ABOVE).

3.4 BELL HUBS SHALL BE EVADED AT ALL SHOW JOINTS.

3.5 SUBURBAN PIPE TO BE A PROPER PERVIOUS PIPE CONFORMING TO APPLICABLE REQUIREMENTS OF THE SPECIFICATION.

3.6 TRENCH BACKFILL TO BE COMPACTED TO 90% DENSITY, ACCORDING AS 90%.

3.7 FILTER FABRIC TO COVER GRANULAR BEDDING MATERIAL AS SHOWN IN IDEAL TRENCH CONDITIONS DETAIL IN ALL CASES.

3.8 DESIGN ENGINEER TO SPECIFY WHEN FILTER FABRIC IS NEEDED BETWEEN EXISTING SUBGRADE AND GRANULAR BACKFILL. REFER TO CURRENTitates SPECIFICATION DESIGN STANDARDS (SECTION 4.2.42) ON PIPING AND PENETRABILITY CRITERIA. USE GRANULAR BACKFILL IN THIS DETAIL AS THE WIDEST IN HOLES. REFER TO INSTRUCTIONS.

3.9 FOR 60" AND LARGER, USE SPECIAL BEDDING AND FILTER FABRIC MAY BE OMITTED.

TABLE 3.  CLASS 67 GRADATION

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>3/4&quot;</th>
<th>1 1/4&quot;</th>
<th>2&quot;</th>
<th>3&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIA.</td>
<td>0.35</td>
<td>0.51</td>
<td>0.75</td>
<td>1.00</td>
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</tbody>
</table>

NOTE: SEE SECTION 4.00 OF THE CDOW STANDARD CONSTRUCTION SPECIFICATIONS.

TABLE 4.  MIN. DEPTH OF BEDDING MATERIAL BELOW BOTTOM OF PIPE

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>3/4&quot;</th>
<th>1 1/4&quot;</th>
<th>2&quot;</th>
<th>3&quot;</th>
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</thead>
<tbody>
<tr>
<td>DIA.</td>
<td>0.35</td>
<td>0.51</td>
<td>0.75</td>
<td>1.00</td>
</tr>
</tbody>
</table>

NOTE: SEE SECTION 5.00 OF THE CDOW STANDARD CONSTRUCTION SPECIFICATIONS.

LEGEND:
- M = TRENCH WIDTH, INCLUDING SHORING (SEE S-301.1)
- D = INSIDE DIAMETER OF PIPE, OR SPAN DIAMETER FOR ARCH OR ELBOW,
- h = DEPTH OF BEDDING MATERIAL BELOW BOTTOM OF PIPE
- d = OUTSIDE DIAMETER OF PIPE
GENERAL NOTES FOR TYPE I, II & III ENCASEMEN:

4.1 CONCRETE TO BE CAST AGAINST UNDISTURBED SOIL OR SLOPING. IF OPTIONAL CONSTRUCTION Joints ARE USED AND BOTTOM HALF OF ENCAIMENT IS POINTED SEPARATELY, A ONE INCH LAYER OF SAND OR MORTAR SHALL BE PLACED BETWEEN BOTTOM OF SANITARY SEWER AND TOP OF CONCRETE.

4.2 LENGTH OF ENCAIMENT REQUIRED:

(a) TYPE I ENCAIMENT SHALL EXTEND FULL TRENCH WIDTH EXCEPT FOR PROPOSED SEWER OR STREET.

(b) TYPE II ENCAIMENT SHALL EXTEND AT LEAST 10 FEET EACH SIDE OF WATER MAIN.

(c) UNLESS OTHERWISE NOTED ON PLANNING DRAWINGS, TYPE I, II & III ENCAIMENT ARE NOT TO BE REINFORCED. REINFORCEMENT, IF REQUIRED, TO BE SPECIFIED AND DEMONSTRATED SEPARATELY ON PLAN & PROFILE DRAWINGS.

4.3 TYPE I I & III ENCAIMENT REQUIRED UNDER FOLLOWING CONDITIONS:

(a) TYPE I OR III ENCAIMENT REQUIRED FOR SANITARY SEVER CROSSING OVER MAIN WATER MAINS.

(b) TYPE I ENCAIMENT REQUIRED FOR SANITARY SEWER CROSSING UNDER WATER MAINS, EXCEPT FOR SANITARY SEWER CROSSING OVER MAIN WATER MAINS.

(c) TYPE II ENCAIMENT REQUIRED FOR SANITARY SEWER CROSSING OVER Top OF WATER MAINS, REGARDLESS OF DIMENSION "D1".

(d) EXCEPT FOR UNUSUAL CIRCUMSTANCES, WATER MAIN CROSSINGS, OR WHERE UNDISTURBED SOIL CONDITIONS ARE ENCOUNTERED, TYPE I ENCAIMENT WILL NORMALLY BE SUFFICIENT.

(e) IF THE SANITARY SEWER IS REPLACED OR CONSTRUCTED OF CAST IRON PIPE (MIN. C=100 OR C=150) OR DUCTILE IRON PIPE (MIN. C=150 OR C=151), CONCRETE ENCAIMENT MAY NOT BE REQUIRED.

4.4 FILLER MATERIAL BETWEEN CONCRETE TO BE:

(a) APPROVED COMPOSTABLE MATERIALS SUCH AS STRIGHTEN, ETC., IF C=50.

(b) COMPACTED GRANULAR BASE IF C=100. (IF C=50 FOR TYPE III ENCAIMENT USE CONCRETE ON UNDISTURBED SOIL.)

(c) OR DETERMINED BY UTILITY OWNER.

4.5 SHOVEL FOR SHOVELING, IF USED, TO BE CAPIED OFF AT TOP OF ENCAIMENT.

4.6 THESE ENCAIMENT DETAILS MAY ALSO BE APPLICABLE FOR CONSULTS OTHER THAN SMOKE OR SANITARY SEWER INSTALLATION.

4.7 IN CERTAIN SITUATIONS WHERE THE EXISTING CONCRETE DETAIL IS EXTREMELY LARGE, FILL SUPPORTS ON EACH SIDE OF SANITARY SEWER MAY ALSO BE REQUIRED. IF REQUIRED, SUPPORTS TO BE SPECIFIED AND DETAILLED SEPARATELY ON PLAN & PROFILE DRAWINGS. NO PIPE JOINTS OVERTOP TOP OF WATER MAIN.

4.8 SMOOTHER PLUMBING CODE APPROVED MATERIALS ALLOWED.
PIPE JOINT NOTES:

5.1 THE CONTRACTOR SHALL SUBMIT ALL TOLERANCES AND DIMENSIONS PERMITTED BY THE SPECIFIC PIPE JOINT DETAILS SHOWN ON THE ENCLOSED DRAWING FOR APPROVAL.

5.2 ALL DIMENSIONS SHALL BE GIVEN IN INCHES, UNLESS OTHERWISE NOTED, AND ARE FOR BELT AND SPIGOT IN CONCRETE POSITION. DEFLECTED PIPE JOINT TOLERANCES AND DIMENSIONS SHALL ALSO BE FURNISHED.

5.3 JOINT CLEARANCE DISTANCES X AND Y ARE AT LEAST 0.001 INCHES.

5.4 SPIGOT "R" DUMP GASKETS SHALL BE IN CONFORMANCE WITH ASTM C-443 OR C-681.

5.5 APPLICABLE CONCRETE PIPE JOINT SPECIFICATIONS:

A. ASTM C-230
B. ASTM C-681

5.6 STEEL REINFORCEMENT SHALL BE IN ACCORDANCE WITH THE APPROPRIATE ASTM SPECIFICATION FOR THE PIPE SIZE AND STEEL CLASS AS SPECIFIED ON PLAN/PROFILE DRAWINGS.

5.7 NO CONNECTION TO GO THROUGH JOINT WITHOUT PRIOR CITY APPROVAL.
**INLET CONNECTION NOTES:**

6.1 The type of connection shall only be used if the following conditions are met:
- (A) \( D \leq \frac{3}{4} D_1 \) or \( D_1 \leq 25 \) ft.
- (B) The point of connection to the sewer main is not more than 70 feet from the nearest manhole on the sewer main.
- (C) All sewers are connected in series.
- (D) Only one inlet connection allowed per joint of sewer main pipe.

6.2 For conditions other than those specified in Note 6.1, a manhole on the sewer main will be required.

6.3 This detail applies to storm sewer connections only. Sanitary sewer pipe shall be made only with approved mechanical joining equipment and approved joining seals/inserts.

**INLET CONNECTION INTO STORM SEWER MAIN**

(ID S M) 
NO SCALE

**VERTICAL SECTION**

**PIPE COLLAR NOTES:**

6.4 For storm laterals only, not to be used on sanitary or main line storm sewers.

6.5 A concrete collar is required where the change in grade exceeds 0.10 foot per foot, and where grade limits exceed the pipe manufacturer's recommendations.

6.6 If the gap exceeds 3 inches, a manhole structure is required.

6.7 Reinforcing shall be used where the gap is 2 1/2" or larger; three circular ties shall be used per vertical section above.

6.8 Concrete collar shall not be used for a size change on the main line.

6.9 For pipe size not listed size next size larger.

6.10 Where reinforcing is required, the diameter of the circular ties shall be 1/2" wall thickness.

6.11 An interior form of unreinforced concrete or equal shall be used to provide a smooth interior joint. The form paper may be left in place.

6.12 Pipes 24" and larger to be designed by engineer and approved by city.

**TABLE 5. MIN. PIPE COLLAR DIMENSIONS**

<table>
<thead>
<tr>
<th>D</th>
<th>L</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>15&quot;</td>
<td>18&quot;</td>
<td>12&quot;</td>
</tr>
<tr>
<td>18&quot;</td>
<td>18&quot;</td>
<td>12&quot;</td>
</tr>
<tr>
<td>21&quot;</td>
<td>18&quot;</td>
<td>12&quot;</td>
</tr>
</tbody>
</table>

**STORM LATERAL PIPE COLLAR DETAIL (21" DIA. OR LESS)**

(ID S M) 
NO SCALE

**CONNECTOR PIPE INTO WALL OF EXISTING OR PRECAST STRUCTURE**

(ID S M) 
NO SCALE

**LEGEND**

- D: ROD DIAMETER OF PIPE
- MD: ROD DIAMETER OF CONNECTOR PIPE
- L: LENGTH OF CONNECTOR PIPE
- LO: LENGTH OF CONNECTIVE OVERLAPPING PIPE
- E: EXTERIOR DIAMETER OF PIPE
- T: THICKNESS OF CONCRETE
MANHOLE NOTES:

7.1 Flat Top Sections may be used in lieu of concentric manholes when specifically approved by the project engineer.

7.2 For manholes deeper than 4' from bottom of invert to top of invert, manhole sections with precast flat top sections are required.

7.3 All precast flat top sections, covers, grade rings, etc. shall conform to the latest revision of ASTM C-476, Standard Specification for Ordinary Precast Reinforced Concrete Manhole Sections.

7.4 Flat Top Sections shall be capable of withstanding 400-PSI live loads.

7.5 Manhole sections, covers, flat top sections, and rings shall rotate date, manufacture, size, and ASTM C-476.

7.6 For depths greater than 25' (9m to invert) shop drawings, calculations of walls, top and bottom slabs shall be submitted.

7.7 An approved flexible plastic sealant is required in precast-in-place flat top sections to ensure watertight joints.

7.8 Design engineers or project engineers may increase wall size for special design considerations.

7.9 Manhole Steps shall not be installed over the flow channel.

7.10 6" (150mm) allowed only with special approval of the Engineer.

7.11 All on a larger pipe size type B (S-803) or type P (S-804).

TABLE 6. MIN. MH RISER DIAMETER & WALL THICKNESS

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Wall Diameter (ID)</th>
<th>Wall Thickness, T</th>
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<tbody>
<tr>
<td>35&quot; or Less</td>
<td>35&quot;</td>
<td>5&quot;</td>
</tr>
<tr>
<td>42&quot;</td>
<td>8&quot;</td>
<td>7&quot;</td>
</tr>
</tbody>
</table>

Note: All pipe diameters specified in Table 7 at.

FOR SITUATIONS WHERE ONE PIPE ENDS AND ONE PIPE BEGINS, ALL WALLS SHALL BE TREATED FOR SITUATIONS OTHER THAN THEIR DESIGN."
CAST-IN-PLACE MANHOLE BASE

CAST-IN-PLACE MANHOLE BASE NOTES:

8.1 MANHOLE BASES SHALL CONFORM TO TABLE 8, S-501.1.

8.2 CIRCUMFERENCE CHANGES AND NOZZLES MAY BE FORMED BY SHAPING WITH LEAN CONCRETE (F = 2000 PSI HR), ALL OTHER CONCRETE SHALL BE FINISHED AT 28 DAYS;

8.3 ALL MANHOLE BASES SHALL BE STRAIGHT THROUGH CAST MANHOLE ОО AND RE FACTORY PLUGGED.

8.4 ALL MANHOLE BASES SHALL CONFORM TO ORNAMENT STANDARDS AND SPECIFICATIONS.

8.5 ALL MANHOLE BASES SHALL BE FINISHED AT 28 DAYS;

8.6 PLANE MANHOLE BASES SHALL CONFORM TO THE latest VERSION OF ASTM C-478, STANDARDS SPECIFICATIONS.

8.7 MANHOLE BASES SHALL BE COMPLIANT TO 8.13 MANHOLE BASES.

8.8 ALL MANHOLE BASES SHALL BE FINISHED AT 28 DAYS;

8.9 ALL MANHOLE BASES SHALL BE FINISHED AT 28 DAYS;

8.10 ALL MANHOLE BASES SHALL BE FINISHED AT 28 DAYS;

8.11 ALL MANHOLE BASES SHALL BE FINISHED AT 28 DAYS;

8.12 ALL MANHOLE BASES SHALL BE FINISHED AT 28 DAYS;

8.13 ALL MANHOLE BASES SHALL BE FINISHED AT 28 DAYS;

PRECAST MANHOLE BASE

PRECAST MANHOLE BASE NOTES:

8.14 THE MANHOLE BASES SHALL BE FINISHED AT 28 DAYS;

8.15 ALL MANHOLE BASES SHALL CONFORM TO THE latest VERSION OF ASTM C-478, STANDARDS SPECIFICATIONS.

8.16 ALL MANHOLE BASES SHALL CONFORM TO THE latest VERSION OF ASTM C-478, STANDARDS SPECIFICATIONS.

8.17 ALL MANHOLE BASES SHALL CONFORM TO THE latest VERSION OF ASTM C-478, STANDARDS SPECIFICATIONS.

8.18 ALL MANHOLE BASES SHALL CONFORM TO THE latest VERSION OF ASTM C-478, STANDARDS SPECIFICATIONS.
TABLE 7A. TYPE P MH - 30° BEND STRUCTURE DIMENSIONS

<table>
<thead>
<tr>
<th>DYE SIZE</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>42&quot;</td>
<td>4</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>48&quot;</td>
<td>5</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>54&quot;</td>
<td>6</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>60&quot;</td>
<td>7</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>66&quot;</td>
<td>8</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>72&quot;</td>
<td>9</td>
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TABLE 7B. TYPE P MH - 45° BEND STRUCTURE DIMENSIONS

<table>
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<tr>
<th>DYE SIZE</th>
<th>A</th>
<th>B</th>
<th>C</th>
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<tbody>
<tr>
<td>42&quot;</td>
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<tr>
<td>72&quot;</td>
<td>9</td>
<td>6</td>
<td>2</td>
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</tbody>
</table>

TYPE P MANHOLE NOTES:

10.1 The standard manhole detail is applicable to circular pipes with 42" ID and larger, and non-circular pipes with a span of 42" ID and larger.

10.2 For 30° bend pipes 30° pipe dimensions along with calculations for design of walls, top and base slab shall be submitted for approval.

10.3 Set top slab and type D elevation no more than 1/2" below finished grade to allow enough cover to add FM rings and cover.

10.4 Precast manhole pipes and top sections shall conform to ASTM C-476, in addition manhole steps, risers, curbs, jointing, rings and cover shall conform to applicable and standard details.

10.5 Concrete in top slab and walls shall be class D concrete and have a 28 day strength of 4000 psi minimum. slab will be 5" to 7", and an extension will be + 7".

10.6 Lean concrete fill shall have a 28 day strength of 2000 psi (Type 8 Cement).

10.7 Reinforcing steel bars shall conform to ASTM A-615 Grade 60 (Deformed Stainless Reinforcing Bars) to be 2" in size from bottom of reinforcement slab. Reinforcing bars will be spaced only at locations shown and detailed on drawings. bars will be 6" apart. no tack welding will be permitted.

10.8 All structures shall be designed to top of pipe.

10.9 All manholes in special structures shall be placed on suitable subsurface material. If subsurface conditions warrant, subsurface foundation material will be designed. Settling subsurface material will be placed as per part 3.0.5 of the NMT standard construction specifications.

10.10 Granular bedding material shall be compacted to 90% maximum dry density in accordance with Malaysia T-100.

10.11 Structure walls shall be formed both inside and outside. casting of sidewalls against earth is not permitted.

10.12 Lateral support shall be provided and maintained for walls during backfilling operations.

10.13 Wall lateral shall be 24" on smaller, if larger, a special structural design is required. See S-804.1 for reinforcement details.

10.14 See S-804.2 for reinforcement details.
CHANNELIZATION NOTES:

12.1 DETAILS SHOWN ARE TYPICAL ONLY FOR INSTALLATIONS WITH ALL INLETS AT SAME RELATIVE ELEVATION.

12.2 FOR EXCESSIVE ELEVATION DIFFERENCE BETWEEN INLETS, ETC. SPECIAL BASE/CHANNEL DETAILS SHALL BE SHOWN ON PLANS.

12.3 CHANNELIZATION DETAILS & STEP PLACEMENT TYPICAL FOR BOTH STORM AND SANITARY SEWER PIPE.

12.4 THE MINIMUM VERTICAL DROP THRU MANHOLE BASE SHALL BE 0.10 FOOT FOR STORM SEWER AND 0.2 FOOT FOR SANITARY SEWER.

12.5 FOR SANITARY SEWER, VERTICAL DROPS IN EXCESS OF 18° REQUIRE AN OUTLET DROP. SEE S-530.
MANHOLE OUTSIDE DROP NOTES:

13.1 Outside drop required for any drop greater than 18".
13.2 All pipe and fittings to be ASME and City approved.
13.3 For tangent purposes, all fittings, pipe, concrete encasement shall be included in the unit price of the outside drop.
13.4 Diameter of the pipe shall not be less than main line pipe diameter.
13.5 For 18" diameter and larger, outside drop shall be a special design.
13.6 The appropriate manhole adapter or connector shall be used for the specified pipe material and shall be approved by the City.
13.7 Outside drop shall be constructed of Class II concrete.
13.8 Concrete encasement shall be a minimum of 6" thick around.
13.9 Pipe dimensions are approximate and may vary from one manufacturer to another.
13.10 All required wall openings shall be precast block-outs or core drilled. Wall thickness of openings is not mandated.

### TABLE 9. MINIMUM DROP DIMENSIONS FOR PVC PIPE

<table>
<thead>
<tr>
<th>Dimensions (Inches)</th>
<th>A</th>
<th>B</th>
<th>Yₐ</th>
<th>Yₖ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe Diameter (Inches)</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Material Dimensions (Inches)</td>
<td>42</td>
<td>47</td>
<td>49</td>
<td>61</td>
</tr>
</tbody>
</table>
MH WATER STOP GASKET

CAST-IN-PLACE MANHOLE CONNECTION DETAILS FOR DISSIMILAR PIPE (NON-POROUS PIPE)

PRECAST MANHOLE CONNECTION DETAILS FOR ANY TYPE OF PIPE

WATER STOP GASKET NOTES:

14.1 PLACE STOP ON PIPE NEAR CENTER OF MANHOLE WALL.
14.2 STAINLESS STEEL NUTS TO ACHIEVE INSIDE SEAL AGAINST PIPE OUTSIDE. A SCREWDRIVER MAY BE USED TO TIGHTEN NUT, BUT A SOCKET WRENCH (9/16") IS PREFERRED TO ENSURE PROPER TIGHTNESS.
14.3 CONCRETE (LEAN WALL) IS NOT ACCEPTABLE.
14.4 MORTARITE, LEMASTER, SEALANT, OR APPROVED EQUAL MAY BE USED FOR LARGE DIAHEDRY PIPE 18" OR CHEATER AT THE DISCRETION OF THE CITY.
SINGLE NUMBER 16 INLET NOTES:

15.1 For payment purposes, inlet structures shall also include 2'-4" curb & gutter transition section at each end of inlet plus separate sections where required behind inlet structure and transition sections.

15.2 Sub-grade shall be 4'-3" of Class B seeding composted per WOW standard construction specifications. On subgrade, undisturbed material, if Subgrade A or class C, the subgrade shall be reconditioned and stabilized with Class B seeding per WOW standard construction specifications.

15.3 Floor slope may be poured working with base.

15.4 S = Slape of connection = 2%.min.

15.5 Unless otherwise specified on drawings or otherwise approved, all No. 16 inlets shall be constructed with an adjustable cast iron curb box (S-716).

15.6 Design conditions for inlet allowing setting of 12'-0" max. for inlets more than 12'-0" feet in depth, shop drawings and design analysis shall be submitted for approval.

15.7 All reinforcing steel shall be ASTM A-615, Grade 60 deformed bars. Diameter of bends measured on the inner face of the bar shall be a minimum of 6" radius.


15.9 No Browse or small rock reinin force structure when complete.

15.10 Concrete mix for curb and any added street panels shall meet Class 2 requirements for concrete resistance in accordance with cost standard section 11.04. Where maximum chloride content is applied, refer to WOW standard construction specifications section 11.04 for requirements for chloride resistant concrete exposed to brine.

15.11 Splicing of reinforcing steel shall be permitted only where detailed in drawings.

15.12 Curb inlets shall be joined with base and outside, cut-off of sidewalks against edge is not permitted.

15.13 Least horizontal fill to be F.C. = 3,000 psi. Inlet sections to be filled to F.C. = 3,000 psi max. F.C = 28 day concrete strength requirement for F.C. field acceptance.

15.14 For through sections, grades must come to top of pipe.

15.15 No corner penetrations on structure.

15.16 See WOW standard construction specifications section 11.04 Storm inlets for more information. Use of this detail without specifications shall be considered non-conforming.

15.17 See S-616.2 for curb placement at wall penetration detail.

15.18 Refer to "Transportation Standards and Details for the Engineering Divisions" for adjacent roadway and sidewalk design criteria.
Plan: Combination Curb Gutter and Sidewalk

6" Vertical Curb and Gutter

Section:

Detail - Connector Outlet

Detail - Rebar Placement Around Connector Pipe

Detail - Placement of Adj. Curb Box on Support Rail (Typ.)

Detail - Frame Placement on Support Rail (Typ.)

Double Number 16 Inlet Notes:

16.1 See details specifications section 11.15 Storm Inlets for more information. Use of this detail without specifications shall be considered non-compliant.

16.2 See General Notes on S-816.1.

16.3 Expansion Joint Material shall be placed full depth of the curb and gutter, sidewalk, concrete pavement, as applicable. The top portion of the joint shall be sealed with flexible sealant.

16.4 See S-816.1 for rebar placement at wall penetration detail.

* Standard details S-716 applies to all of the grate & frame geometry. Dimensions for the double number 16 inlet except for the frame length. Frame length should be manufactured for the dimensions called out on this sheet.
SINGLE NO. 16 VALLEY INLET

DOUBLE NO. 16 VALLEY INLET

TABLE 10V. NO. 16 VALLEY TOTAL INLET LENGTH

<table>
<thead>
<tr>
<th>INLET CONFIGURATION</th>
<th>Lw or Lb</th>
<th>Lp or Lf</th>
<th>Total Inlet Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>SINGLE NO. 16 VALLEY</td>
<td>10'-6&quot;</td>
<td>12'-6&quot;</td>
<td>23'-0&quot;</td>
</tr>
<tr>
<td>DOUBLE NO. 16 VALLEY</td>
<td>10'-6&quot;, 12'-6&quot;, 15'-0&quot;</td>
<td>31'-6&quot;</td>
<td></td>
</tr>
</tbody>
</table>

* Standard Detail S-718 applies to all of the above and frame geometric dimensions for the number 16 valley inlet except for the frame length. Frame length should be manufactured for the dimensions called out on this sheet.

Reinforcement also applicable to single and double number 16 valley inlets.
NUMBER 14 INLET NOTES:

20.1 See show standard construction specifications section 11.05 storm inlets for more information. Use of this detail without specifications shall be considered non-compliant.

20.2 See general notes on S-810.1 and S-820.1.
GRADE RING NOTES:

21.1 Concrete shall be Type I cement, high-air content Type I cement, or Type II cement per work standard construction specifications.

21.2 All manholes shall be 8" or 12" inside diameter, and the minimum tensile strength shall be 25 ksi. The test bar designation is not defined at this time.

21.3 All manholes shall be 36" inside diameter, and the minimum tensile strength shall be 25 ksi. The test bar designation is not defined at this time.

21.4 Sections shall be 36" inside diameter, and the minimum tensile strength shall be 25 ksi. The test bar designation is not defined at this time.

CAST IRON LID NOTES:

21.5 All manholes shall have a 4" frame, 1-1/2" riser, and 1-1/2" red set on full bed of non-shrink grout.

21.6 The casting shall be of gray cast iron, ASTM designation A152, and the minimum tensile strength shall be 25 ksi. The test bar designation is not defined at this time.

21.7 All manholes shall be of gray cast iron, ASTM designation A152, and the minimum tensile strength shall be 25 ksi. The test bar designation is not defined at this time.
ADJUSTABLE CURB BOX

MINIMUM CURB OPENING AREA = 150 in²

PLAN

SECTION

FRAME TOP VIEW

FRAME SECTION

GRATE TOP VIEW

GRATE SECTION

NO. 16 INLET FRAME - RIGHT OR LEFT

NO. 16 INLET FRAME - CENTRE

NO. 16 INLET GRATE

GRATE & FRAME NOTES:

22.1 A casting shall consist of ASTM A45. (Class 30, Min. 30)

22.2 Castings shall comply with testing specifications in AASHTO

22.3 All castings shall be properly marked to show weight and grade.

22.4 Castings shall not be shipped or painted prior to final inspection.

No. 16 Inlet Frame - Center

No. 16 Inlet Frame - Right or Left

No. Scale
MANHOLE STEP NOTES:

23.1 ASTM SPECIFICATIONS
   (A) ASTM C-428 (MANHOLE STEPS AND LADDERS)
   (B) ASTM A-565 (DRAGEE STEEL HEAVY)
   (C) ASTM 4001 (POLYPROPYLENE)

23.2 STEPS SHALL BE INSTALLED BY THE "PRESS-FIT" METHOD UTILIZING A SPECIALLY TOOTED PIN TO FORM THE INSERT HOLE AS SHOWN, FOLLOWING MANUFACTURER'S RECOMMENDED PROCEDURE AND SHALL NOT BE Drilled IN PLACE.

23.3 INSTALLED STEPS SHALL BE CAPABLE OF WITHSTANDING A PULL OUT FORCE OF 2500 LB PER LEG FOR A MINIMUM PERIOD OF TWO MINUTES.

23.4 PIN MUST BE SMOOTH AND CONTINUOUSLY TAPPED HARD. INSTALLATIONS REQUIRE A MATCHED COMBINATION OF A TOOTED PIN ON MANHOLE STEPS, AS RECOMMENDED OR REQUIRED BY SPECIFIC MANUFACTURER OF THE STEP TO BE USED.

23.5 THIS STEP CAN ALSO BE USED IN THE POCKET INSTALLATIONS PROVIDED 5" CLEARANCE IS ALLOWED. MANHOLE STEPS SHALL NOT BE INSTALLED OVER THE FLUSH CHANNEL. THEY SHALL BE PLACED 12" MINIMUM OR 18" MAXIMUM IN A STRAIGHT HORIZONTAL ALIGNMENT WITH THE BOTTOM STEP 18" ABOVE THE DESIGN MINIMUM. SEE STANDARD DETAIL S-600.